Pima County Department of Transportation and Flood Control District

STREET LIGHTING and ITS CONDUIT DESIGN MANUAL

August 2003
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INTRODUCTION

Purpose

The first edition of the Pima County Street Lighting and ITS (Intelligent Transportation Systems) Conduit Design Manual expands upon existing guidelines to more completely identify guidelines and layouts for street lighting on County roads, and design standards for ITS facilities.

In the past, roadway lighting requirements were generally limited to intersections with traffic signals. When continuous roadway lighting was required on a road project, the design team was required to study and develop the construction plans for the lighting system for each given project. The primary purpose of this manual is to provide a consistent set of guidelines and layouts for use by engineers, contractors, and Pima County Department of Transportation Traffic Engineering Division (PCDOT/TED) staff for street lighting when required at signalized intersections, at unsignalized intersections, at mid-block pedestrian crosswalks, and as continuous lighting along roadways.

Another purpose of this manual is to provide the standards and specifications for the installation of ITS conduit and related facilities on roadway projects for the immediate or future installation of ITS communication systems.

This manual will be used in conjunction with the latest edition of the Pima County/City of Tucson Standard Specifications for Public Improvements, the Pima County/City of Tucson Standard Details for Public Improvements, and the October 2001 PCDOT/TED Supplementary Specifications. This document supersedes the 1998 Pima County Roadway Design Manual, its March 2000 and October 2002 updates, and the January 2002 Pima County Traffic Signal Design Manual.

Application of Manual

This manual is to be used for the layout of street lighting after the decision is made to install street lighting on a project. Street lighting at the intersection is always included with all traffic signal projects using traffic signal combination poles (signal faces and street lights). Street lighting is sometimes installed at non-signalized intersections and along roadway segments. This manual does not establish any criteria nor requirements for the use of street lighting at non-signalized intersections nor along roadway segments (as continuous lighting). The decision to install street lighting at these locations is made on a project by project basis based on other considerations, such as type of development activity, available funding levels, community acceptance, etc.

The ability of street lights to provide illumination of the intersection or roadway area is a function of many variables. Some of the variables, such as pole/luminaire spacing and set backs, have to be adjusted at specific pole locations due to conflicting roadway elements. Many of the variables change over time for a given application, such as the light output of the luminaire, the level of reflectance of the roadway surface, the impact of vegetation, etc. Other factors, such as the eye’s ability to absorb light and to adapt to changing light conditions, literally vary from
person to person. Therefore, the lighting industry typically uses “average” values of these factors in determining lighting systems. While typical lighting levels recommended by lighting industry sources for various roadway environments were incorporated into the development of the lighting layouts contained within this manual, this manual does not establish specific lighting levels for use on County roads or intersections. The layouts represent configurations of street lighting poles and luminaires that will provide desirable lighting, in general, for various roadway and intersection environments.

This manual assembles and documents guidance developed by PCDOT/TED regarding typical street lighting pole and luminaire layouts for a variety of typical roadway and intersection types. The goals of the manual are to (1) reduce the amount of time and resources project engineers spend on developing street lighting construction plans, and (2) reduce the amount of time PCDOT/TED staff spend on reviewing these plans. However, users of this manual are expected to use engineering judgment when applying the street lighting layouts within this manual to project specific locations and/or conditions.

**Revision Process**

All users of this manual are encouraged to suggest changes to this manual. Suggestions should be submitted in written and/or diagram form to PCDOT/TED. Suggestions will be reviewed as time and resources permit. Adopted modifications will be incorporated into future revisions of the manual.

Questions regarding the use of this manual should be referred to the Pima County TED project manager (on specific projects) or to the Pima County Traffic Engineer.

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Priscilla S. Cornelio, P.E.  
Director

Albert G. Letzkus, P.E., P.T.O.E.  
County Traffic Engineer.
## ABBREVIATIONS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tr>
<td>AASHTO</td>
<td>American Association of State Highway and Transportation Officials</td>
</tr>
<tr>
<td>ADA</td>
<td>Americans with Disabilities Act</td>
</tr>
<tr>
<td>ADOT</td>
<td>Arizona Department of Transportation</td>
</tr>
<tr>
<td>ANSI</td>
<td>American National Standards Institute</td>
</tr>
<tr>
<td>AWG</td>
<td>American Wire Gauge</td>
</tr>
<tr>
<td>COT</td>
<td>City of Tucson</td>
</tr>
<tr>
<td>Fc</td>
<td>Foot-candle</td>
</tr>
<tr>
<td>HID</td>
<td>High Intensity Discharge</td>
</tr>
<tr>
<td>IESNA</td>
<td>Illuminating Engineering Society of North America</td>
</tr>
<tr>
<td>ITS</td>
<td>Intelligent Transportation Systems</td>
</tr>
<tr>
<td>HPS</td>
<td>High Pressure Sodium</td>
</tr>
<tr>
<td>LPS</td>
<td>Low Pressure Sodium</td>
</tr>
<tr>
<td>MSL</td>
<td>Micro-Site-Lite Computer Program</td>
</tr>
<tr>
<td>NEC</td>
<td>National Electrical Code</td>
</tr>
<tr>
<td>NEMA</td>
<td>National Electrical Manufacturers Association</td>
</tr>
<tr>
<td>PCDOT/TED</td>
<td>Pima County Department of Transportation Traffic Engineering Division</td>
</tr>
<tr>
<td>PPG</td>
<td>Policies, Procedures and Guidelines</td>
</tr>
<tr>
<td>RP-8-00</td>
<td>IESNA Recommended Practice-8-2000</td>
</tr>
<tr>
<td>TWLTL</td>
<td>Two-Way Left Turn Lane</td>
</tr>
<tr>
<td>V</td>
<td>Volt</td>
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<tr>
<td>W</td>
<td>Watt</td>
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# DEFINITIONS

**Clear Zone**
Term used to designate the unobstructed, relatively flat area provided beyond the edge of the traveled way for the recovery of errant vehicles. The clear zone includes any shoulder or auxiliary lanes.

**Conduit Run**
An underground conduit from pull box to pull box or from pull box to pole foundation. Conduits in the same trench are often given one conduit run number.

**Full Cutoff**
Term used to indicate that a luminaire directs almost no light above the horizontal plane through the luminaire.

**Luminaire**
A complete lighting fixture consisting of a lamp or lamps together with the ballast, reflector, refractor, photocell when required, and the housing.

**Mounting Height**
The vertical height of the luminaire as mounted on the street light pole or mast arm. The height is typically the perpendicular measured distance from the ground or pavement to the center of the luminaire light source.

**Pedestrian Night Time Activity Levels:**
1. **High**
   - Areas with significant number of pedestrians expected to be on the sidewalks or crossing the streets during darkness. Examples are downtown retail areas, near theatres, concert halls, stadiums and transit terminals.
2. **Medium**
   - Areas where lesser numbers of pedestrians utilize the streets at night. Typical locations are downtown office areas, blocks with libraries, apartments, neighborhood shopping areas, industrial, older city areas, and streets with transit lines.
3. **Low**
   - Areas with very low volumes of night pedestrian usage. These can occur in any of the cited roadway classifications but may be typified by suburban single family streets, very low density residential developments, and rural or semi-rural areas.

**Pole Offset (relating to crosswalks)**
The distance between the center of a pedestrian crosswalk and the center of a street lighting pole.

**Pole Setback**
The perpendicular measured distance from the traveled roadway edgeline or face of curb to the center of the street light pole.
### DEFINITIONS

**Continued**

<table>
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<tr>
<th>Type III Distribution</th>
<th>An asymmetrical (non-circular) light distribution pattern that indicates how far a luminaire directs light across the width of a street. Distribution patterns vary from Type I to Type V. The higher the number, the further the light is directed across the street. A Type V is a circular pattern.</th>
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**Roadway Classification:**

1. **Major**
   - That part of the roadway system that serves as the principal network for through traffic flow. Major routes connect areas of principal traffic generation and important rural roadways leaving the city.
2. **Collector**
   - Roadways servicing traffic between major and local streets. These are streets used mainly within residential, commercial and industrial areas.
3. **Local**
   - Local streets are used primarily for direct access to residential, commercial and industrial, or other abutting property.
# COMMON SYMBOLS

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>DESCRIPTION</th>
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<tr>
<td>☐☐</td>
<td>Metersed Service Pedestal</td>
</tr>
<tr>
<td>☐☐</td>
<td>Traffic Signal/Street Lighting Controller</td>
</tr>
<tr>
<td>☐</td>
<td>No. 7 Pull Box</td>
</tr>
<tr>
<td>☐☐</td>
<td>No. 7 Pull Box with Extension</td>
</tr>
<tr>
<td>☐☐</td>
<td>No. 3 1/2 Pull Box</td>
</tr>
<tr>
<td></td>
<td>Conduit Run</td>
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<tr>
<td>☐☒</td>
<td>Traffic Signal Pole with Luminaire Mast Arm</td>
</tr>
<tr>
<td>☐☒</td>
<td>Street Lighting Pole</td>
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<tr>
<td>☐☐</td>
<td>Pedestrian Crosswalk</td>
</tr>
<tr>
<td>☐☐</td>
<td>Street Lighting Pole Number</td>
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<tr>
<td>☐☐</td>
<td>Street Lighting Circuit Number</td>
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STREET LIGHTING GENERAL NOTES

1. ALL EQUIPMENT / MATERIALS AND CONSTRUCTION SHALL MEET OR EXCEED THE REQUIREMENTS CONTAINED IN THE CURRENT PIMA COUNTY / CITY OF TUCSON "STANDARD SPECIFICATIONS FOR PUBLIC IMPROVEMENTS" AND "STANDARD DETAILS FOR PUBLIC IMPROVEMENTS", THE SPECIAL PROVISIONS AND THE PLANS.

2. THE EXACT LOCATION OF EACH NEW POLE FOUNDATION, PULL BOX, OR ELECTRIC SERVICE PEDESTAL FOUNDATION SHALL BE APPROVED BY THE TRAFFIC ENGINEER PRIOR TO INSTALLATION.

3. THE TOP OF THE POLE FOUNDATION SHALL BE LEVEL WITH THE SURROUNDING FINISHED GRADE. IF THE SLOPE OR SHOULDER DROPS OFF FROM FINISHED GRADE, THE CONTRACTOR SHALL GRADE AROUND POLE FOUNDATION. THE TOP OF THE FOUNDATION SHALL EXTEND NO MORE THAN FOUR (4) INCHES ABOVE SURROUNDING FINISHED GRADE.

4. SHALLOW TYPE FOUNDATIONS, IF THEY ARE NECESSARY, SHALL BE PER PC/DOT STD. DTL. T-433. CONTRACTOR SHALL VERIFY POLE BOLT PATTERN AND DIMENSIONS AS MAY BE REQUIRED FOR THE PROJECT. POLE LOCATIONS OF SUCH FOUNDATIONS SHALL BE FIELD IDENTIFIED BY THE INSPECTOR.

5. POLE FOUNDATIONS SHALL MAINTAIN A MINIMUM OF 36 INCHES HORIZONTAL DISTANCE FROM EXISTING WATER MAINS, MEASURED FROM OUTSIDE OF THE FOUNDATION WALL TO THE OUTSIDE OF PIPE WALL.

6. PULL BOXES ARE SHOWN ON PLANS ARE DIAGRAMMATIC REPRESENTATIONS. FINAL LOCATION OF PULL BOX IS ADJACENT TO POLE ONLY AT LOCATIONS PRE-APPROVED BY THE INSPECTOR.

7. PULL BOXES SHALL NOT BE INSTALLED WITHIN CONCRETE CURB ACCESS RAMPS OR LANDINGS. IN ADDITION, ANY PULL BOXES INSTALLED BEHIND CURBS SHALL BE INSTALLED BETWEEN THE CURB AND THE PROPOSED / FUTURE SIDEWALK OR BEYOND THE PROPOSED / FUTURE SIDEWALK. AN EXCEPTION TO THIS NOTE WOULD BE PULL BOXES INSTALLED IN A MEDIAN. ANY PULL BOXES INSTALLED ALONG AN UNCURBED ROADWAY SHALL BE INSTALLED TEN (10) FEET FROM EDGE OF PAVEMENT TO EDGE OF PULL BOX WHERE RIGHT-OF-WAY PERMITS OR AS FAR FROM PAVEMENT AS PRACTICAL WHEN THERE IS INSUFFICIENT RIGHT-OF-WAY TO PROVIDE THE TEN (10) FOOT OFFSET.

8. A ¾ INCH X 10 FOOT GROUND ROD SHALL BE INSTALLED IN THE NO. 7 PULL BOX (WITH THE EXTENSION) ADJACENT TO THE CONTROLLER CABINET. A ¾ INCH X 10 FOOT GROUND ROD SHALL BE INSTALLED IN THE NO. 3 ½ PULL BOX AT THE END OF EACH STREET LIGHT CURCUIT. TWO GROUND ROD CLAMPS SHALL BE FURNISHED FOR EACH GROUND ROD FOR GROUNDING THE GROUND WIRE.
9. ONLY NEW CONDUIT AND CABLE SHALL BE INSTALLED.

10. THE CONDUIT LOCATIONS SHOWN ON PLAN ARE DIAGRAMMATIC REPRESENTATIONS ONLY. CONTRACTOR SHALL INSTALL CONDUIT TO AVOID CONFLICTS. ALL CONDUITS SHALL BE INSTALLED WITHIN EXISTING RIGHT-OF-WAY UNLESS OTHERWISE APPROVED.

11. CONDUIT INSTALLED UNDER EXISTING PAVED DRIVEWAYS, THAT ARE NOT SCHEDULED TO BE RECONSTRUCTED AS PART OF THIS PROJECT, SHALL BE INSTALLED BY MEANS OF BORING.

12. ALL CONDUIT SHALL BE INSTALLED A MINIMUM OF 30 INCHES BELOW FINISHED GRADE, EXCEPT WHEN CONDUITS CROSS CULVERTS OR ARE ROUTED ALONG BRIDGE AND WING WALLS. ANY CONDUIT INSTALLED LESS THAN 30 INCHES DEEP SHALL BE ENCASED IN CONCRETE PER PC/COT STANDARD SPECIFICATIONS 732-3.01.

13. ALL ROADWAY STREET LIGHT SYSTEM CONDUIT SHALL BE PVC SCHEDULE 40 UNLESS NOTED OTHERWISE. CONDUIT ADJACENT TO CURB SHALL BE INSTALLED SIX (6) INCHES BACK OF CURB AND 36 INCHES BELOW TOP OF CURB.

14. ALL CONDUITS SHALL BE CLEANED BY COMPRESSED AIR. A PROPERLY SIZED CONDUIT PISTON OR MANDREL SHALL BE PULLED THROUGH THE CONDUIT PRIOR TO CABLE INSTALLATION.

15. CONDUITS FOR FUTURE USE SHALL BE SEALED WITH A PROPERLY SIZED TAPERED POLYETHYLENE DUCT PLUG AT EACH TERMINATION POINT. THE #8 BARE BOND WIRE SHALL BE LOOPED THROUGH THE PLUG PULL TAB AND TWO FEET OF SLACK DOUBLED BACK INTO THE CONDUIT.

16. AVOID PLACING UNDERGROUND CONDUIT OVER EXISTING WATER MAINS AND MAINTAIN 36 INCHES MINIMUM HORIZONTAL SEPARATION, TYPICAL FOR ALL CONDUIT INSTALLATIONS THROUGHOUT PROJECT.

17. ALL POLES SHALL BE WIRED AND GROUNDED PER PC/COT STD. DTL. 107, WITH THE EXCEPTION OF THE WIRE TYPE. REFER TO NOTE 18 FOR WIRE SIZE AND TYPE UNLESS OTHERWISE NOTED ON THE PLANS.

18. TWO #10 AWG-XHHW CONDUCTORS SHALL BE INSTALLED FROM EACH LUMINAIRE TO THE CONCRETE PULL BOX ADJACENT TO THE POLE FOUNDATION, LEAVING THREE FEET OF SLACK FOR EACH CONDUCTOR (MEASURED FROM THE TOP OF THE PULL BOX) IN THE PULL BOX. ROUTE FOUR CONDUCTORS TO THE LUMINAIRE WITH THE PHOTOELECTRIC CELL. AN IN-LINE FUSE SHALL BE INSTALLED FOR EACH LUMINAIRE IN THE ASSOCIATED PULL BOX.

19. DUAL ARC TUBE LAMPS SHALL BE USED ON ALL LUMINAIRES.
20. The street lighting photoelectric cell shall be mounted on the luminaire pole closest to the street lighting controller or, if a controller is not required, the luminaire pole closest to the meter pedestal.

21. The Tucson Electric Power Company Construction Department (918-8300) shall be contacted by the contractor to verify the location of the electric service connection at the intersection. The contractor shall be responsible for excavating and backfilling the trench and installing any necessary sleeves under sidewalks or driveways in which the electric service cable in conduit (CIC) is to be installed by TEP. [Note: If not TEP, modify name of electric utility and provide the correct number for the utility contact phone number]

22. A minimum of ten (10) foot radial clearance shall be maintained between all metallic parts and overhead electric conductors while installing poles and luminaires. Blue stake shall be contacted if contractor requires overhead protection.

23. A minimum horizontal separation of 24 inches shall be maintained from all gas lines.

24. The traffic signal operation at existing signalized intersections shall be maintained throughout the duration of the project.

25. Upon commencement of work, traffic control devices shall be posted and maintained by the contractor until such a time as the work is complete. All traffic control device shall be in accordance with the most recent edition of the Manual of Uniform Traffic Control Devices and approved by the engineer.

Responsibilities:

1. The contractor shall obtain all permits required by all governmental agencies, with the exception that Pima County must jointly obtain the NPDES permit and file the NOI and NOT. For work beyond the scope of these project limits, plans or specifications, the contractor shall obtain a separate floodplain and/or grading permit prior to commencing such work.

2. The contractor shall contact Blue Stake at 1-800-782-5348, a minimum of two (2) working days prior to any excavation.

3. The contractor shall maintain and allow access to all Pima County waste water manholes located within the row. Access must be maintained 24 hours per day, seven days per week. No electrical utilities may be placed within six feet of a force main.
4. THE LOCATION OF UTILITIES SHOWN ON THE PLANS IS APPROXIMATE. THE CONTRACTOR IS RESPONSIBLE FOR VERIFYING / POTHOLING UNDERGROUND UTILITIES IN THE VICINITY OF THE PROPOSED POLE FOUNDATIONS. THE CONTRACTOR IS ALSO RESPONSIBLE FOR VERIFYING CLEARANCE BETWEEN OVERHEAD LINES AND STREET LIGHTING EQUIPMENT PRIOR TO INSTALLATION OF POLES AND FOUNDATIONS.

5. ANY EQUIPMENT AND/OR UTILITIES WITHIN THE PROJECT LIMITS THAT ARE DAMAGED OR DESTROYED BY THE CONTRACTOR SHALL BE REPAIRED OR REPLACED AT THE SOLE EXPENSE OF THE CONTRACTOR.

6. THE CONTRACTOR SHALL SUPPLY AND INSTALL THE FOLLOWING EQUIPMENT AND MATERIALS AS SPECIFIED IN THE PLANS: STEEL POLE ANCHOR BOLTS (WITH NUTS AND WASHERS), CONCRETE POLE FOUNDATIONS WITH REINFORCEMENT (WHERE SPECIFIED), CONCRETE PULL BOXES, ELECTRICAL CONDUIT, GROUND RODS AND CONNECTORS, BARE BOND WIRE AND ALL OTHER CONDUCTORS, POLES, MAST ARMS, LUMINARIES, PHOTOCELLS, ELECTRICAL SERVICE PEDESTAL(S) AND CONCRETE FOUNDATION(S), AND ALL OTHER APPURTENANCES NECESSARY FOR THE INSTALLATION AND OPERATION OF THE STREET LIGHTS, EXCEPT AS MODIFIED IN THE PLANS.

7. THE CONTRACTOR SHALL CAREFULLY DISASSEMBLE AND SALVAGE ALL EXISTING TRAFFIC SIGNAL AND STREET LIGHTING EQUIPMENT THAT IS NOT TO REMAIN OR BE RELOCATED, EXCEPT EXISTING WIRELESS COMMUNICATIONS AND PTZ CAMERA EQUIPMENT. ALL OF THE EQUIPMENT SHALL BE SAFELY STORED AT THE CONSTRUCTION SITE UNTIL IT IS SAFELY RETURNED TO THE PCDOT MAINTENANCE YARD, 1313 S. MISSION RD. THE EQUIPMENT SHALL BE SAFELY UNLOADED BY THE CONTRACTOR. CONTACT SIGNAL SHOP SUPERVISOR (520-740-5887) AT LEAST TWO (2) WORKING DAYS PRIOR TO RETURNING THE EQUIPMENT.

8. WHEN APPLICABLE, THE CONTRACTOR SHALL SALVAGE AND REPLANT ANY LANDSCAPING VEGETATION THAT MAY BE DAMAGED BY CONSTRUCTION ACTIVITIES. THE CONTRACTOR SHALL OBTAIN PRIOR APPROVAL FROM THE OPERATIONS DEPARTMENT'S PUBLIC WORKS SUPERVISOR (520-740-5969) BEFORE ANY PLANTS ARE MOVED.

9. WHEN APPLICABLE, THE CONTRACTOR SHALL REPAIR/RESTORE ANY LANDSCAPE IRRIGATION COMPONENTS DAMAGED BY CONSTRUCTION ACTIVITY TO THEIR ORIGINAL CONDITION.

10. THE CONTRACTOR SHALL VISIT SITE AND OBSERVE AND NOTE CONDITIONS FOR CONDUIT, POLE FOUNDATIONS, PULL BOXES, ETC. PRIOR TO SUBMITTING BID TO DETERMINE ALL INSTALLATION REQUIREMENTS.
LIGHTING DESIGN GUIDELINES

Background

The generally accepted authority in the area of roadway related lighting is the Illuminating Engineering Society of North America (IESNA). In 2000, under the rules of procedure of the American National Standards Institute (ANSI), the IESNA sponsored the development of the American National Standard Practice for Roadway Lighting. The practice was issued as the ANSI/IESNA Recommended Practice-8-00 (RP-8-00). It is from the RP-8-00 that the basis for various lighting criteria for the Pima County Street Lighting and ITS Conduit Design Manual has been derived.

Purpose of Roadway Lighting

The principle purpose of roadway lighting is to produce quick, accurate, and comfortable visibility at night. RP-8-00 goes on to state “the proper use of roadway lighting as an operative tool provides economic and social benefits to the public including:

(a) Reduction in night time accidents, attendant human misery, and economic loss
(b) Aid to police protection and enhanced sense of personal security
(c) Facilitation of traffic flow
(d) Promotion of business and the use of public facilities during the night time hours”

Signalized & Unsignalized Intersection Lighting Design Guidelines

Intersecting roadways with continuous lighting: The lighting requirements for these locations were determined using the RP-8-00 Table 9. Each intersecting roadway was evaluated between major, collector and local functional classifications and the pedestrian classification was determined. The table was then referenced to determine the recommended average lighting level and uniformity.

Intersecting roadways with no lighting: The lighting recommendations for these locations were determined using the roadway recommended lighting values shown in RP-8-00 Table 2, for the pavement classification column R2/3. The recommended lighting levels and uniformity were determined by referencing the table using the roadway with the highest functional class and the determined pedestrian classification. The recommended intersection lighting level is 1.5 times the corresponding recommended roadway lighting level from RP-8-00 Table 2.

Signalized & Unsignalized Intersection Lighting Layouts: The selected lighting layouts for signalized intersections are provided in Chapter 3, sheets 3-01 through 3-08. The selected lighting layouts for unsignalized intersections are provided in Chapter 4, sheets 4-01 through 4-06. These recommended layouts meet the above recommendations for the widest range of configurations of two (2) lane through six (6) lane divided intersections.
Pedestrian Crossing Lighting Design Guidelines

**Mid-Block Pedestrian Crossings:** Each roadway was evaluated between major, collector and local functional classifications. The pedestrian classification was also determined to be high, medium or low. The lighting level recommendations for mid-block pedestrian crossings on non-continuously lighted roadways were determined using the recommended lighting levels for roadways in the RP-8-00, Table 2, for pavement classification R2/3. The lighting level recommendations for mid-block pedestrian crossings on continuously lighted roadways are 1.5 times the recommended lighting levels used for the non-continuously lighted roadways.

**Pedestrian Crossings at Intersections:** The lighting level recommendations for pedestrian crossings at intersections default to the recommended lighting levels and layouts for the respective intersections discussed above.

**Mid-Block Pedestrian Crossing Lighting Layouts:** The selected lighting layouts for pedestrian crossings are provided in Chapter 5, sheets 5-01 through 5-05. These recommended layouts meet the pedestrian crossing recommendations for the widest range of configurations of two (2) lane through six (6) lane divided roadways.

Roadway Lighting Design Guidelines

**Roadway Segments:** The lighting level recommendations for roadway segments were determined using the RP-8-00, Table 2, for pavement classification R2/3 and the Pima County/City of Tucson Standard Detail T 324. Each roadway was evaluated between major, collector and local functional classifications. The pedestrian classification was also determined to be high, medium or low. The tables were then referenced to determine the recommended average lighting level and uniformity.

**Roadway Lighting Layouts:** The selected lighting layouts for roadway segments are provided in Chapter 6, sheets 6-01 through 6-03. These recommended layouts meet the above recommendations for the widest range of configurations (two (2) lane through six (6) lane divided roadway) where a staggered pole configuration can be used. In locations where a staggered pole configuration is not appropriate, a lighting analysis study will need to be performed to determine the appropriate single-sided or median lighting layout.
DESIGN CRITERIA REFERENCES FOR STREET LIGHTING

1. Street lighting design should meet or exceed the average illuminance per the AASHTO publication, *An Informational Guide for Roadway Lighting*, 1984.

2. Pole locations should be positioned beyond the AASHTO clear zone requirements specified in the AASHTO *Roadside Design Guide*, 2006, unless otherwise directed by Pima County DOT Traffic Engineering Division (TED).

3. Light Distribution shall satisfy the most recent edition of the Pima County Outdoor Lighting Code.

4. All installations shall meet the *National Electric Code* requirements.

General Guidelines for Signalized Intersection Lighting Layouts

General

1. All installations shall meet the national Electric Code requirements and conform to the most recent edition of the Pima County Outdoor Lighting Code.

2. Signalized intersection street lighting layouts may be modified with approval from the Pima County DOT/TED Project Manager.

Equipment

3. All street lighting equipment at signalized intersection shall be placed according to the current edition of the PCDOT Traffic Signal Design Manual. Street lighting equipment is to include, but not limited to, the following items.
   a. Poles, mast arms and foundations
   b. Conduit, pull boxes and control cabinets

4. The street lighting pole setback shall meet the clear zone requirements as discussed in the Pima County Roadway Design Guidelines, unless otherwise directed by DOT/TED staff.

5. Signalized intersection street lighting will utilize 20 foot mast arms at a 35 foot mounting height.

6. The number and orientation of street lights at signalized intersections shall correspond to the layouts on sheets 3-01 through 3-08 of the PCDOT Street Lighting and ITS Conduit Design Manual. These layouts assume adjacent roadways are on continuously lighted. Additional fixtures may be needed if the adjacent roadways are continuously lighted.

7. Luminaires placed at signalized intersections shall be 120 volt, 400 watt High Pressure Sodium fixtures with Type III distributions and Full Cutoff lenses.

Power

8. Luminaire conductors and circuiting shall be completed as shown in the PCDOT Traffic Signal Design Manual and in PC/COT Standard Detail T 107. Power shall be provided through the traffic signal controller cabinet from a metered service pedestal.

9. The street lighting photoelectric cell shall be mounted on the luminaire of the pole closest to the traffic signal controller.
LAYOUTS

<table>
<thead>
<tr>
<th>POLE #</th>
<th>POLE TYPE</th>
<th>MAST ARM</th>
<th>MOUNTING HEIGHT</th>
<th>LUMINAIRE</th>
<th>CIRCUIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 &amp; 3</td>
<td>Signal Pole</td>
<td>20'</td>
<td>36'</td>
<td>120 V, 400 W HPS, Type III Full Cutoff</td>
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<td>2 &amp; 4</td>
<td>Signal Pole</td>
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4. Pole locations for street light (only) poles to follow typical layout for traffic signal poles.
5. Type 2 street lighting poles to be used only when lighting on the arterial is present.
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PCDOT Traffic Engineering Division
Street Lighting & ITS Conduit Design Manual
Signalized Intersection 3
4 Lane Divided Intersecting 4 Lane Divided
All Approaches with Dual Left Turn Lanes

SHEET NO. 3-03

PRINCIPAL ENGINEER

ISSUED
August 2003

REVISED
LAYOUTS

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LAYOUTS  (When 3 Lane Roadway Has A Major Roadway Classification)

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LAYOUTS  (When 3 Lane Roadway Has A Collector Roadway Classification)

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4. Pole locations for street light (only) poles to follow typical layout for traffic signal poles.
5. Type 2 street lighting poles to be used only when lighting on the arterial is present.

ISSUED
August 2003

PCDOT Traffic Engineering Division
Street Lighting & ITS Conduit Design Manual
Signalized Intersection 7
6 Lane Divided with Single Left Turn Lane
Intersecting 3 Lane with a TRMLTL

SHEET NO.
3-07
LAYOUTS

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<th>POLE #</th>
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General Guidelines for Unsignalized Intersection Lighting Layouts

General

1. All installations shall meet the national Electric Code requirements and conform to the most recent edition of the Pima County Outdoor Lighting Code.

2. Unsignalized intersection street lighting layouts may be modified with approval from the Pima County DOT/TED Project Manager.

Equipment

3. Street lighting poles at unsignalized intersections shall correspond to the layouts on sheets 4-01 through 4-06 of the PCDOT Street Lighting and ITS Conduit Design Manual. Pole setback locations can be adjusted +/- two (2) feet from the roadway edge dimension to avoid any of the following conflicts. Adjustments greater than two (2) feet require written approval by the Pima County DOT/TED Project Manager.
   a. Right-of-way restrictions
   b. Utilities (underground or overhead)
   c. Drainage structures
   d. Buildings
   e. Roadway alignments
   f. Other miscellaneous structures and obstructions

4. The street lighting pole setback shall meet the clear zone requirements as discussed in the Pima County Roadway Design Guidelines, unless otherwise directed by DOT/TED staff.

5. Street lighting equipment, including but not limited to, pole type, power source, conduit, conductors, pull boxes and control device, are to be determined and designed for each individual unsignalized intersection project.

6. Unsignalized intersection street lighting will utilize 20 foot mast arms at a 35 foot mounting height.

7. Luminaires placed at signalized intersections shall be 120 volt, 400 watt High Pressure Sodium fixtures with Type III distributions and Full Cutoff lenses.

8. Layouts 4-01 through 4-06 of the PCDOT Street Lighting and ITS Conduit Design Manual assume adjacent roadways are on continuously lighted. Additional fixtures may be needed if the adjacent roadways are continuously lighted.

Power

9. Luminaire conductors and circuiting shall be completed as shown in the PCDOT Traffic Signal Design Manual and in PC/COT Standard Detail T 107.

10. The street lighting photoelectric cell shall be mounted on the luminaire of the pole closest to the traffic signal controller.
### LAYOUTS (When 2 Lane Roadway Has A Collector Roadway Classification)

<table>
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<tr>
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<th>MOUNTING HEIGHT</th>
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<th>CIRCUIT</th>
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<tr>
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LAYOUTS (When 3 Lane Roadway Has A Major Roadway Classification)

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<th>MAST ARM</th>
<th>MOUNTING HEIGHT</th>
<th>LUMINAIRE</th>
<th>CIRCUIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 &amp; 3</td>
<td>To Be Determined</td>
<td>20'</td>
<td>35'</td>
<td>120 V, 400 W HPS, Type III Full Cutoff</td>
<td>1</td>
</tr>
<tr>
<td>2 &amp; 4</td>
<td>To Be Determined</td>
<td>20'</td>
<td>35'</td>
<td>120 V, 400 W HPS, Type III Full Cutoff</td>
<td>2</td>
</tr>
</tbody>
</table>
General Guidelines for Mid-Block Pedestrian Crossing Lighting Layouts

General

1. All installations shall meet the national Electric Code requirements and conform to the most recent edition of the Pima County Outdoor Lighting Code.

2. Mid-block pedestrian crossing street lighting layouts may be modified with approval from the Pima County DOT/TED Project Manager.

Equipment

3. Street lighting poles at mid-block pedestrian crossings shall correspond to the layouts on sheets 5-01 through 5-05 of the PCDOT Street Lighting and ITS Conduit Design Manual. Pole setback locations can be adjusted +/- two (2) feet from the roadway edge dimension to avoid any of the following conflicts. Adjustments greater than two (2) feet require written approval by the Pima County DOT/TED Project Manager.
   a. Right-of-way restrictions
   b. Utilities (underground or overhead)
   c. Drainage structures
   d. Buildings
   e. Roadway alignments
   f. Other miscellaneous structures and obstructions

4. The street lighting pole setback shall meet the clear zone requirements as discussed in the Pima County Roadway Design Guidelines, unless otherwise directed by DOT/TED staff.

5. Street lighting equipment, including but not limited to, pole type, power source, conduit, conductors, pull boxes and control device, are to be determined and designed for each individual unsignalized intersection project.

6. Mid-block pedestrian crossing street lighting will utilize 20 foot mast arms at a 35 foot mounting height.

7. Luminaires placed at signalized intersections shall be 120 volt, 400 watt High Pressure Sodium fixtures with Type III distributions and Full Cutoff lenses.

Power

8. Luminaire conductors and circuiting shall be completed as shown in the PCDOT Traffic Signal Design Manual and in PC/COT Standard Detail T 107.

9. The street lighting photoelectric cell shall be mounted on the luminaire of the pole closest to the traffic signal controller.
LAYOUTS (For All Non-Continuously Lighted Roadways & Continuously Lighted Collector Roadways)

<table>
<thead>
<tr>
<th>POLE #</th>
<th>POLE TYPE</th>
<th>MAST ARM</th>
<th>MOUNTING HEIGHT</th>
<th>LUMINAIRE</th>
<th>CIRCUIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>To Be Determined</td>
<td>20'</td>
<td>35'</td>
<td>120 V, 250 W HPS, Type III Full Cutoff</td>
<td>1</td>
</tr>
</tbody>
</table>

NOTE 1: Use a 400 W HPS luminaire for Continuously Lighted Major Roadways.
NOTE 2: This configuration can be used for a roadway width less than 37 feet. Two lane roadways with a width of 37 feet or greater should use Mid-Block Pedestrian Crossing 2 on Sheet No. 5-02.
LAYOUTS  (For All Non-Continuously Lighted Roadways & Continuously Lighted Collector Roadways)

<table>
<thead>
<tr>
<th>POLE #</th>
<th>POLE TYPE</th>
<th>MAST ARM</th>
<th>MOUNTING HEIGHT</th>
<th>LUMINAIRE</th>
<th>CIRCUIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>To Be Determined</td>
<td>20'</td>
<td>35'</td>
<td>120 V, 250 W HPS, Type III Full Cutoff</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>To Be Determined</td>
<td>20'</td>
<td>35'</td>
<td>120 V, 250 W HPS, Type III Full Cutoff</td>
<td>2</td>
</tr>
</tbody>
</table>

NOTE 1: Use 400 W HPS luminaires for Continuously Lighted Major Roadways.
LAYOUTS  (For Non-Continuously Lighted Roadways)

<table>
<thead>
<tr>
<th>POLE #</th>
<th>POLE TYPE</th>
<th>MAST ARM</th>
<th>MOUNTING HEIGHT</th>
<th>LUMINAIRE</th>
<th>CIRCUIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>To Be Determined</td>
<td>20'</td>
<td>35'</td>
<td>120 V, 400 W HPS, Type III Full Cutoff</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>To Be Determined</td>
<td>20'</td>
<td>35'</td>
<td>120 V, 400 W HPS, Type III Full Cutoff</td>
<td>2</td>
</tr>
</tbody>
</table>

NOTE 1: Use 25'± Pole Offsets for Continuously Lighted Roadways.
LAYOUTS  (For Non-Continuously Lighted Roadways)

<table>
<thead>
<tr>
<th>POLE #</th>
<th>POLE TYPE</th>
<th>MAST ARM</th>
<th>MOUNTING HEIGHT</th>
<th>LUMINAIRE</th>
<th>CIRCUIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>To Be Determined</td>
<td>20'</td>
<td>35'</td>
<td>120 V, 250 W HPS, Type III Full Cutoff</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>To Be Determined</td>
<td>20'</td>
<td>35'</td>
<td>120 V, 250 W HPS, Type III Full Cutoff</td>
<td>2</td>
</tr>
</tbody>
</table>

NOTE 1: Use 400 W HPS luminaires for Continuously Lighted Roadways.
LAYOUTS  (For Non-Continuously Lighted Roadways)

<table>
<thead>
<tr>
<th>POLE #</th>
<th>POLE TYPE</th>
<th>MAST ARM</th>
<th>MOUNTING HEIGHT</th>
<th>LUMINAIRE</th>
<th>CIRCUIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>To Be Determined</td>
<td>20'</td>
<td>35'</td>
<td>120 V, 400 W HPS, Type III Full Cutoff</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>To Be Determined</td>
<td>20'</td>
<td>35'</td>
<td>120 V, 400 W HPS, Type III Full Cutoff</td>
<td>2</td>
</tr>
</tbody>
</table>

NOTE 1: Use 15-20' Pole Offsets for Continuously Lighted Roadways.
General Guidelines for Continuous Roadway Lighting Layouts

General

1. All installations shall meet the national Electric Code requirements and conform to the most recent edition of the Pima County Outdoor Lighting Code.

2. Mid-block pedestrian crossing street lighting layouts may be modified with approval from the Pima County DOT/TED Project Manager.

Equipment

3. Street lighting equipment placement and pole spacing shall correspond to the typical layout shown on sheet 6-01 of the PCDOT Street Lighting and ITS Conduit Design Manual. Pole setback locations can be adjusted +/- two (2) feet from the roadway edge dimension to avoid any of the following conflicts. Adjustments greater than two (2) feet require written approval by the Pima County DOT/TED Project Manager.
   a. Right-of-way restrictions
   b. Utilities (underground or overhead)
   c. Drainage structures
   d. Buildings
   e. Roadway alignments
   f. Other miscellaneous structures and obstructions

4. The street lighting pole setback shall meet the clear zone requirements as discussed in the Pima County Roadway Design Guidelines, unless otherwise directed by DOT/TED staff.

5. Continuous roadway street lighting will utilize 20 foot mast arms at a 35 foot mounting height.

6. Luminaires used in roadway lighting shall be 480 volt, with 250 or 400 watt High Pressure Sodium fixtures with Type III distributions and Full Cutoff lenses.

7. The street lighting controller shall be placed in the vicinity of the power supply source from Tucson Electric Power.

Power

8. Luminaire conductors and circuiting shall be completed as shown in the PC/COT Standard Details T 107 and T 325. The use of a 120, 240 or 480 volt system will be determined by the most convenient available source from Tucson Electric Power. The use of a step up transformer is required should 480 volt power not be available.

9. The street lighting photoelectric cell shall be mounted on the luminaire of the pole closest to the traffic signal controller.

10. The preferred location of the street lighting controller is in the middle of the street lighting system as shown on sheet 6-01. If this is not possible, the poles shall be circuited so that as close to an equal load as possible is placed on each of the four street lighting circuits so that no more than two-thirds (2/3) of the number of poles on one side of the street are placed on one circuit. This may require additional conductors in a single conduit. Conductor size shall follow the requirements on sheet 6-03.
NOTE:
Staggered street lighting configuration is required. A project specific lighting analysis will need to be performed if the location dictates the need for a single-sided or median lighting configuration.

LEGEND

Street Lighting Circuit Number
For PC/COT Std. Dtl. T.S. 3-25

Roadway Width:
- Varies from 2 lane roadway to a 6 lane divided roadway with a median

Pole Setback:
- 20' Typical With Out Curb
- 10' Typical With Curb
See Notes on Sheet 6-00

Pole Spacing:
- Varies Per Table on Sheet 6-02

2" PVC Street Lighting Conduit
- Use No. 3 1/2 Pull Boxes typically placed behind the curb
- Conduits are typically placed behind the curb at a 30° depth
- Conductor sizes per sheet 6-03
USE OF TABLES
1. Determine the roadway classification as either arterial or collector for the roadway to be lighted based on the Federal Highway code displayed on the Pima County Map Guide or as directed by Pima County TED staff.
2. Determine the type (width) of the roadway to be lighted.
3. Use the tables below to determine the street lighting system wattage, mounting height and pole spacing based on roadway type and classification.
4. Refer to Sheet 6-03 for conductor size requirements.

### STAGGERED ROADWAY LIGHTING LAYOUTS FOR COLLECTOR ROADWAYS

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>ROADWAY WIDTH (TYP.)</th>
<th>LAMP</th>
<th>MOUNTING HEIGHT</th>
<th>TYP POLE SETBACK (1)</th>
<th>POLE SPACING (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 Lane Roadway</td>
<td>24'</td>
<td>250 W</td>
<td>35'</td>
<td>20' w/o Curb/</td>
<td>120' - 130'</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10' w/ Curb</td>
<td>135' - 145'</td>
</tr>
<tr>
<td>3 Lane Roadway with a TWLTL</td>
<td>48'</td>
<td>250 W</td>
<td>35'</td>
<td>20' w/o Curb/</td>
<td>95' - 105'</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10' w/ Curb</td>
<td>110' - 120'</td>
</tr>
<tr>
<td>4 Lane Roadway</td>
<td>60'</td>
<td>400 W</td>
<td>35'</td>
<td>20' w/o Curb/</td>
<td>140' - 150'</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10' w/ Curb</td>
<td>170' - 180'</td>
</tr>
<tr>
<td>4 Lane Divided Roadway</td>
<td>86'</td>
<td>400 W</td>
<td>35'</td>
<td>20' w/o Curb/</td>
<td>110' - 120'</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10' w/ Curb</td>
<td>120' - 130'</td>
</tr>
<tr>
<td>5 Lane Roadway with a TWLTL</td>
<td>72'</td>
<td>400 W</td>
<td>35'</td>
<td>20' w/o Curb/</td>
<td>125' - 135'</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10' w/ Curb</td>
<td>150' - 160'</td>
</tr>
<tr>
<td>6 Lane Divided Roadway</td>
<td>110'</td>
<td>400 W</td>
<td>35'</td>
<td>20' w/o Curb/</td>
<td>90' - 100'</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10' w/ Curb</td>
<td>100' - 110'</td>
</tr>
</tbody>
</table>

### STAGGERED ROADWAY LIGHTING LAYOUTS FOR ARTERIAL ROADWAYS

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>ROADWAY WIDTH (TYP.)</th>
<th>LAMP</th>
<th>MOUNTING HEIGHT</th>
<th>TYP POLE SETBACK (1)</th>
<th>POLE SPACING (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 Lane Roadway</td>
<td>24'</td>
<td>400 W</td>
<td>35'</td>
<td>20' w/o Curb/</td>
<td>145' - 155'</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10' w/ Curb</td>
<td>150' - 160'</td>
</tr>
<tr>
<td>3 Lane Roadway with a TWLTL</td>
<td>48'</td>
<td>400 W</td>
<td>35'</td>
<td>20' w/o Curb/</td>
<td>110' - 120'</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10' w/ Curb</td>
<td>130' - 140'</td>
</tr>
<tr>
<td>4 Lane Roadway</td>
<td>60'</td>
<td>400 W</td>
<td>35'</td>
<td>20' w/o Curb/</td>
<td>95' - 105'</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10' w/ Curb</td>
<td>115' - 125'</td>
</tr>
<tr>
<td>4 Lane Divided Roadway</td>
<td>86'</td>
<td>400 W</td>
<td>35'</td>
<td>20' w/o Curb/</td>
<td>75' - 85'</td>
</tr>
<tr>
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<td></td>
<td>10' w/ Curb</td>
<td>90' - 100'</td>
</tr>
<tr>
<td>5 Lane Roadway with a TWLTL</td>
<td>72'</td>
<td>400 W</td>
<td>35'</td>
<td>20' w/o Curb/</td>
<td>90' - 100'</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10' w/ Curb</td>
<td>110' - 120'</td>
</tr>
<tr>
<td>6 Lane Divided Roadway</td>
<td>110'</td>
<td>400 W</td>
<td>35'</td>
<td>20' w/o Curb/</td>
<td>60' - 70'</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10' w/ Curb</td>
<td>70' - 80'</td>
</tr>
</tbody>
</table>

NOTES:
(1) Preferred pole setback distance may be adjusted ±2 feet to conform to project or individual pole site conditions. Adjustments greater than 2 feet require written approval of the Pima County DOT/TED Project Manager.

(2) Lighting layouts are expected to have a consistent, uniform pole spacing per project within these spacing ranges. Pole spacing outside these ranges require written approval of the Pima County DOT/TED Project Manager.
USE OF TABLES

1. Layout the street lighting system per tables on sheet 6-02.
2. Calculate the average pole spacing on the designed street lighting system.
3. Use the tables below to determine the conductor size required based on the number of poles per circuit and the average pole spacing.

### MINIMUM CONDUCTOR SIZES FOR 250W LUMINAIRE
#### AVERAGE POLE SPACING (STAGGERED)

<table>
<thead>
<tr>
<th>Number of Poles per Circuit</th>
<th>91'-100'</th>
<th>101'-110'</th>
<th>111'-120'</th>
<th>121'-130'</th>
<th>131'-140'</th>
</tr>
</thead>
<tbody>
<tr>
<td>18**</td>
<td>#8</td>
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</tbody>
</table>

* See Roadway General Notes Sheet 6-00, Note #10.

** A project specific design will need to be completed for lighting systems with more than 19 poles per circuit.

### MINIMUM CONDUCTOR SIZES FOR 400W LUMINAIRE
#### AVERAGE POLE SPACING (STAGGERED)

<table>
<thead>
<tr>
<th>Number of Poles per Circuit</th>
<th>61'-70'</th>
<th>71'-80'</th>
<th>81'-90'</th>
<th>91'-100'</th>
<th>101'-110'</th>
<th>111'-120'</th>
<th>121'-130'</th>
<th>131'-140'</th>
<th>141'-150'</th>
<th>151'-160'</th>
</tr>
</thead>
<tbody>
<tr>
<td>18**</td>
<td>#8</td>
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</tr>
</tbody>
</table>

* See Roadway General Notes Sheet 6-00, Note #10.

** A project specific design will need to be completed for lighting systems with more than 19 poles per circuit.
ITS CONDUIT DESIGN GUIDELINES

1. The Pima County ITS Conduit Design Guidelines and associated Special Provisions are based upon the City of Tucson Department of Operations Technical Planning and Resources Division Section 975 - Telecommunications Infrastructure recommendations.

2. The intent of the ITS conduit design is for future fiber optic use throughout Pima County.

3. A set of special provisions (Section 975 – Telecommunications Infrastructure) is provided on sheet 7-01 and includes all of the requirements for equipment and construction of the ITS conduit system. Additional standard details are included on sheets 7-02 through 7-04.

4. The provided special provisions include design requirements for a 4 inch PVC ITS conduit system that is innerduct ready as well as a four (4) PVC with four (4) –One (1) inch innerduct ITS conduit system that is cable ready. The decision as to which system is used will be made on a per project basis.

5. The ITS conduit system can contain PVC field bends with minimum radii of 50 feet or greater and 30 degrees or less. Factory bends can be used for smaller radii when necessary. Factory bends must be manufactured out of PVC or rigid steel conduit per the special provisions provided.

6. The general ITS conduit system layout requires vaults to be placed a maximum of 1500 feet apart. The maximum spacing between ITS pull boxes or between an ITS pull box and a vault is 600 feet. The completed four (4) inch conduit system will be required to run a three and three-quarter (3 ¾) inch mandrel.
Section 975 - Telecommunications Infrastructure

975-1 DESCRIPTION

The work covered under this section shall consist of a Complete-in-Place installation, furnishing all material, labor and equipment, and installing conduit, pull boxes, vaults, and tracer wires for an underground fiber optic conduit system, including excavation, backfilling, compacting, jacking, and boring in accordance with the details.

975-2 MATERIALS

975-2.01 Polyvinyl Chloride (PVC) Conduit. All conduit shall be listed by Underwriters Laboratory (UL) and conform to NEC standards. Unless otherwise specified, all conduits to be installed underground or installed in concrete structures shall be four (4) inch diameter, rigid Polyvinyl Chloride (PVC) Non-Metallic Conduit. The PVC conduit shall be schedule 40, heavy wall, sunlight resistant, manufactured from high impact material and shall be rated for use at 90 degrees centigrade. The conduit shall meet the specifications of UL 651 and NEMA TC-2, and furnished with interface fit bell ends. Fittings shall be schedule 40 PVC, meeting the specifications of NEMA TC-3 and UL 514. PVC bends of 30 degrees or greater may be used when necessary. Field bends should not have a radius of less than 50 feet. Factory bends shall have a radius of not less than 12 times the nominal diameter of the conduit.

975-2.02 Conduit with Integral Innerduct. Conduit with Integral Innerduct shall be of schedule 40 PVC in modular, slip fit lengths. Shall have pre-lubricated innerducts with internal spacers and which expand and contract at the same rate as the outerduct. Conduits shall have anti-reversing gaskets and an o-ring gasket at bell base. Shall have inward tapering holes on coupling body for easy assignment, printed indication such as “Install Print Side Up” to keep system straight during installation, and marked innerduct and marked hole on coupling body to insure proper innerduct alignment and allow crews to work from opposite directions. Bends shall be flexible and engineered to be cut-through resistant. Innerducts shall be Carlon Telecom Systems Multi-Gard brand or equivalent. All integral innerducts shall have a continuous non-spliced, unknotted detectable 1250 pound test mule tape installed.

975-2.03 Solvent Cement for Polyvinyl Chloride (PVC) Conduit and Couplings. All solvent cement shall meet the requirements of ASTM D 2564. The cement shall be of medium or heavy bodied cement capable of making watertight joints. The cement and primer shall be of a type recommended by the manufacturer of the conduit.

975-2.04 Rigid Steel Conduit Bends. Conduit bends shall be listed by UL and conform to NEC standards. The bends shall be steel, hot dipped zinc coated, meeting the requirements of UL 6 and ANSI C80.1, and shall carry the UL label. Non-thread couplings shall not be used. Bends shall have a minimum radius of 12 times the nominal diameter.
diameter of the conduit. Steel conduit bends shall have a factory applied 40 mil PVC coating or be doubled (half overlap) wrapped with a ten (10) mil PVC plastic tape specifically manufactured for corrosion protection of metallic conduits installed below grade. For PVC conduit bends see section 975-2.01.

975-2.05 Flexible Conduit. When specifically indicated on the plans and where approved by the engineer, flexible solid wall direct bury conduit may be used. The conduit shall be manufactured of Polyvinyl Chloride (PVC), or Polyethylene (PE) plastic. The conduit shall be specifically manufactured for direct buried fiber optic raceway systems and shall be Carlon “Optic-Gard PE” conduit, or approved equal. Flexible conduit shall not be utilized for making bends in conduit system. Connection between the flexible conduit and conduits of other materials shall be made with a watertight transition coupling manufactured for the specific type of material.

975-2.06 Plastic Conduit Spacers. Spacers shall be constructed of Polyvinyl Chloride (PVC) or other non-metallic material. The spacers shall be vertical and horizontal interlocking and provide a minimum of three (3) inch clearance between conduits. Base spacers shall be provided with a wide base plate to provide solid support on the bottom of the trench. The base spacers shall provide for a minimum clearance of three (3) inches between the bottom of the trench and the conduit.

975-2.07 Aggregate Bedding Material. Aggregate material for bedding material shall meet the gradation indicated in the specifications and on the drawings for the subject project. The plasticity index shall also conform to the specifications under which the subject project is designed and constructed.

975-2.08 Not Used

975-2.09 Detectable Warning Tape. On open trenching an electronically detectable six (6) inch Fiber Warning tape shall be installed 18 inches above the conduit. Tape shall be acid and alkali-resistant polyethylene film, with a minimum thickness of 0.004 inch. The tape shall have a minimum strength of 7500 PSI lengthwise and 1,500 PSI crosswise. The tape shall be manufactured with integral wires, foil backing, or other means to enable its detection by a metal detector when the tape is buried up to a depth of 3 feet deep. The tape shall be orange in color and have the following continuous inscription, “CAUTION - FIBER OPTIC CABLE BURIED BELOW”. The inscription shall be two (2) inch black letters.

975-2.10 Backfill Material. The backfill material shall be designed and constructed using the plans and specifications of the subject project.

975-2.11 Tracer Conductor. The cable and conductor shall be listed by UL and conform to NEC standards. The conductor shall be a continuous unspliced stranded CU 6AWG, rated for 600 volts, and shall have THW or XHHW insulation. The color of the
insulation shall be green. The conductors shall be of the required length to eliminate all splices within the conduit.

975-2.12 Pull Boxes. Communications pull boxes shall be UL listed. All pull boxes shall have an etched polyethylene face, anchored in concrete, with an ultraviolet inhibitor and be of a neutral color. Unless specified otherwise, pull box lids shall be of ‘fiberlight’ material, polyester pre-mix with Calcium Carbonate, and shall be equipped with a bolt-down cover secured by a minimum of two (2) recessed penta-head bolts. The pull box cover shall have the word “COMMUNICATIONS” in permanent raised or stamped letters. Pull boxes shall be open base. The pull box cover shall have two (2) – half (½) inch x four (4) inch pull slots. The pull box base shall have two (2) – four and one half (4 ½) inch x four and one half (4 ½) inch mouse holes, one at each end. Pull boxes may be extended by means of an “extension”. The extension shall have eight (8) – four and one half (4 ½) inch x four and one half (4 ½) inch knockouts, two (2) on each side. Contractor shall provide all necessary collars, extensions, hardware, sealant, and conduit caps. All conduit entrances shall be sealed. The assigned pull box number shall be painted on the box at the time of installation. Chipped, cracked, or otherwise damaged boxes and covers will not be accepted.

975-2.13 Vaults. (Also known as ADOT No. 9 Pull Box) Communications vaults shall be UL listed. Vault base shall be pre-cast concrete with a minimum thickness of six (6) inches. Vault cover shall be fabricated steel, 36 inch diameter, secured by a minimum of one (1) recessed penta-head bolt. The cover lid shall have “COMMUNICATIONS” written on it in permanent raised, stamped or welded lettering. The vault base and vault cover shall be gasketed and weather proof. Vaults shall have a minimum outside dimension of 48 inches long by 48 inches wide by 50 inches high with a minimum thickness of four (4) inches. The base shall have one (1) – eight (8) diameter by four (4) inch deep sump hole knockout in the floor. The base interior shall have a minimum of one (1) – two and one half (2 ½) inch diameter ground rod knockout in the floor, at a corner; the base interior shall have four (4) – 7/8-inch diameter pulling irons, one centered on each side. The base exterior walls shall have four (4) 36 inch “C” channels precast in the sides, one on each side; the base exterior shall have four (4) - 18 inch x 18 inch knockouts, one on each side; and, the base exterior shall have sixteen (16) – four and one half (4 ½) inch diameter knockouts for four (4) inch conduit entrances, four (4) on each side. The contractor shall provide all necessary collars, extensions, hardware, sealant, and conduit caps. All conduit entrances shall be sealed. The assigned box number shall be painted on the box at the time of installation. Chipped, cracked, or otherwise damaged boxes and covers will not be accepted.

975-2.14 Portland Cement Concrete. Concrete shall be Class B meeting the requirements of Section 1006 of the Pima County/City of Tucson Standard Specifications for Public Improvements.
975-2.15 **Innerduct.** Innerduct shall be one (1) inch PVC constructed of a smooth walled exterior and a longitudinally ribbed interior with a continuous unknotted 1250 lbs test mule tape installed. No corrugated innerduct will be accepted. Each innerduct within a single conduit shall be of a different color (orange, brown, blue and black).

975-2.16 **Watertight Alibi.** Watertight Alibi shall consist of a Quadraplex Duct Plug designed to seal around, organize, and support innerduct where it emerges at the top of the riser. Fasteners shall be stainless steel. Plug shall support a minimum of 400 lbs of cable, and shall be removable. Jackmoon or equivalent. No chemical seals will be accepted.

975-2.17 **Blank Duct Plugs.** Blank Duct Plugs shall be installed in each individual innerduct where it emerges at the top of the riser. Duct plugs shall be all plastic construction, corrosion proof, water and air tight to 30 psi. Jackmoon or equivalent.

**975-3 **CONSTRUCTION DETAILS

**975-3.01 Conduit.**

(A) **Handling and Storage.** All conduit shall be transported in modules or bundled in a straight and level position. The straps securing the conduit to the vehicle shall be a minimum of 4 inches in width and shall not deform or damage the conduit in any manner. Conduits shall be unloaded in accordance with the manufacturer’s recommendations and shall not be dropped to the ground.

Conduits shall be stored in a straight and level position in stacks not exceeding eight (8) feet in height. Materials shall be stored in an approved manner and covered to prevent ultraviolet deterioration due to the exposure to sunlight. When stored, conduit ends shall not be capped nor shall conduit be subject to temperatures in excess of 140°F.

(B) **Cleaning.** The interior of the conduit shall be kept clean and free of debris. Prior to installation, all foreign materials shall be removed from the interior of the conduit with compressed air and a swab.

(C) **Size.** Unless otherwise indicated on the plans or special provisions, all conduit shall be four (4) inch diameter.

(D) **Cuts and Connections.** The conduit shall be cut square, de-burred, and trimmed to remove all rough edges.

PVC conduit connections shall be of the solvent weld type. Wipe conduit dry and clean before joining. Apply a full coat of primer to the pipe and coupling per the manufacturer’s recommendations. Apply a full and even coat of solvent cement to the entire area inserted into the fitting. Prevent excess cement from accumulating in the
interior of the conduit. Allow joint to cure a minimum of 20 minutes. The complete joint shall be water tight. Where a connection is made to a steel bend, the coupling used shall be a PVC female adapter.

Expansion fittings shall not be installed in PVC conduit runs unless otherwise specified. Expansion fittings shall be installed in conduit runs where both ends are fixed in-place, such as between two foundations, and within concrete structures. Expansion fittings shall allow for a minimum linear expansion of six (6) inches.

(E) Bends. Bends shall be installed only when absolutely necessary. All bends shall be manufactured out of PVC or rigid steel conduit. Bend shall be factory bent or field bent. Field bends should not have a radius of less than 50 feet. Factory bends shall have a radius of not less than 12 times the nominal diameter of the conduit. Conduit shall be bent without crimping or flattening, using the longest radius practicable. The sum of the deflection angles of all bends in any conduit run shall not exceed 270 degrees between termination and/or junction points. For the purpose of calculating the sum of the deflection angles, bends with a radius of 500 feet or greater may be excluded from these criteria.

(F) End Treatment. Conduit ends shall be capped with conduit end caps at all times when work is not in progress. Rigid steel bends terminating in pull boxes shall terminate with an approved plastic bushing.

(G) Placement. Conduit runs shown on the plans shall be changed only to avoid underground obstructions and only as directed by the Pima County DOT/TED Project Manager.

Unless otherwise specified, conduits shall be placed with a minimum cover of 36 inches to the top of the conduit below the finished grade; the minimum requirement for transportation projects is 30 inches due to the depth of electrical conduit placement. When conduit runs, or any part thereof, cannot be installed at the minimum depth, the run, or part thereof, shall be encased in concrete.

Conduits shall be installed along the straightest horizontal and vertical alignment practicable, and with a uniform depth of cover. Variations in the alignment shall be accomplished with smooth transitions maximizing the radius of the bends. In cases where it is impossible to maintain the alignment of the conduit, the grade of the conduit shall be transitioned using the minimum number and the longest radius bends. Should discovered field conditions necessitate additional bends in the conduit run, the location and number of pull boxes shall be adjusted as directed by the Pima County DOT/TED Project Manager.

Conduits to be encased within concrete shall be installed on plastic conduit spacers. The spacers shall be placed at suitable locations to prevent sagging of the conduit between
spacers or at ten (10) foot maximum centers. Prior to the placement of the concrete, the conduits shall be tied down to prevent them from floating.

Conduit penetrations into pull boxes shall be made using the knockouts or shall be cored in the structure. Conduits entering through the side wall of pull boxes shall be located 3 inches above the floor and three (3) inches away from the end wall of the box. Conduit entering the bottom of pull boxes shall be located in the near side corner of the box, approximately three (3) inches away from the side and end walls. The conduit shall be sloped towards the top center of the box to facilitate pulling of the cables and innerduct. Conduits terminating in pull boxes shall terminate a minimum of three (3) inches inside the box wall. The void between the conduit and the box shall be completely filled with mastic to form a watertight seal.

Conduits entering vaults shall enter through single duct knockouts. The location of the knockout shall be as indicated on the plans, or directed by the engineer. The joint between the knockout and the conduit shall be filled to form a watertight seal.

At all locations where the conduits cross under a new curb, the letters “FO” shall be cut into the top of the curb directly over the conduit run. The letters shall be three (3) inches tall and shall be clearly defined.

975-3.02 Trenching. Unless otherwise specified, all conduit runs shall be installed by trenching methods. Trenching shall include the removal of all material to the design grade no matter what type of material is encountered. The alignment of the conduit shall be staked in the field per the Pima County standard procedures.

When trenching in excess of 5 feet is required, the contractor shall submit, in writing to the Pima County DOT/TED Project Manager, a detailed description of their proposed trenching operations, including shoring methods, prior to the commencement of construction.

All conduit shall be covered with bedding material or concrete at the completion of each day’s work to prevent shrinkage and thermal expansion that could influence the alignment of the conduit.

Concrete encasement shall be a minimum of Class B (2,500 PSI) in accordance with Pima County/City of Tucson Standard Specifications and provide a minimum cover of three (3) inches on all sides of the conduit. Otherwise, bedding and shading of the conduit shall be in accordance with the plans and specifications of the subject project. When installed adjacent to water mains, the conduit shall be encased in concrete.

(A) Bedding and Shading. Bedding and shading of the conduit shall be in accordance with the following:
Conduits installed in conjunction with Tucson Water projects shall be designed and installed using the plans and specifications of the subject project.

Conduits installed with traffic signal or street lighting conduits shall be designed and installed using the plans and specifications of the subject project.

Conduits with a depth of cover less than cited above, and where indicated on the plans, shall be encased in concrete. The concrete shall be placed to provide a minimum of three (3) inches of encasement on all sides of the conduit.

**(B) Backfill.** Upon completion of the conduit and bedding installation, the trench shall be backfilled and compacted. The backfill shall be designed and constructed using the plans and specifications of the subject project. Place the detectable warning tape in the backfill, 18 inches below finished grade and directly above the conduit.

975-3.03 Boring and Jacking. Conduit runs shall be installed by boring and jacking methods when required by the plans or directed by the Pima County DOT/TED Project Manager. The boring and jacking method shall be approved by the Pima County DOT/TED Project Manager prior to the commencement of work. Where a conduit run is required by the plans to be installed by boring or jacking, the trenching method shall not be utilized except with prior written approval of the Pima County DOT/TED Project Manager.

When casing is used, the casing shall be schedule 40 “standard wall” steel pipe. The casing shall not deviate more than 0.20 feet from the design grade. The joints in the casing shall be fully welded in accordance with A.S.M.E. Section 9. Concrete end seals shall be provided at each end. The intervening annular space shall be filled with sand material approved by the Pima County DOT/TED Project Manager.

Conduits installed within the casing used for water mains shall consist of either four (4) each one (1) inch, four (4) each one and one-half (1 1/2) inch, or two (2) or more, two (2) inch diameter flexible conduits. The largest practical size shall be used. The conduits shall be strapped to the glass reinforced skids installed on the water line, pulled into the casing after the water main is installed, or installed on a hanger welded to the casing. The alignment of the conduits shall be maintained as straight as possible. The placement of sand within the annular space of the casing shall be controlled to a rate that does not displace the conduit.

Boring and jacking pits shall be located a minimum of two (2) feet outside the pavement edge. The diameter of the bore shall be as close to the outside diameter of the conduit such that it will enable the conduit to be installed. At all locations where the diameter of the bore is two (2) inches, or greater, than the outside diameter of the conduit, the interstitial space between the conduit and the bore shall be filled with slurry. All boring
and jacking methods used shall neither damage nor deform the conduit. The installed conduit shall conform to the alignment and grade shown on the plans.

975-3.04 Concrete Structures. Conduit embedded in concrete structures shall be securely attached to the reinforcing steel at locations and intervals detailed on the plans. Expansion fittings shall be installed at all locations where the conduit crosses expansion joints in the structure. Expansion joints shall also be installed at the point where the conduit enters and exits the concrete structure. Where it is not possible to install expansion joints, the conduit shall be installed in a conduit sleeve of sufficient size to provide a minimum of 1/2-inch clearance between the outside diameter of the conduit and the inside wall of the sleeve. Sleeves shall be discontinuous across the expansion joints in the structure.

975-3.05 Pull Boxes and Vaults. Prior to setting the pull box or vault, verify that the excavation is to the design elevation and alignment. Pull boxes and vaults shall be placed such that the crushed stone does not wash away or into the conduit. Vaults and pull boxes shall NOT be placed in a location of water drainage or standing water. Set boxes and vaults true and plumb. The top plane of the cover shall be a minimum of 1 inch above finished grade and six (6) inches above possible standing water level for the location. Backfill and compact around the structure avoiding damage to the structure. The backfill shall be compacted to a minimum of 95 percent of the maximum density as determined by ASTM D698. Pull boxes are to be placed on a minimum of 5 cubic feet of clean 1 inch (size 57) rock and vaults are to be placed on a minimum of 16 cubic feet of clean 1 inch (size 57) rock.

Pull boxes shall be encased in a concrete ring a minimum 10 inches wide and a minimum of 12 inches deep on compacted soil. Each pull box/vault shall be provided with a 5/8-inch by eight (8) foot ground rod and acorn, driven vertically in the corner with six (6) inches of rod exposed above the top of the drainage rock.

Install the precast sections in accordance with ASTM C891. Joints between the precast sections shall be sealed with a flexible butyl sealant meeting the requirements of AASHTO M-198. Install precast adjustment rings and the frame and cover to finished grade. Pull boxes shall be encased in a concrete ring a minimum ten (10) inches wide and a minimum of 12 inches deep on compacted soil.

Cables passing through pull boxes require a minimum 50 feet service loop where attainable without exceeding manufacturer’s minimum bend radius. Cables pulled through vaults require not less than 150 feet before exiting.

975-3.06 Innerducts. All 4 inch conduits shall have a minimum of four (4) – one (1) inch smooth wall exterior, longitudinally ribbed interior innerducts with 1250 lbs test rated pull strength mule tape installed. Each innerduct within a single conduit shall be of a different color (orange, brown, blue and black).
975-3.07  **Tracer Wire, Electronic Marker, Mule Tape.** A continuous, separate #6 AWG THW/XHHW CU insulated tracer wire shall be installed in each conduit run, external to the innerducts. All lubricants used in the pulling of the tracer wire shall be water soluble. No splicing of the tracer wire shall be permitted in the conduit runs. The ends of the wire shall extend into each pull box, or vault, a minimum of 5 feet, coiled and secured. Connect the ends of all tracer wires within a pull box, or vault, together to a common lug. An electronic marker, 3M model 1255 mini-marker shall be placed by the Contractor at the location of any capped conduit not in a building or pull box/vault. All unoccupied or capped conduits shall have a continuous unspliced unknotted detectable 2500 lbs test rated pull strength mule tape installed, secured at each end and shall be labeled with location of opposite end.

975-3.08  **Testing and Cleaning.** The completed conduit runs shall be cleaned and tested prior to final acceptance. Cleaning shall consist of pulling a swab through the conduit and removing all foreign material from within the conduit. If water is allowed to enter the conduit during construction, it shall be blown out or removed by other satisfactory means prior to the acceptance of the system. Vaults and pull boxes shall be cleaned of all debris. Upon completion of the cleaning operations, the ends of the conduit shall be capped. RGS sweeps terminating in pull boxes shall be plugged.

All conduit runs shall be clearance tested after the completion of all backfilling and subgrade preparation operations. This test shall consist of pulling a mandrel through the conduit run. The mandrel shall be segmented with an outer diameter of ¼-inch less than the inside diameter of the conduit, and shall be ten (10) inches in length. The test shall be considered acceptable when the mandrel can be passed through the entire conduit run with a pulling force of 300 lbs or less. Each conduit run shall be verified for continuity along its entire length, as noted on the plans, and by means of an underground line locator. The installed conduit system shall be marked on the ground using standard bluestake color code and markings procedures.

All testing of the system shall be scheduled with, and conducted in the presence of the Pima County DOT/TED Project Manager. All portions of the system that do not pass the specified testing shall be repaired by the contractor, and retested, at no additional cost.

975-4  **METHOD OF MEASUREMENT**

975-4.01  **Conduits.** Conduits shall be measured by the linear foot for each diameter size of conduit. The measurement shall be from center to center of pull box or vault. No measurement or direct payment will be made for the trenching, bedding, encasement, tracer wire, marking tape, mule tape, backfill and testing, the cost being considered as included in the contract price for the conduit.
**975-4.02 Pull Boxes.** Pull boxes will be measured as a unit for each pull box installed complete with cover and accessories.

**975-4.03 Vaults.** Vaults will be measured as a unit for each vault complete with frame and cover and accessories.

**975-5 BASIS OF PAYMENT**

**975-5.01 Conduit.** Acceptable quantities of conduit, measured as provided above, will be paid for at the contract unit price per linear foot, which price shall be full compensation for the work, complete in place, including any excavation, removals of obstruction, bedding, encasement, backfill, and any incidentals necessary to complete the work.

**975-5.02 Pull Boxes.** Acceptable quantities of pull boxes, measured as provided above, will be paid for at the contract unit price each, which price shall be full compensation for the work, complete in place, including any excavation, removals of obstruction, bedding, coring, knockouts, backfill, and any incidentals necessary to complete the work.

**975-5.03 Vaults.** Acceptable quantities of vaults, measured as provided above, will be paid for at the contract unit price each, which price shall be full compensation for the work, complete in place, including any excavation, removals of obstruction, coring, knockouts, support channels, bedding, backfill, risers, frames and covers, accessories, and any incidentals necessary to complete the work.
TYPE 1: SINGLE FO CONDUIT

REFER TO SHEET 6 OF 6 FOR GENERAL NOTES AND SYMBOLS.

NOTE: CONCRETE ENCASEMENT REQUIREMENT FOUND IN SECTION 975-3.01(C)
SUMMARY:

PAD

SEE SD-216 FOR DETAILS

DETECTABLE WARNING TAPE

FINISHED GRADE

BACKFILL MATERIAL AND COMPACTION SHALL BE IN ACCORDANCE WITH THE PIMA COUNTY/CITY OF TUCSON SPECIFICATIONS AND DETAILS

CONDUITS

SHORING, OR SLOPE SIDES PER OSHA REQUIREMENTS.

BEDDING MATERIAL SHALL CONSIST OF CLASS B PORTLAND CEMENT CONCRETE WHEN REQUIRED BY SECTION 975-3.01 (G)

PLASTIC CONDUIT SPACERS, INSTALL CONDUIT AS REQUIRED TO MAINTAIN CONDUIT ALIGNMENT TIE DOWN SPACERS TO PREVENT DISPLACEMENT DURING ENCASEMENT

36" MIN. COVER

18"

3" MIN.

D

3" MIN.

D

3" MIN.

D

3" MIN.

D

3" MIN.

3" MIN.

CONDUITS

CONDUITS

TYPE 2: MULTIPLE FO CONDUITS

REFER TO SHEET 6 OF 6 FOR GENERAL NOTES AND SYMBOLS.

NOTE: CONCRETE ENCASMENT REQUIREMENT FOUND IN SECTION 975-3.01(G)
EXCAVATION, BEDDING, SHADING, BACKFILL, COMPACTION, AND PAVEMENT REPAIR PER TUCSON WATER SPECIFICATIONS AND SD-216

FINISHED GRADE

DETECTABLE WARNING TAPE

SHORING, OR SLOPE SIDES PER OSHA REQUIREMENTS

CONDUIT

BEDDING MATERIAL SHALL CONSIST OF CLASS B PORTLAND CEMENT CONCRETE WHEN REQUIRED BY 975-3.02

NEW WATER MAIN

36" MIN. COVER

18"

6" MIN.

3" MIN.

D

3" MIN., INCREASE AS REQUIRED TO ACCOMMODATE SHORING

12" MIN. CLEARANCE BETWEEN WATER MAIN AND FO CONDUIT

NOT TO SCALE

TYPE 3: FO CONDUIT INSTALLED ADJACENT TO TUCSON WATER MAIN

REFER TO SHEET 6 OF 6 FOR GENERAL NOTES AND SYMBOLS.
SEE SD-216 FOR PAVEMENT PATCHING DETAILS

AGGREGATE BEDDING MATERIAL SHALL CONSIST OF CLASS B PORTLAND CEMENT CONCRETE WHEN REQUIRED BY 975-3.02

CONDUIT

6" MIN. D

3" MIN.

3" MIN., INCREASE AS REQUIRED TO ACCOMMODATE SHORING.

12" MIN. CLEARANCE BETWEEN WATER MAIN AND FO CONDUIT.

CONTRACTOR MAY BENCH TRENCH OR EXCAVATE ENTIRE WIDTH TO THE DEPTH REQUIRED FOR THE WATER LINE. OVER EXCAVATION SHALL BE BACKFILLED AND COMPACTED PER TUCSON WATER’S STANDARD SPECIFICATION 0209.

EXCAVATION, BEDDING, SHADING, BACKFILL, COMPACTION, AND PAVEMENT REPAIR PER TUCSON WATER SPECIFICATIONS

NEW WATER MAIN

FINISHED GRADE

DETECTABLE WARNING TAPE

DEPTH OF COVER SPECIFIED ON TUCSON WATER CONSTRUCTION PLANS

NOT TO SCALE

TYPE 4: FO CONDUIT INSTALLED ABOVE TUCSON WATER MAIN

REFER TO SHEET 6 OF 6 FOR GENERAL NOTES AND SYMBOLS.
FINISHED GRADE

DETECTABLE WARNING TAPE, REFER TO NOTE 1, THIS SHEET

FUTURE CURB LINE

FINISH GRADE OF PAVEMENT

EXCAVATION, BACKFILL, AND PAVEMENT REPAIR PER COT STANDARDS AND SD-216

DETECTABLE WARNING TAPE, REFER TO NOTE 1, THIS SHEET

PLASTIC CONDUIT SPACERS, INSTALL AS REQUIRED TO MAINTAIN CONDUIT ALIGNMENT

REFER TO NOTE 2, THIS SHEET

NOTES:

1. INSTALL WARNING TAPE FOR THE FIBER OPTIC SYSTEM AND THE STREET LIGHTING / TRAFFIC SIGNAL CONDUITS, SIDE BY SIDE AT THE SPECIFIED DEPTH.

2. AT STREET CROSSINGS, WHERE THE STREET LIGHTING / TRAFFIC SIGNAL CONDUIT IS ENCASED IN CONCRETE, ENCASE FO CONDUIT IN CLASS B CONCRETE.

3. EXCAVATION, BEDDING, SHADING, BACKFILL, AND COMPACTION OF THE STREET LIGHTING AND TRAFFIC SIGNAL CONDUITS SHALL BE IN ACCORDANCE WITH THE PIMA COUNTY/CITY OF TUCSON STANDARD SPECIFICATIONS AND DETAILS FOR PUBLIC IMPROVEMENT.

TYPE 5: FO CONDUIT INSTALLED WITH STREET LIGHTING OR TRAFFIC SIGNAL CONDUIT

REFER TO SHEET 6 OF 6 FOR GENERAL NOTES AND SYMBOLS.

NOTE: CONCRETE ENCASEMENT REQUIREMENT FOUND IN SECTION 975-3.01(C)
GENERAL NOTES:

1. FOR CONDUIT IN THE ROADWAY RIGHT-OF-WAY WHERE REQUIRED BY THE CITY OF TUCSON/PIMA COUNTY SPECIFICATIONS AND DETAILS, AND WHERE SPECIFICALLY CALLED OUT ON THE DRAWINGS, CONDUIT SHALL BE ENCASED IN CLASS B PORTLAND CEMENT CONCRETE.

2. CONSTRUCTION STAKING SHALL BE IN ACCORDANCE WITH PROJECT REQUIREMENTS.

3. SHORING AND / OR BRACING SHALL CONFORM TO OSHA REQUIREMENTS.

4. REFER TO SPECIFICATIONS FOR THE REQUIREMENTS FOR THE DETECTABLE WARNING TAPE.

LEGEND:

D OUTSIDE DIAMETER OF CONDUIT.

CONDUIT SHALL BE 4" IN DIAMETER UNLESS OTHERWISE NOTED ON THE PLANS.

THE LOWER OF EXISTING OR FUTURE FINISHED GRADE.

PAVEMENT PATCHING SHALL CONFORM WITH THE REQUIREMENTS OF PIMA COUNTY / CITY OF TUCSON STANDARD DETAIL FOR PUBLIC IMPROVEMENTS, STANDARD DETAIL No. 216, AND THE CONSTRUCTION DOCUMENTS.

36" MINIMUM COVER, AND A MINIMUM OF 24" BELOW THE LIMITS OF SUBGRADE SCARIFICATION.

NATIVE UNDISTURBED SOIL.

BACKFILL MATERIAL AND COMPACTION SHALL BE IN ACCORDANCE WITH THE REQUIREMENTS OF THE AUTHORITY THAT HAS JURISDICTION OVER THE RIGHT-OF-WAY, AND PROJECT SPECIFICATIONS.

AGGREGATE BEDDING MATERIAL OR CLASS B PORTLAND CONCRETE CEMENT AS REQUIRED IN SECTIONS 975-3.01 AND 975-3.02.

BACKFILL, BEDDING AND SHADING MATERIAL OF A JOINT TRENCH TO BE CONTROLLED BY THE SPECIFICATIONS AND DETAILS OF THE AGENCY RESPONSIBLE FOR THE UTILITY.
GENERAL NOTES:

1. BASE AND COVER SHALL BE IN A NEUTRAL COLOR.
2. BASE SHALL BE MOLDED HIGH DENSITY POLYETHYLENE.
3. PULL BOX SHALL BE OF THE DIMENSIONS 30" WIDTH BY 48" LENGTH BY 24" DEPTH.
4. COVER SHALL BE A POLYESTER PRE-MIX WITH CALCIUM CARBONATE.
5. COVER SHALL BE FACTORY EMBOSSED WITH "COMMUNICATIONS".
6. COVER SHALL BE SECURED BY 3/8-16 PENTA HEAD BOLTS.
7. PULLBOX MAY BE EXTENDED BY MEANS OF EXTENSION.
GENERAL NOTES
1. Pull irons are ¾" Ø cold rolled galvanized steel.
2. Weight Concrete: Cover = 663#, Vault = 2858#, Total = 3689#.
   Rebar: Cover = 91#, Vault = 79#, Total = 170#.
   Door: 175#.

STRUCTURAL NOTES
1. Concrete: 28 Day compressive strength f’c = 4500 PSI.
2. Rebar: ASTM A-615 Grade 60.

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ITS Conduit Plan General Notes

1. ALL EQUIPMENT / MATERIALS AND CONSTRUCTION SHALL MEET OR EXCEED THE REQUIREMENTS CONTAINED IN THE CURRENT PIMA COUNTY/ CITY OF TUCSON “STANDARD SPECIFICATIONS FOR PUBLIC IMPROVEMENTS” AND “STANDARD DETAILS FOR PUBLIC IMPROVEMENTS”, THE SPECIAL PROVISIONS AND THE PLANS.

2. PULL BOXES AND VAULTS SHOWN ON PLANS ARE DIAGRAMMATIC REPRESENTATIONS. THE EXACT LOCATION OF EACH VAULT OR PULL BOX SHALL BE APPROVED BY THE TRAFFIC ENGINEER PRIOR TO INSTALLATION.

3. VAULTS SHALL BE USED FOR LONG RUNS OF CONDUIT. THE MAXIMUM SPACING BETWEEN VAULTS IS 1500 FEET. A VAULT SHALL BE INSTALLED ON ONE CORNER OF EVERY SIGNALIZED OR FUTURE SIGNALIZED INTERSECTION AS SHOWN ON PLANS.

4. EVERY SIGNALIZED INTERSECTION OR FUTURE SIGNALIZED INTERSECTION SHALL BE RINGED WITH INTERCONNECT CONDUIT. ON THE THREE CORNERS OF THE INTERSECTION NOT CONTAINING THE VAULT, ITS PULL BOXES SHALL BE UTILIZED. THE MAXIMUM SPACING BETWEEN ITS PULL BOXES OR BETWEEN AN ITS PULL BOX AND A VAULT SHALL BE 600 FEET.

5. AT ALL SIGNALIZED INTERSECTIONS, A ONE AND ONE HALF (1 ½) INCH PVC CONDUIT SHALL BE INSTALLED FROM THE TRAFFIC SIGNAL CONTROLLE TO THE ADJACENT ITS PULL BOX OR VAULT.

6. THE TOP OF THE VAULTS AND PULL BOXES SHALL BE LEVEL WITH THE SURROUNDING FINISHED GRADE. IF THE SLOPE OR SHOULDER DROPS OFF FROM FINISHED GRADE, THE CONTRACTOR SHALL GRADE AROUND POLE FOUNDATION. THE TOP OF THE FOUNDATION SHALL EXTEND NO MORE THAN FOUR (4) INCHES ABOVE SURROUNDING FINISHED GRADE.

7. VAULTS SHALL MAINTAIN A MINIMUM OF SIX (6) FEET HORIZONTAL DISTANCE FROM EXISTING WATER MAINS, MEASURED FROM OUTSIDE OF THE WALL OF THE VAULT TO THE OUTSIDE OF PIPE WALL.

8. ITS PULL BOXES SHALL BE A 30 INCH X 48 INCH PENCELL BOX OR APPROVED EQUAL.

9. VAULTS SHALL BE PRECAST CONCRETE WITH A MINIMUM OUTSIDE DIMENSION OF 48 INCH LONG BY 48 INCH WIDE BY 50 INCH HIGH.

10. PULL BOXES SHALL NOT BE INSTALLED WITHIN CONCRETE CURB ACCESS RAMPS OR LANDINGS. IN ADDITION, ANY PULL BOXES INSTALLED BEHIND CURBS SHALL BE INSTALLED BETWEEN THE CURB AND THE PROPOSED / FUTURE SIDEWALK OR BEYOND THE PROPOSED / FUTURE SIDEWALK. AN EXCEPTION TO THIS NOTE WOULD BE PULL BOXES INSTALLED IN A MEDIAN. ANY PULL BOXES INSTALLED ALONG AN UNCURBED ROADWAY SHALL BE INSTALLED TEN (10) FEET FROM...
EDGE OF PAVEMENT TO EDGE OF PULL BOX WHERE RIGHT-OF-WAY PERMITS OR AS FAR FROM PAVEMENT AS PRACTICAL WHEN THERE IS INSUFFICIENT RIGHT-OF-WAY TO PROVIDE THE TEN (10) FOOT OFFSET.

11. A THREE FOURTH (¾) INCH X TEN (10) FOOT GROUND ROD SHALL BE INSTALLED IN EVERY ITS VAULT AND ITS PULL BOX. TWO GROUND ROD CLAMPS SHALL BE FURNISHED FOR EACH GROUND ROD FOR GROUNDING THE GROUND WIRE.

12. THE CONDUIT LOCATIONS SHOWN ON PLAN ARE DIAGRAMMATIC REPRESENTATIONS ONLY. CONTRACTOR SHALL INSTALL CONDUIT TO AVOID CONFLICTS. ALL CONDUITS SHALL BE INSTALLED WITHIN EXISTING RIGHT-OF-WAY UNLESS OTHERWISE APPROVED.

13. CONDUIT INSTALLED UNDER EXISTING PAVED DRIVEWAYS, WHICH ARE NOT SCHEDULED TO BE RECONSTRUCTED AS PART OF THIS PROJECT, SHALL BE INSTALLED BY MEANS OF BORING.

14. ALL CONDUIT SHALL BE INSTALLED A MINIMUM OF 36 INCHES BELOW FINISHED GRADE, EXCEPT WHEN CONDUITS CROSS CULVERTS OR ARE ROUTED ALONG BRIDGE AND WING WALLS. ANY CONDUIT INSTALLED LESS THAN 36 INCH DEEP SHALL BE ENCASED IN CONCRETE PER PC/COT STANDARD SPECIFICATIONS 732-3.01.

15. ONLY NEW CONDUIT SHALL BE INSTALLED. ALL ITS INTERCONNECT CONDUIT SHALL BE FOUR (4) INCH PVC SCHEDULE 40 UNLESS NOTED OTHERWISE. CONDUIT ADJACENT TO CURB SHALL BE INSTALLED SIX (6) INCHES BACK OF CURB AND 42 INCHES BELOW TOP OF CURB.

16. ALL CONDUITS SHALL BE CLEANED BY COMPRESSED AIR. A PROPERLY SIZED CONDUIT PISTON OR MANDREL SHALL BE PULLED THROUGH THE CONDUIT PRIOR TO INNERDUCT INSTALLATION.

17. FOUR (4) – ONE (1) INCH INNERDUCTS SHALL BE INSTALLED WITHIN INTERCONNECT CONDUIT UNLESS OTHERWISE NOTED ON PLANS OR SPECIAL PROVISIONS.

18. INNERDUCTS SHALL BE PRE-LUBRICATED WITH SMOOTH EXTERIOR WALLS AND LONGITUDINALLY RIBBED INTERIOR WALLS. INTERNAL SPACERS WHICH EXPAND AND CONTRACT AT THE SAME RATE AS THE INTERCONNECT CONDUIT SHALL BE INSTALLED. ANTI-REVERSING GASKETS AND AN O-RING GASKET AT THE BELL BASE ARE REQUIRED. INNERDUCTS SHALL BE CLARON TELECOM SYSTEMS MULTI-GARD BRAND OR EQUIVALENT. EACH INNERDUCT WITHIN A SINGLE CONDUIT SHALL BE OF A DIFFERENT COLOR (ORANGE, BROWN, BLUE, AND BLACK).

19. ALL INTEGRAL INNERDUCTS SHALL HAVE A CONTINUOUS NON-SPLICED, UNKNOTTED DETECTABLE 1250 POUND TEST MULE TAPE INSTALLED.
20. CONDUITS FOR FUTURE USE SHALL BE SEALED WITH A PROPERLY Sized TAPERED POLYETHYLENE DUCT PLUG AT EACH TERMINATION POINT. THE #8 BARE BOND WIRE SHALL BE LOOPED THROUGH THE PLUG PULL TAB AND TWO FEET OF SLACK DOUBLED BACK INTO THE CONDUIT.


22. A GREEN TRACER CONDUCTOR SHALL BE INSTALLED WITHIN EACH INTERCONNECT CONDUIT. THE CONDUCTOR SHALL BE A CONTINUOUS UNSLICED STRANDED CU 6 AWG, RATED FOR 600 VOLTS, AND SHALL HAVE THW OR XHHW INSULATION. TRACER CONDUCTOR SHALL BE INSTALLED ON THE OUTSIDE OF THE INNERDUCTS.

23. FOR UNDERGROUND CONDUIT, A MINIMUM HORIZONTAL SEPARATION OF SIX (6) FEET SHALL BE MAINTAINED FROM LANDSCAPE IRRIGATION MAINLINES OR WATER LINES. TYPICAL FOR ALL CONDUIT INSTALLATIONS THROUGHOUT PROJECT.

24. A MINIMUM HORIZONTAL SEPARATION OF 24 INCHES SHALL BE MAINTAINED FROM ALL GAS LINES.

25. THE TRAFFIC SIGNAL OPERATION AT EXISTING SIGNALIZED INTERSECTIONS SHALL BE MAINTAINED THROUGHOUT THE DURATION OF THE PROJECT.


RESPONSIBILITIES:

1. THE CONTRACTOR SHALL OBTAIN ALL PERMITS REQUIRED BY ALL GOVERNMENTAL AGENCIES WITH THE EXCEPTION THAT PIMA COUNTY MUST JOINTLY OBTAIN THE NPDES PERMIT AND FILE THE NOI AND NOT. FOR WORK BEYOND THE SCOPE OF THESE PROJECT LIMITS, PLANS OR SPECIFICATIONS, THE CONTRACTOR SHALL OBTAIN A SEPARATE FLOODPLAIN AND/OR GRADING PERMIT PRIOR TO COMMENCING SUCH WORK.
2. THE CONTRACTOR SHALL CONTACT BLUE STAKE AT 1-800-782-5348, A MINIMUM OF TWO (2) WORKING DAYS PRIOR TO ANY EXCAVATION.

3. THE CONTRACTOR SHALL MAINTAIN AND ALLOW ACCESS TO ALL PIMA COUNTY WASTE WATER MANHOLES LOCATED WITHIN THE ROW. ACCESS MUST BE MAINTAINED 24 HOURS PER DAY, SEVEN DAYS PER WEEK. NO ELECTRICAL UTILITIES MAY BE PLACED WITHIN SIX FEET OF A FORCE MAIN.

4. THE LOCATION OF UTILITIES SHOWN ON THE PLANS IS APPROXIMATE. THE CONTRACTOR IS RESPONSIBLE FOR VERIFYING / POTHOLING UNDERGROUND UTILITIES IN THE VICINITY OF THE PROPOSED POLE FOUNDATIONS. THE CONTRACTOR IS ALSO RESPONSIBLE FOR VERIFYING CLEARANCE BETWEEN OVERHEAD LINES AND STREET LIGHTING EQUIPMENT PRIOR TO INSTALLATION OF POLES AND FOUNDATIONS.

5. ANY EQUIPMENT AND/OR UTILITIES WITHIN THE PROJECT LIMITS THAT ARE DAMAGED OR DESTROYED BY THE CONTRACTOR SHALL BE REPAIRED OR REPLACED AT THE SOLE EXPENSE OF THE CONTRACTOR.


7. THE CONTRACTOR SHALL CAREFULLY DISASSEMBLE AND SALVAGE ALL EXISTING TRAFFIC SIGNAL AND STREET LIGHTING EQUIPMENT THAT IS NOT TO REMAIN OR BE RELOCATED, EXCEPT EXISTING WIRELESS COMMUNICATIONS AND PTZ CAMERA EQUIPMENT. ALL OF THE EQUIPMENT SHALL BE SAFELY STORED AT THE CONSTRUCTION SITE UNTIL IT IS SAFELY RETURNED TO THE PCDOT MAINTENANCE YARD, 1313 S. MISSION RD. THE EQUIPMENT SHALL BE SAFELY UNLOADED BY THE CONTRACTOR. CONTACT SIGNAL SHOP SUPERVISOR (740-2632) AT LEAST 2 WORKING DAYS PRIOR TO RETURNING THE EQUIPMENT.

8. WHEN APPLICABLE, THE CONTRACTOR SHALL SALVAGE AND REPLANT ANY LANDSCAPING VEGETATION THAT MAY BE DAMAGED BY CONSTRUCTION ACTIVITIES. THE CONTRACTOR SHALL OBTAIN PRIOR APPROVAL FROM THE OPERATIONS DEPARTMENT'S PUBLIC WORK SUPERVISOR (520-740-5969) BEFORE ANY PLANTS ARE MOVED.

9. WHEN APPLICABLE, THE CONTRACTOR SHALL REPAIR/RESTORE ANY LANDSCAPE IRRIGATION COMPONENTS DAMAGED BY CONSTRUCTION ACTIVITY TO THEIR ORIGINAL CONDITION.

10. THE CONTRACT SHALL VISIT SITE AND OBSERVE AND NOTE CONDITIONS PRIOR TO SUBMITTING BID TO DETERMINE ALL INSTALLATION REQUIREMENTS.