

UTILITIES STANDARD OF PRACTICE

2015

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Utilities Standard of Practice

DC Streetcar

Table of Contents

- 1.0 Document Purpose..... 5**
 - 1.1. Project Background..... 5
 - 1.2. Purpose of the Utilities Standard of Practice..... 5
- 2.0 Streetcar and Utility Systems..... 7**
 - 2.1. Definitions..... 7
 - 2.2. Streetcar infrastructure and Operations 9
 - 2.2.1. Streetcar Infrastructure 9
 - 2.2.2. Streetcar Envelope 9
 - 2.2.3. Streetcar Loading and Vibration 10
 - 2.2.4. Streetcar Operation 10
 - 2.2.5. Overhead Contact System and Stray Current 11
 - 2.3. Utility Infrastructure and Operation..... 11
 - 2.3.1. Utility Types 11
 - 2.3.2. Materials 12
 - 2.3.3. Utility Maintenance and Repair 12
 - 2.3.4. New Utility Construction..... 12
 - 2.4. Zone of Influence 13
 - 2.4.1. Subsurface Zone of Influence..... 14
 - 2.4.2. Overhead Zone of Influence 14
 - 2.5. Utility Agreements 14



3.0 Streetcar Infrastructure Impacts on Underground Utilities..... 15

3.1. Gas Utilities 16

3.2. Water Utilities 16

3.3. Other Pressurized Liquids 17

3.4. Sanitary Sewers..... 18

3.5. Storm Sewers 19

3.6. Electric and Communication Utilities..... 20

3.7. Other Underground Utilities 20

3.8. Utility Design References 20

4.0 Overhead Utilities 23

5.0 Service for Streetcar Tractive Power 25

6.0 Implementation and Enforcement 27

6.1. Relocations..... 27

6.2. Agreements..... 27

6.3. Permits 27

6.3.1. PSRA Permit Process Overview 28

6.3.2. PSRA Construction Permit Process 28

6.3.3. PSRA Occupancy Permit Process..... 28

6.3.4. PSRA Utility Emergency Work Permit Process..... 28

6.4. Implementation 29

6.5. Worker Safety 29



List of Figures

Figure 1 | Zone of Influence – Embedded Concrete Track 33

Figure 2 | Zone of Influence - Ballast Track..... 34

Figure 3 | Overhead Contact System Clearance to Non-OCS Wires 35

Figure 4 | Overhead Contact System Vertical Clearance 36

Figure 5 | Zone of Influence - Overhead 37

Figure 6 | Utility Encasement..... 38

Figure 7 | Manhole in Embedded Concrete Track 39

Figure 8 | Catch Basin at Embedded Concrete Track..... 40

Figure 9 | Utility Line Crossing Track 41

Figure 10 | Utility Excavation Below Track Slab 42

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1.0 Document Purpose

1.1. Project Background

The District Department of Transportation (DDOT) has a program to implement streetcar routes within the District of Columbia (The District). Approximately 37 miles of streetcar lines are planned, with the intention to serve all eight (8) wards and provide connectivity to other transit facilities including Washington Metropolitan Area Transit Authority Metro stations and Union Station, which serves Amtrak and MARC Train Service. The purpose of the program is to:

- Provide an additional transit option for residents and visitors
- Promote more sustainable travel practices
- Improve access to employment
- Connect neighborhoods and commercial corridors
- Encourage economic development

1.2. Purpose of the Utilities Standard of Practice

The DC Streetcar system utilizes a fixed guideway system typically constructed within the street and shared with automobile traffic. At some locations the fixed guideway will also be constructed on direct fixation track as well as ballast track, both within a transit dedicated right-of-way and not shared with automobile traffic. In addition, the streetcar is powered by an overhead contact system (OCS) supported by poles with foundations constructed within the sidewalk or median. As a result, the proposed streetcar infrastructure needs to be designed to coexist with other infrastructure elements, including existing and new overhead and underground utilities.

As the streetcar program is implemented in the District, challenges associated with the existing utility infrastructure in the District's highly developed urban corridors pose a risk that must be managed effectively. The District's urban right-of-way contains a variety of subsurface and overhead utilities. These utilities form a web of potential conflicts for the new streetcar infrastructure since they will run parallel to and cross over and under the proposed guideway that will be constructed in the District's urban roadways. Addressing these conflicts proactively will benefit the service life, operation, and maintenance of both the streetcar and the utilities. The District has developed standard guidelines in collaboration with the local public utility agencies and private utility companies in order to deliver the streetcar program in a realistic, cost effective and sustainable manner. The resulting Utilities Standard of Practice (USP) is formulated to guide the planning and design of the streetcar infrastructure and utility facilities. When implemented and enforced, the USP document will establish expectations and reduce uncertainty for utility stakeholders before engineering designs are progressed and construction begins.



The USP is strictly a guidance document and shall not be considered a professional engineering document. The USP is intended to work in conjunction with the District's existing Design and Engineering Manual, standard specifications, standard drawings, and the DC Streetcar Design Criteria. The USP presents planning and design guidelines to provide safe access for maintenance of utility infrastructures with minimal impact to the streetcar infrastructure and operation. Additionally, these design guidelines identify required clearances between utilities and the streetcar which could lead to relocation, adjustment, or abandonment of existing utility facilities. The USP guidelines also address the permit process for maintenance and emergency access to the utility facilities.

The USP covers the most commonly encountered utility issues. In the event that a unique resolution becomes necessary for an unusual condition that is not specifically or adequately addressed within the USP, a collaborative approach involving all affected stakeholders shall be initiated.

The USP does not establish financial responsibility for the cost of design and/or construction of utility modifications. Costs of relocations and/or betterments that may result from its implementation on a specific project will be agreed upon by the District and the Utility Owner on a project-by-project basis.

The utility guidelines for similar projects in other cities were reviewed and considered in the development of this document. Street-running transit projects in Charlotte, NC; Dallas, TX; Tucson, AZ; Los Angeles, CA; and Cincinnati, OH were considered where applicable.

2.0 Streetcar and Utility Systems

The streetcar system has many components. The infrastructure includes visible items such as the guideway, passenger platforms, signs, streetcar vehicle(s), maintenance and storage facilities, traction power substations (TPSS) and overhead contact system (OCS) poles and wires. As with most transit facilities, portions of the infrastructure are not visible at grade such as pole foundations and conduits. The entire streetcar facility includes more than the infrastructure; streetcar vehicle loads, vehicle operating clearances, electrical clearances, vibration, and stray current may also impact the adjacent facilities.

Utility companies and agencies have many facilities sharing the public space with the existing and proposed streetcar routes. Standard operating procedures for utility companies and agencies require access for routine maintenance, replacement, and emergency repairs. Utility companies and agencies require adequate space for equipment and manpower to accomplish the work required for routine maintenance, replacement, and emergency repairs.

The USP is intended to minimize disruptions to streetcar operations resulting from utility routine maintenance, replacement, and emergency repairs. The USP provides a framework of recommended engineering practices to minimize disruptions of the utility's level of service for routine maintenance, replacement, and emergency repairs. The guidelines also provide recommendations to enhance the safety of the public and provide safe access for streetcar and utility company or agency personnel.

2.1. Definitions

Ballast Track: Guideway that includes cross ties supporting the running rails on a structure of ballast and sub-ballast aggregate. Depending on site conditions, the ballast track may be abutted by a ballast curb or a drainage ditch.

Casing Pipe (Encasement Pipe): A pipe used in underground construction to protect a utility's facility from damage, simplify pipe replacement, and protect the surrounding infrastructure in the event of a pipe rupture. The utility's facility is located within the casing pipe. Facilities may be removed from casing pipes without jeopardizing the integrity of the casing pipe. Casing pipes support the soil and surrounding earth in the event of a failure of the utility's facility.

Corrosion Control: The means to mitigate the deterioration of metallic structures due to stray electrical current.

DC Streetcar Design Criteria: A document that provides the general framework and basis for a uniform design for the DC Streetcar system.



Direct Fixation Track: Guideway that typically utilizes a plate type assembly to hold the running rail in place on a support (usually concrete, steel, or superstructure materials).

Embedded Concrete Track – Guideway that utilizes a reinforced concrete slab to support embedded steel rails for operating the streetcar, typically shared with other vehicular traffic.

Guideway: The structure upon which a streetcar runs, typically embedded concrete track, ballast track, or direct fixation track.

In-Situ Pipe Rehabilitation: The repair of an existing pipe using a trenchless technology such as pipe lining or pipe bursting.

Overhead Contact System (OCS): The system of overhead electrical wires supported by poles to power the streetcar, otherwise known as catenary.

Offset Manhole: A manhole located such that the influent and effluent pipes are not centered horizontally in the manhole.

Private Utility: A private entity, subject to governmental regulation, that provides an essential commodity or service, such as water, electricity, transportation, or communication, to the public which may include equipment or a piece of equipment to provide such service or a comparable service.

Public Utility : A public entity, subject to governmental regulation, that provides an essential commodity or service, such as water, electricity, transportation, or communication, to the public which may include equipment or a piece of equipment to provide such service or a comparable service

Public Space: Publically-owned property between the property lines on a street, park, or other public property, as such property lines are shown on the records of the District. This includes any roadway, tree space, sidewalk, or parking between such property lines.

Sewer Service: A sewer facility that runs from a public sewer main and serves a single property. In general, sewer services will be perpendicular to the streetcar guideway.

Special Trackwork: A section of track consisting of more than two rails. Examples of special trackwork are turnouts, crossovers and track crossings.

Supported Trench Wall: A construction excavation supported by temporary shoring to prevent or minimize the surrounding soil from collapsing into the excavated area.

Water Service: Any water facility that runs from a public water main and serves a single property. In general, water services will be perpendicular to the streetcar guideway.

Zone of Influence: An area defined by the Utilities Standard of Practice in which the location of utilities is restricted in order to protect both the utility and the streetcar infrastructure.

2.2. Streetcar infrastructure and Operations

The streetcar infrastructure includes a guideway and an overhead contact system (OCS) typically supported by poles with reinforced concrete foundations. The guideway can be categorized as embedded concrete track, ballast track, or direct fixation track. The vehicle loadings, vehicle operating clearances, and electrical clearances are factors to consider when determining the impacts to an existing utility, the placement of new utilities, and providing access for maintenance and repairs. In addition, the operation of a streetcar may distribute vibrations and stray current to the surrounding environment that may also have an impact to existing utilities and the placement of new utilities.

2.2.1. Streetcar Infrastructure

The DC Streetcar is a system of fixed rail vehicles powered by electricity from an overhead contact system and typically in a travel lane. The rail gauge used is the Association of American Railroads (AAR) standard wheel gauge of 4'-8 ½" as measured between the inside heads of the running rail. The rails are supported by a track structure of embedded concrete track, ballast track, or direct fixation track.

When operating within a shared travel lane, the streetcar guideway shall be embedded concrete track. The embedded concrete track standard consists of a reinforced concrete foundation 8'-4" wide and 12 inches thick as a support for the streetcar rails. The top of the embedded concrete track slab is installed flush with the adjacent pavement. When the streetcar is operating outside of a travel lane, on an aerial structure or in a dedicated right-of-way, the streetcar guideway shall typically consist of either ballast track or direct fixation track. Depending on site conditions, the ballast track may be abutted by a ballast curb or a drainage ditch.

Streetcar platforms are similar to typical WMATA bus stops and concrete sidewalks within the District and do not have a large foundation. No special utility design is anticipated for streetcar platforms beyond the District's typical public realm considerations.

2.2.2. Streetcar Envelope

The static envelope of the standard DC Streetcar vehicle has a car body that is generally eight feet (8') wide. With side-mounted mirrors, the static envelope is increased to approximately nine feet (9') wide.

The dynamic envelope of the standard DC Streetcar vehicle accounts for the most extreme car body movements in comparison to the vehicle's static envelope. The movements are lateral, vertical, and rotational. These movements include vehicle lean due to guideway superelevation, vehicle offsets in



curves, construction tolerances, and operational factors. Operational factors include but are not limited to standard wear of rails and wheels, typical suspension motion, and suspension failure.

On tangent track the dynamic envelope of the streetcar vehicle extends beyond the edge of the track slab by approximately six inches (6"). On curved track the dynamic envelope extends beyond the edge of the track slab by more than six inches (6"). The amount over six inches (6") varies relative to the radius of the curve. The offset from the track slab is also different on the inside and the outside of the curve at the vehicle mid-ordinate and end overhangs.

2.2.3. Streetcar Loading and Vibration

The calculated load or force from the embedded concrete track is not significantly different from the calculated load or force of the District's roadway section without the track slab. The DC Streetcar vehicle load is less than a large truck. According to Section 10.3.2 of the DC streetcar Design Criteria, the system shall be designed to accommodate HL-93 truck loads.

Ground vibration may be produced by the interaction of the standard DC Streetcar vehicle's wheels on the running rail. The vibration forces may be distributed through the subsurface to adjacent facilities. Protective measures included in the design of the guideway reduce but do not eliminate the vibration in the surrounding environment.

2.2.4. Streetcar Operation

The standard DC Streetcar vehicle operates on fixed rails in a shared travel lane; therefore, detours of the streetcar route are not possible. This restricts the utility's ability to close the guideway during the streetcar's operating hours.

The level of service for each DC Streetcar segment may vary; however, the streetcar system is intended to operate approximately 18 hours each day. The typical frequency or headway is 10 minutes during peak periods and up to 20 minutes during off-peak periods. Closing or impeding the streetcar guideway during the hours of operation will impact the level of service.

The streetcar typically does not operate for several hours during the night. During these time periods, the streetcar segments may be available for utilities to access facilities that require a closure of the shared travel lane in which the guideway is located.

The actual operating schedule for a specific streetcar segment will be used to determine the time periods available for a utility to access the guideway. The access time and duration will be coordinated through the Public Space Regulations Administration (PSRA) utilizing the Transportation Online Permitting System (TOPS).

To maintain safe and reliable streetcar operating conditions, the streetcar infrastructure requires routine maintenance and inspections. The placement of adjacent, overhead and crossing utilities shall be in accordance with the criteria of the USP to provide an adequate condition for safe maintenance of the streetcar facility and/or the utility.

2.2.5. Overhead Contact System and Stray Current

The standard DC Streetcar vehicle's tractive power is powered by electricity, using an overhead contact system for power distribution to the streetcar vehicle through the pantograph which contacts the overhead wire. Various protective measures are standard in the design of the traction power infrastructure to minimize the amount of current straying into the surrounding environment. The protective measures reduce, but do not entirely eliminate the potential for current straying into the surrounding environment. The stray current, which may be minimal and intermittent, may degrade nearby metallic utilities over an undefined period of time.

Stray current varies based on the resistivity in the soil. The influence of soil conditions on the streetcar and affected utilities will be a design consideration based on soil borings and soil resistivity tests. Soil with low resistivity may require additional corrosion control for the streetcar or utility facilities.

2.3. Utility Infrastructure and Operation

All proposed new and relocated utilities to be constructed through the guideway will require the utility owner to coordinate with DDOT on the location and means of future access through the PSRA permit process for new facilities in the District's Public Space or through the Project Development Process as identified in the District's *Design and Engineering Manual*.

2.3.1. Utility Types

The USP categorizes a Utility as either an *Underground* or *Overhead* utility based on its location relative to grade. A *Wet* underground utility includes facilities that convey liquids such as potable water, pressurized liquids, wastewater (sanitary) and storm water. A *Dry* underground utility includes facilities that do not convey liquids such as natural gas, electric cable, and communication cable (fiber optic or copper). Electric and communication facilities may be underground or overhead.

The District's public space accommodates a broad spectrum of underground and overhead utilities owned and operated by private and public entities. The owners of each utility may each have their own guidelines for installation, clearance, and access. These guidelines are not superseded by the USP; however, the USP shall supplement the private or public entity's guidelines when the facility encroaches upon the streetcar Zone of Influence.

2.3.2. Materials

The material used for an underground facility varies and is dependent on the age, utility owner's requirements, and magnitude of the facility. The material and condition of any existing facility shall be evaluated for its ability to accommodate the potential loading and stray current of the streetcar infrastructure. The materials used for a new or proposed underground utility shall meet the criteria of the USP, the utility's standards, the most current standards and specifications of the responsible jurisdiction, and applicable Codes.

2.3.3. Utility Maintenance and Repair

Routine maintenance and repair due to emergency failures are expected activities for underground and overhead utilities. For purposes of the USP, routine maintenance shall be considered as but not limited to the following:

- a. Access and operation of below ground structures (i.e., manholes, valves, meters, cleanouts);
- b. Removing or replacing valves;
- c. Removal or replacement of a pipe or conduit in a casing below the guideway.

Excavation underneath the guideway for a utility repair shall be avoided because it may significantly impact streetcar operations. Excavation may be permitted upon DDOT approval if the utility's designer demonstrates that the embedded concrete track slab can safely be temporarily structurally supported. Any approved excavation shall not exceed ten feet (10') longitudinal to the embedded concrete track slab. Excavation and backfilling must be completed when the streetcar is not in service. When excavation under the embedded concrete track may be required, it must be coordinated with DDOT through the PSRA.

Where possible, the access for utility maintenance and emergency repairs will be outside the Zone of Influence described in Section 2.4. When unique situations make this impossible, the utility owner shall coordinate with DDOT to agree on an amicable and collaborative approach to performing the work. The coordination shall be initiated through the PSRA permit process.

DDOT may address access to utilities for maintenance and emergencies within the Zone of Influence or under the guideway through an agreement with the Utility Owner.

2.3.4. New Utility Construction

For a new utility's facility to be constructed near an existing streetcar facility, a proposed streetcar facility, or within the Zone of Influence, the utility owner will coordinate with DDOT for the location and means of future access. The coordination will be facilitated through the PSRA permit process for new

facilities in the District's Public Space or through the Project Development Process as identified in the District's *Design and Engineering Manual*.

2.4. Zone of Influence

The streetcar operates in the public space, travel lanes, and corridors where many existing utilities are located. Utilities will continue to be present in these locations and new utilities will be constructed in the future. For a utility to maintain its intended level of service unimpeded access to its infrastructure for emergencies, inspections, repairs, and routine maintenance is paramount. It is equally as critical that access to a utility does not impede streetcar operation.

The Zone of Influence is the defined area around the streetcar infrastructure that is free from utilities to allow for the safe operation of the streetcar while minimizing impacts to a utility's facility. The Zone of Influence takes into consideration the loads produced by the streetcar infrastructure and the dynamic envelope. The vertical and horizontal extents of the Zone of Influence account for dissipation of the potential vibrations and stray currents caused by streetcar operations. The Zone of Influence is also a protective measure that minimizes exposure to stray current and which may be increased if the soil resistivity in a certain location is determined to be too low; although it may be increased, the Zone of Influence cannot be reduced.

The Zone of Influence represents the nearest point a utility's facility or access may be located in relation to the streetcar's guideway (reference Figure 1 and Figure 2). The Zone of Influence differs based on the type of streetcar guideway. The Zone of Influence for Embedded Concrete Track is shown in Figure 1 | Zone of Influence – Embedded Concrete Track. The Zone of Influence for Ballast Track is shown in Figure 2 | Zone of Influence - Ballast Track. The Zone of Influence for direct fixation track varies based on the site configuration and shall be coordinated on a case-by-case basis. Direct fixation track sections are intended to be the exception and are typically limited to elevated transportation structures in a designated guideway not shared with vehicular traffic.

Limitations and exceptions for utility access within the Zone of Influence will be addressed based on whether long term or short term access is required. For long term access, routine entry periods shall be identified through an agreement between DDOT and the utility owner and each routine entry shall be coordinated through the PSRA permit process with the agreement serving as a condition of the permit. Consultation with DDOT or its Operations and Maintenance Contractor (OMC) is included in the PSRA permit process for streetcar corridors within the District. Short term access is addressed through initiating the required PSRA permit process to perform the work (i.e. emergency, annual manhole inspection) and is also supplemented with consultation.

In order to decrease the risk for all stakeholders, minimize impacts to the streetcar operation, and decrease the level of effort to repair or replace the facility due to a utility's failures, it is preferred to avoid installing utilities longitudinally under the guideway.

2.4.1. Subsurface Zone of Influence

The Zone of Influence for embedded concrete track extends horizontally 7'-2" from the track centerline and vertically 2'-6" below top of rail (reference Figure 1).

The Zone of Influence for ballast track extends vertically 4'-6" below the top of rail. Horizontally, the Zone of Influence varies based on the edge condition of the ballast and subballast. At locations where a ballast curb or retaining wall is used, the Zone of Influence is extended horizontally two feet (2') from the outside edge (face) of the curb or retaining wall. At locations with no curb or wall, the Zone of Influence extends fourteen feet (14') horizontally from the nearest track centerline. For the ballast track Zone of Influence reference Figure 2.

The Zone of Influence for Direct Fixation Track will vary based on the support structure's size and shape and will be determined on a case by case basis in coordination with DDOT and the utility owner.

2.4.2. Overhead Zone of Influence

The National Electrical Code (NEC) provides guidelines for clearances between the OCS infrastructure and adjacent features. The minimum clearances are demonstrated in Figure 3 and Figure 4. The Zone of Influence around OCS contact wires and poles is ten feet (10') to meet OSHA requirements (reference Figure 5).

2.5. Utility Agreements

The USP is intended to provide guidance for the most commonly expected interfaces between the streetcar and utility facilities. In the event that a unique resolution becomes necessary for an unusual condition that is not specifically or adequately addressed in the USP, a collaborative approach involving all affected stakeholders shall be employed, whereas, DDOT and the Utility Owner shall endeavor to execute an Agreement that identifies the terms of the unique resolution. The terms shall be managed through the PSRA permit process with the agreement serving as a condition of the permit. Additional discussion on agreements and the PSRA permit process is included in Section 6.0.

3.0 Streetcar Infrastructure Impacts on Underground Utilities

Existing underground utilities within the Zone of Influence (reference Section 2.4 for limits) shall be removed and relocated outside the zone or abandoned in place and filled with approved material if deemed necessary by DDOT and the utility's owner. Proposed new underground utilities shall be placed outside the Zone of Influence. At locations where utility relocation outside the Zone of Influence may be impossible, a resolution will be presented to DDOT by the utility agency for review and consideration for approval. Relocation of existing and the installation of new underground utilities shall comply with *DC Streetcar Design Criteria*, ANSI, AWWA, Federal standards, District standards, and utility owner's standards. All new utility crossings shall be approved by DDOT. All existing services to properties shall be maintained during construction.

All utilities below the guideway shall cross at a ninety degree angle to the track to provide the minimum length under the track (reference Figure 9). However, at locations where it's not possible to cross at a ninety degree angle, the utility shall cross at a minimum angle of forty-five degrees.

All utilities located horizontally within ten feet (10'-0") of the track centerline for any type of guideway shall be designed to support the streetcar loading when the internal pipe pressure range is between zero and the pipe's maximum. All pressurized utilities crossing beneath the guideway at a vertical depth of eight feet (8'-0") or less from top or rail to top of pipe, shall be encased. The casing shall be steel (solid or split) or an approved equivalent material. The casing material shall extend horizontally one foot (1'-0") beyond the edge of the Zone of Influence (reference Figure 6). For split steel casings the joints, seams, gaps, and interfaces shall be fully welded or mechanically connected to allow containment.

All utilities outside the Zone of Influence and near the guideway shall be evaluated to allow access for maintenance and repair according to the USP and utility owner's requirements. Utilities that do not adhere to these guidelines will require relocation. Any utility which does not require relocation per USP guidelines may be relocated at the utility owner's discretion. A casing pipe larger than required may be placed at the Utility Owner's discretion for future expansion so long as it is installed per the requirements in the USP.

All ferrous metal and reinforced concrete piping shall be protected against corrosion and have cathodic protection with corrosion monitoring features. Other materials and structures shall be evaluated to confirm corrosion protection in accordance with the DC Streetcar Design Criteria and the utility owner's standards. All non-metallic utilities shall include detection aids or tone wires to support future locating. The necessity for stray current monitoring of facilities shall be determined by both DDOT and the Utility Owner on a case-by-case basis.

No utility shall be taken out of service without prior approval of the governing agency or utility owner. All new crossings shall be approved by DDOT.

3.1. Gas Utilities

All existing gas utilities located within the Zone of Influence (reference Section 2.4 for limits) shall be relocated, removed or abandoned in place. All existing gas utilities located outside the Zone of Influence and crossing below the guideway at an angle less than 45 degrees from the track centerline shall also be relocated, removed or abandoned-in-place. When an existing gas utility is outside the Zone of Influence, it may remain in place as long as it can accommodate the streetcar loading. All abandoned gas utilities shall be purged, plugged, and filled with a flowable-fill or other suitable equivalent material to prevent intrusion and degradation of subgrade.

All new gas utilities crossing below the guideway shall be outside the Zone of Influence and cross perpendicular to the track centerline. In addition, all new gas utilities shall be designed to cross the guideway at a vertical depth of eight feet (8'-0") or less from ground surface and shall be encased and protected from stray current. The casing shall extend one foot (1'-0") beyond the edge of the Zone of Influence (reference Figure 6). Any gas utility below the guideway at a vertical depth greater than eight feet (8'-0") from ground surface shall be evaluated to confirm if it can accommodate the streetcar loading and the level of corrosion control measures required. Valves and other appurtenances shall be located outside of the Zone of Influence.

Any gas utility within a horizontal distance of ten feet (10'-0") from the track centerline shall be designed to support the streetcar loading when the internal pipe pressure range is between zero and the pipe's maximum.

Gas utilities located outside the Zone of Influence but adjacent to the guideway shall have corrosion control measures applied conforming to the guidelines within Section 14.0 of *the DC Streetcar Design Criteria* and the utility owner's standards. New and relocated gas utilities crossing the guideway will require approval from DDOT.

3.2. Water Utilities

All existing water utilities located within the Zone of Influence (reference Section 2.4 for limits) shall be relocated, removed or abandoned in place. All existing water utilities located outside the Zone of Influence and crossing below the guideway at an angle less than 45 degrees from the track centerline shall also be relocated, removed or abandoned-in-place. When an existing water utility is outside the Zone of Influence, it may remain in place as long as it can accommodate the streetcar loading. All abandoned water utilities shall be purged, plugged, and filled with a flowable-fill or other suitable equivalent material to prevent intrusion and degradation of subgrade.

All new water utilities designed to cross below the guideway shall be outside the Zone of Influence and cross perpendicular to the track centerline. In addition, all new water utilities designed to cross the guideway at a vertical depth of eight feet (8'-0") or less from ground surface shall be encased and

protected from stray current. The casing shall extend one foot (1'-0") beyond the edge of the Zone of Influence (reference Figure 6). Any water utility below the guideway at a vertical depth greater than eight feet (8'-0") from ground surface shall be evaluated to confirm if it can accommodate the streetcar loading and the level of corrosion control measures required. Valves and other appurtenances shall be located outside of the Zone of Influence. Any water services connected to a water facility beneath the Zone of Influence shall be relocated outside of the proposed casing. Fire hydrants shall be located outside of the Zone of Influence and meet the standards of the District or governing agency.

Any water utility within a horizontal distance of ten feet (10'-0") from the track centerline shall be designed to support the streetcar loading when the internal pipe pressure range is between zero and the pipe's maximum.

Water utilities located outside the Zone of Influence but adjacent to the guideway shall have corrosion control measures applied conforming to the guidelines within Section 14.0 of the *DC Streetcar Design Criteria* and the utility owner's standards. New and relocated water utilities crossing the guideway will require approval from DDOT.

All relocated water utilities shall be replaced with a facility of equal or greater capacities, meet applicable design requirements, and comply with the standards of the governing agency and the utility owner unless otherwise noted and approved. Relocated services shall comply with plumbing codes of the District or local jurisdiction. New and relocated water utilities crossing the guideway will require approval from DDOT.

3.3. Other Pressurized Liquids

All existing utilities with pressurized liquids located within the Zone of Influence (reference Section 2.4 for limits) shall be relocated, removed or abandoned in place. All existing utilities with pressurized liquids located outside the Zone of Influence and crossing below the guideway at an angle less than 45 degrees from the track centerline shall also be relocated, removed or abandoned-in-place. When an existing utility with pressurized liquids is outside the Zone of Influence, it may remain in place as long as it can accommodate the streetcar loading. All abandoned utilities of pressurized liquids shall be purged, plugged, and filled with a flowable-fill or other suitable equivalent material to prevent intrusion and degradation of subgrade.

All new utilities with pressurized liquids designed to cross below the guideway shall be outside the Zone of Influence and cross perpendicular to the track centerline. In addition, all new utilities with pressurized liquids designed to cross the guideway at a vertical depth of eight feet (8'-0") or less from ground surface shall be encased and protected from stray current. The casing shall extend one foot (1'-0") beyond the edge of the Zone of Influence (see Figure 6). Any utilities with pressurized liquids below the guideway at a vertical depth greater than eight feet (8'-0") from ground surface shall be evaluated to

confirm whether it can accommodate the streetcar loading and the level of corrosion control measures required. Valves and other appurtenances shall be located outside of the Zone of Influence.

Any utilities with pressurized liquids within a horizontal distance of ten feet (10'-0") from the track centerline shall be designed to support the streetcar loading when the internal pipe pressure range is between zero and the pipe's maximum.

Utilities with pressurized liquids located outside the Zone of Influence but adjacent to the guideway shall have corrosion control measures applied conforming to the guidelines within Section 14.0 of the *DC Streetcar Design Criteria* and the utility owner's standards. New and relocated utilities with pressurized liquids crossing the guideway will require approval from DDOT.

3.4. Sanitary Sewers

All existing sanitary sewers located within the Zone of Influence (see Section 2.4 for limits) shall be relocated, removed or abandoned in place. All existing sanitary sewers located outside the Zone of Influence and crossing below the guideway at an angle less than 45 degrees from the track centerline shall also be relocated, removed or abandoned-in-place. When an existing sanitary sewer is outside the Zone of Influence, it may remain in place as long as it can accommodate the streetcar loading. All abandoned sanitary sewers shall be purged, plugged, and filled with a flowable-fill or other suitable equivalent material to prevent intrusion and degradation of subgrade.

All new sanitary sewers designed to cross below the guideway shall be outside the Zone of Influence and cross perpendicular to the track centerline. Service connections to the sanitary sewer shall also be placed outside the Zone of Influence.

All relocated sanitary sewers shall be replaced with a facility of equal or greater capacities, meet applicable design requirements, and comply with the standards of the governing agency and the utility owner unless otherwise noted and approved. Relocated services shall comply with codes of the District or local jurisdiction.

Manhole centerlines shall be located a minimum distance of five feet (5'-0") outboard from the edge the embedded concrete track slab. However, existing manholes located below this distance can remain if the structure can withstand the streetcar loading. Under special circumstances and at the discretion of the District, existing manholes may be reconstructed with the covers placed between the two rails. The nearest part of the manhole shall be nine inches (9") from the nearest rail (reference Figure 7). Offset manholes are to be avoided if possible. Manholes along ballast track shall be placed outside the Zone of Influence.

A sanitary sewer may be considered for repair or replacement utilizing in-situ or pipe-bursting methods if the streetcar loading can be accommodated.

New and relocated sanitary sewers crossing the guideway will require approval from DDOT. Access to a manhole located within the Zone of Influence will require a maintenance agreement between the utility owner and DDOT to address the conditions of access.

3.5. Storm Sewers

All existing storm sewers located within the Zone of Influence (reference Section 2.4 for limits) shall be relocated, removed or abandoned in place. All existing storm sewers located outside the Zone of Influence and crossing below the guideway at an angle less than 45 degrees from the track centerline shall also be relocated, removed or abandoned-in-place. When an existing storm sewer is outside the Zone of Influence, it may remain in place as long as it can accommodate the streetcar loading. All abandoned storm sewers shall be purged, plugged, and filled with a flowable-fill or other suitable equivalent material to prevent intrusion and degradation of subgrade.

All new storm sewers designed to cross below the guideway shall be outside the Zone of Influence and cross perpendicular to the track centerline.

All relocated storm sewers shall be replaced with a facility of equal or greater capacities, meet applicable design requirements, and comply with the standards of the governing agency and the utility owner unless otherwise noted and approved. Relocated services shall comply with codes of the District or local jurisdiction.

Manhole centerlines shall be located a minimum distance of five feet (5'-0") outboard from the edge the embedded concrete track slab. However, existing manholes located below this distance can remain if the structure can withstand the streetcar loading. Under special circumstances and at the discretion of the District, existing manholes may be reconstructed with the covers placed between the two rails. The nearest part of the manhole shall be nine inches (9") from the nearest rail (reference Figure 7). Offset manholes are to be avoided if possible. Manholes along ballast track shall be placed outside the Zone of Influence.

Generally, the embedded concrete track is adjacent to the street's storm sewer gutter pan. When a storm drain is located at the curb and adjacent to the embedded concrete track, the storm drain shall be a curb inlet opening and not a grated inlet (reference Figure 8). Track drains and underdrains installed to drain the guideway shall outfall into the storm sewer. Street storm sewers shall not drain into track drains or underdrains.

A storm sewer may be considered for repair or replacement utilizing in-situ or pipe-bursting methods if the streetcar loading can be accommodated.

New and relocated storm sewers crossing the guideway will require approval from DDOT. Access to a manhole located within the Zone of Influence will require a maintenance agreement between the Utility Owner and DDOT to address the conditions of access.

3.6. Electric and Communication Utilities

All existing electric and communication utilities located within the Zone of Influence (reference Section 2.4 for limits) shall be relocated, removed or abandoned in place. All existing electric and communication utilities located outside the Zone of Influence and crossing below the guideway at an angle less than 45 degrees from the track centerline shall also be relocated, removed or abandoned-in-place. When an existing electric or communication utility is outside the Zone of Influence, it may remain in place as long as it can accommodate the streetcar loading.

All new electric and communication utilities designed to cross below the guideway shall be outside the Zone of Influence and cross perpendicular to the track centerline. Service connections to the electric and communication utilities shall also be placed outside the Zone of Influence.

All relocated electric and communication utilities shall be replaced with a facility of equal or greater capacities, meet applicable design requirements, and comply with the standards of the governing agency and the utility owner unless otherwise noted and approved. Relocated services shall comply with the Electrical code of the District or local jurisdiction, and the National Electrical Safety Code (NEC).

Junction boxes, vaults and other appurtenances shall be located outside the Zone of Influence.

All existing electric or communication services shall be maintained during construction. Temporary ducts, manholes, vaults, etc. may be used when required to maintain service during streetcar construction.

New and relocated electric or communication utilities crossing the guideway will require approval from DDOT. Access to a manhole located within the Zone of Influence will require a maintenance agreement between the Utility Owner and DDOT to address the conditions of access.

3.7. Other Underground Utilities

Any existing underground vault, basement, or other structure within the Zone of Influence (reference Section 2.4 for limits) shall be relocated or reconstructed and placed outside of the zone. Any structure under the streetcar track shall be designed to accommodate the required loading and complies with applicable local, state and federal building codes, electrical codes, and plumbing codes.

3.8. Utility Design References

Public and private utility relocations and adjustments shall be performed in accordance with the following references as appropriate:

- DDOT Design and Engineering Manual
- DDOT DC Streetcar Design Criteria



- DDOT DC Streetcar Standard Drawings
- Manual of Uniform Traffic Control Devices (MUTCD)
- PEPCO Standard Drawings
- Washington Gas Standard Drawings and Details
- DC Water Standard Details
- DC Water Green Infrastructure Utility Protection Guidelines
- National Electric Safety Code (NESC)
- National Electrical Code (NEC)
- District of Columbia Plumbing Code
- District of Columbia Electrical Code
- DDOT Standard Specifications for Highways and Structures
- WMATA:
 - Design Criteria
 - Design Standards
 - Standard Drawings
 - Adjacent Construction Project Manual

All facilities shall be designed in accordance with the latest revisions of these documents set forth by the local jurisdiction and/or private utility.



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4.0 Overhead Utilities

Many overhead facilities and their supporting structures exist along the streetcar route. These facilities include but are not limited to electric distribution lines, electric transmission lines, communication lines, streetlights, and traffic signals.

All existing overhead facilities within the Zone of Influence (reference section 2.4) shall be relocated. All overhead lines and supporting structures shall comply with applicable local codes, owner standards, and the National Electrical Safety Code (NESC).



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5.0 Service for Streetcar Tractive Power

The standard DC Streetcar vehicle's tractive power is supplied by electricity. The system that provides the electricity to the vehicle is the OCS. The OCS is powered through a Traction Power Substation (TPSS) located along the corridor which may be supplied with high-voltage or low-voltage AC electricity and distributes DC voltage electricity to the OCS. The electrical power to the TPSS units is typically supplied by the local electric utility provider. DDOT will coordinate the electrical requirements of the system and the locations of the power connections with the local electric company.

It is anticipated on particular streetcar segments that streetcars may be supplied with tractive power through off-wire and ground level propulsion technologies. The USP may be amended in the future to include guidance based on these technologies.



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6.0 Implementation and Enforcement

6.1. Relocations

Relocations of existing utilities due to streetcar impacts will be documented on plans prepared according to the guidelines stated in Section 7.10 of the *DC Streetcar Design Criteria Manual*. The plans will identify utility conflicts with the streetcar design and provide details to facilitate development of relocation alternatives. The design and construction of all relocations shall comply with the *DC Streetcar Design Criteria*, DC Water and Sewer Authority standards, ANSI, AWWA, Federal Standards, District standards, and utility standards. As described in Section 6.3, permits shall be obtained for required relocations and new construction.

6.2. Agreements

The USP is intended to cover the most commonly encountered utility issues and conflicts. In the event that a unique resolution becomes necessary for an unusual condition that is not specifically or adequately addressed in the USP, these guidelines encourage and support a collaborative approach involving all affected stakeholders to reach an agreement that meets the needs of the project(s).

DDOT and the Utility Owner may enter into maintenance agreements as the exception and not the norm. When an unusual or non-typical condition exists, whereas the resolution may not meet the expectations of the USP or the time and cost components of a preferred resolution do not meet the expectations of both stakeholders, then a maintenance agreement between DDOT and the Utility Owner may be initiated.

When exceptions to the USP are necessary for permanent or temporary utility relocations, the exceptions shall be documented in a specific agreement between DDOT and the owner per the *DC Streetcar Design Criteria Manual* Section 7.3.3. The agreement will memorialize the terms and understanding for a utility's facility within the Zone of Influence when conditions do not allow relocation.

A maintenance agreement or permit will define the manner and locations of access to the utility's facility and any restrictions if access will impact streetcar operations.

6.3. Permits

To address the challenge of implementing and enforcing the Utilities Standard of Practice, DDOT will utilize its Transportation Online Permitting system (TOPS) through the Public Space Regulations Administration (PSRA). The PSRA already effectively manages Construction Permits, Occupancy Permits, and Utility Emergency Work Requests. The PSRA process is utilized by all public and private entities that

seek to perform work in the District's public space. A summary of PSRA's core permitting processes are as follows:

6.3.1. PSRA Permit Process Overview

All utility work requires both a construction and occupancy permit from DDOT. The construction permit verifies that all proposed excavation and work done in public space adheres to all Federal and District regulations, standards, and policies. The occupancy permit approves the timing and location of the work and ensures that the work zone is safe for pedestrian and vehicular traffic. In regard to DDOT projects or work done by utility agencies on behalf of DDOT, PSRA issues a review-less occupancy permit for tracking and monitoring permitting conflicts.

6.3.2. PSRA Construction Permit Process

The applicant submits an online application through TOPS. Applications must include engineering drawings (site plan, details, calculations, etc.) detailing the work in the public space. The permit is reviewed by PSRA internal and external reviewers through TOPS. The review process typically takes thirty (30) business days and once approved, fees are assessed and collected and then the permit is issued.

6.3.3. PSRA Occupancy Permit Process

The applicant submits an application through TOPS referencing their corresponding construction application tracking number. The applicants are required to submit a traffic control plan detailing safety measures in place for pedestrian and vehicular traffic. This traffic control plan is reviewed internally by PSRA reviewers. The review process typically takes ten (10) business days to complete. This process may be reduced to one (1) business day if the traffic control plan is submitted for review with the construction permit and it is approved during the construction drawing review.

6.3.4. PSRA Utility Emergency Work Permit Process

When an emergency arises, the utility agency notifies DDOT by applying for an Emergency Work Request (EWR) which is automatically approved. This allows the utility company to respond to an emergency immediately while notifying DDOT of their presence. If the emergency work and restoration is not completed within three (3) business days, then the utility agency must apply for a construction and occupancy permit for it is no longer considered an emergency.

6.4. Implementation

The Public Space Regulations Administration (PSRA) enforces public space laws and regulations, and inspects all work in public space completed under a public space permit to ensure that work is completed according to DDOT standards. DDOT standards include DC Streetcar Standard Drawings and ultimately will incorporate the *Utility Standard of Practice* prior to streetcar passenger operation in the District. Any public or private utility will be required to utilize the PSRA process to perform routine maintenance, emergency, replacement, and rehabilitation work activities on their facilities that are in public space and more importantly within the Zone of Influence of the existing streetcar facilities.

The Streetcar Operator shall be included in TOPS as a “Reviewing Agency” and any TOPS submission for performance of routine maintenance, emergency, replacement, or rehabilitation activities on a public or private utility will be coordinated, reviewed, and approved by the streetcar operator when the utility is identified within the Zone of Influence of an existing streetcar segment. Only where public or private utilities are outside the Zone of Influence is coordination, review, or approval by the streetcar operator not required.

6.5. Worker Safety

The USP is intended to provide guidelines to utility agencies so their facilities are accessible without interrupting streetcar service or encroaching upon the Zone of Influence. There is a need to emphasize and educate the utility owners’ staff on the risks while working within or adjacent to the Zone of Influence. It is also necessary that PSRA inspection staff be apprised of the work zone risks in or adjacent to the Zone of Influence. The Streetcar Operator’s criterion for track allocation and roadway worker protection requirements is the baseline for worker safety when a Utility Owner is permitted to perform work or maintenance activities within or adjacent to the streetcar Zone of Influence. In general, the workers for the Utility Owner must abide by the safety precautions and established, industry specific processes, when working within the defined Zone of Influence of the at-grade streetcar facility or near the overhead contact wire. Safety practices shall be similar to typical published standards for working in and around live railroad traffic or live electrical lines. Safety guidelines will be initiated during the TOPS process and included in the permitted activity through the Streetcar Operator’s criterion for track allocation and roadway worker protection requirements.



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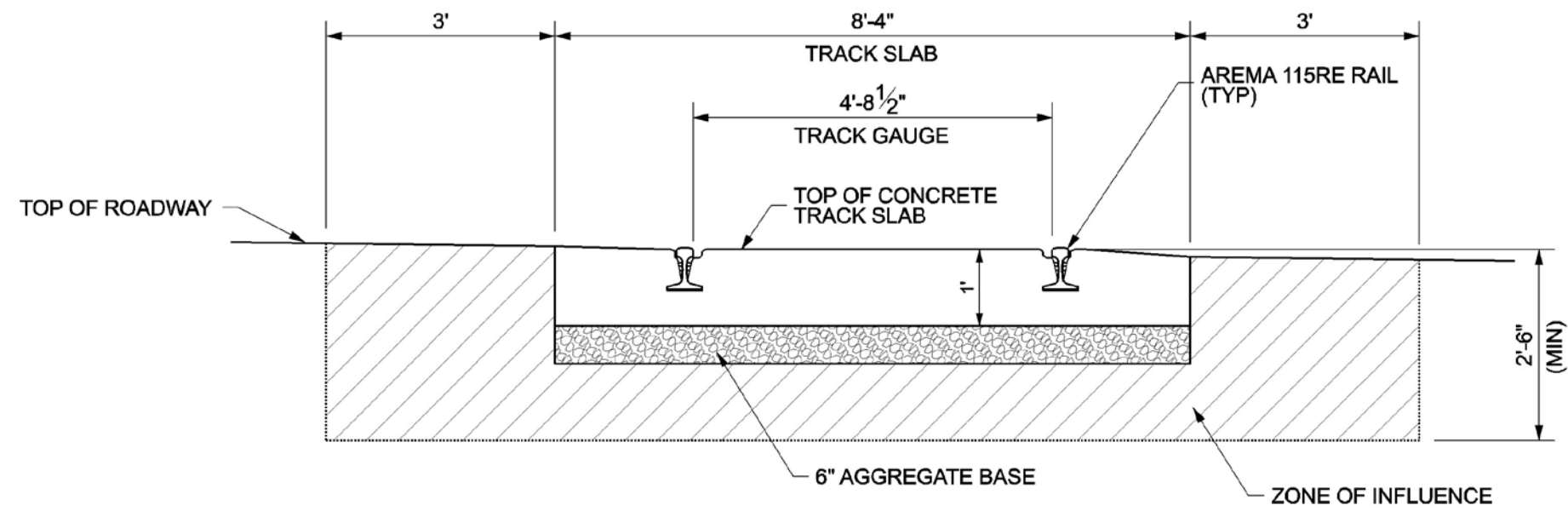


USP FIGURES



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Figure 1 | Zone of Influence – Embedded Concrete Track

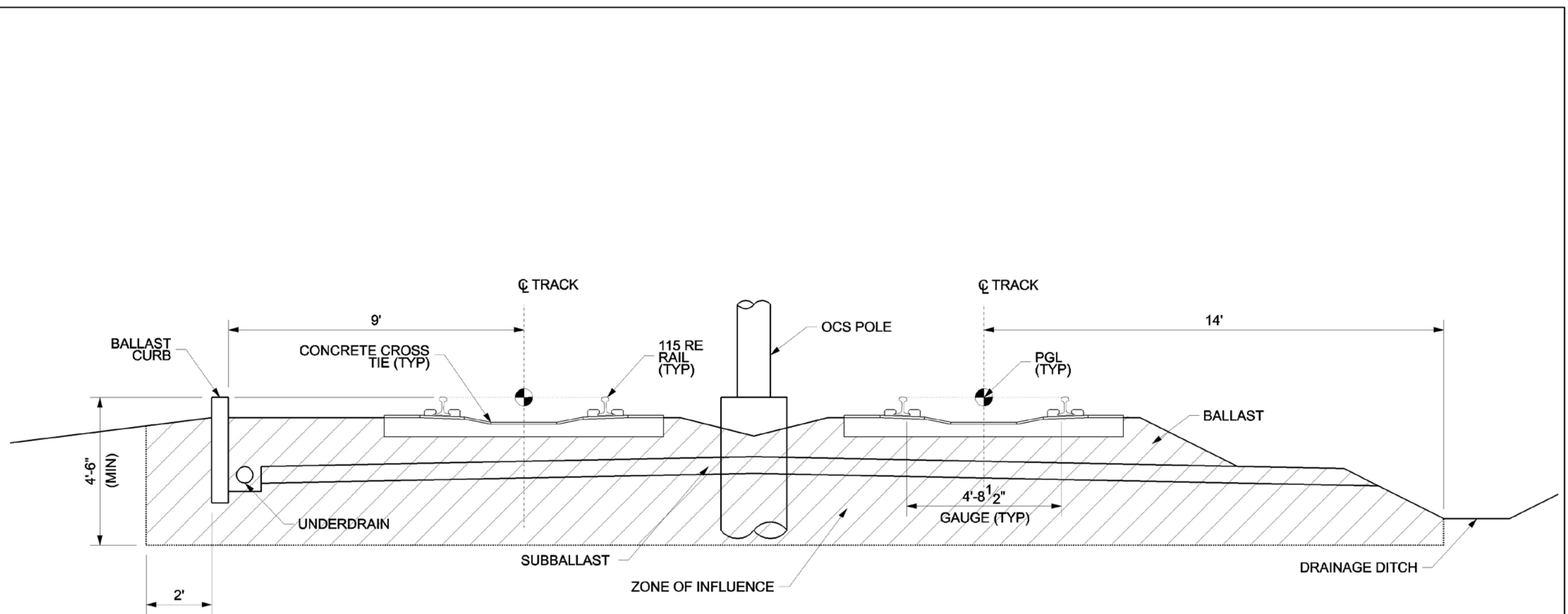


ZONE OF INFLUENCE - EMBEDDED CONCRETE TRACK
NTS

NOTE:
THE ZONE OF INFLUENCE MAY BE GREATER
DEPENDING ON THE SOIL RESISTIVITY.

FIGURE 1

Figure 2 | Zone of Influence - Ballast Track



ZONE OF INFLUENCE - BALLAST TRACK

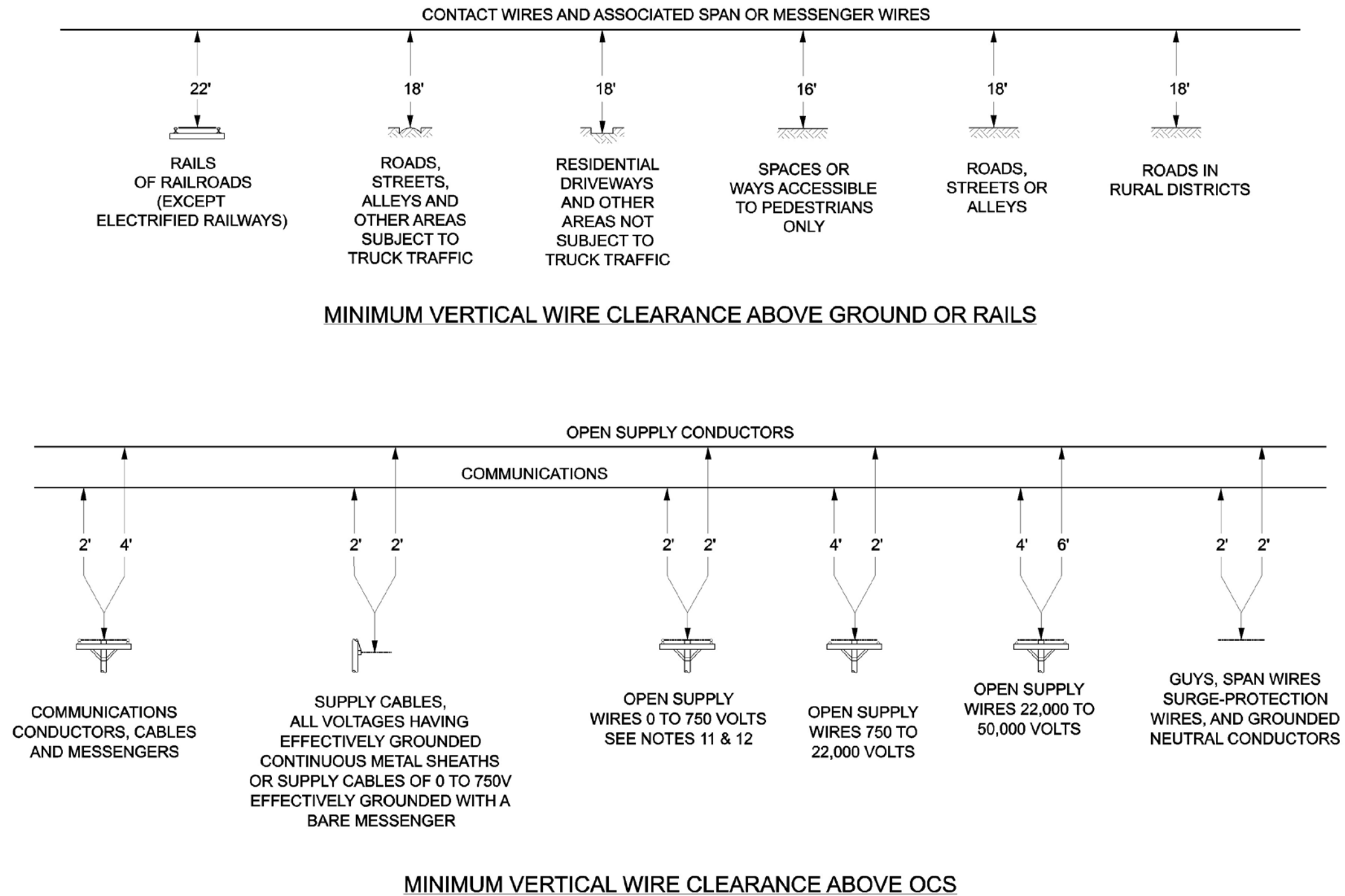
NTS

NOTE:

COVER INCLUDING AT DITCHES FOR ALL UTILITY LINES SHALL MEET OR EXCEED FACILITY OWNER REQUIREMENTS.

FIGURE 2

Figure 3 | Overhead Contact System Clearance to Non-OCS Wires



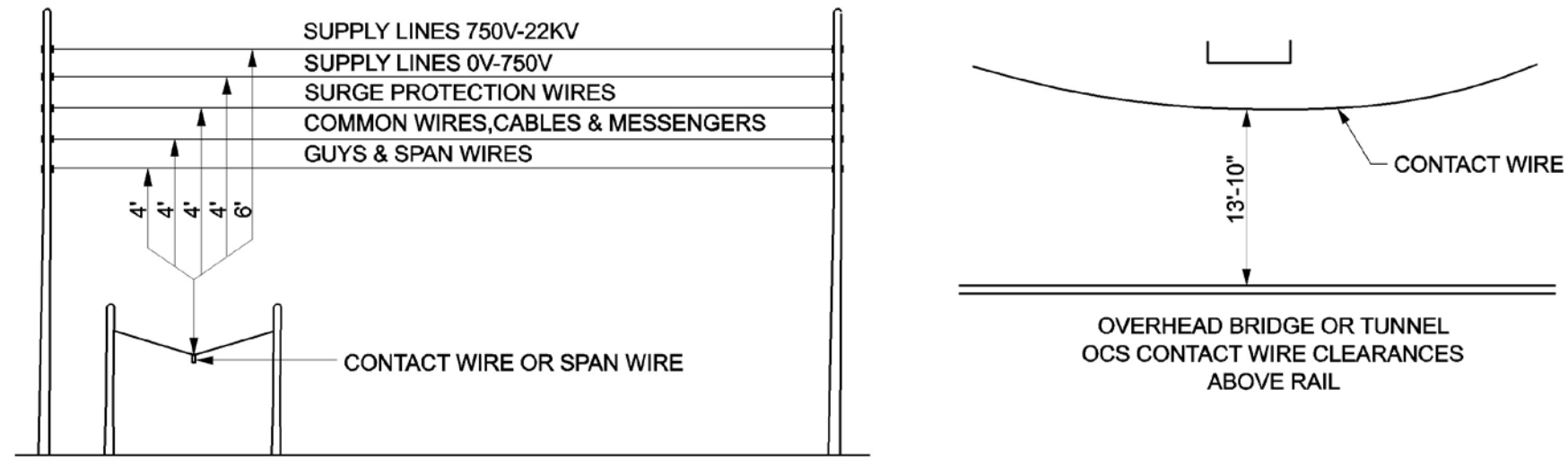
NOTE:

1. MINIMUM DISTANCES ARE SHOWN.
2. FOR ADDITIONAL NOTES AND DIMENSIONS TO FEATURES NOT SHOWN SEE DDOT STREETCAR STANDARD DRAWINGS OCT-4 AND OCT-05.

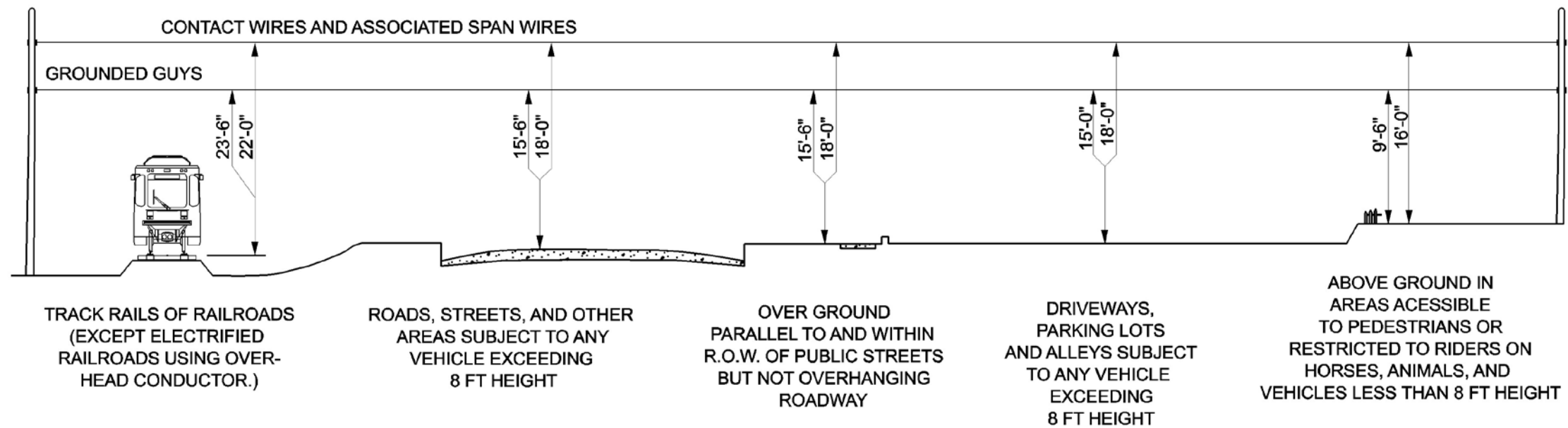
OVERHEAD CONTACT SYSTEM CLEARANCE TO NON-OCS WIRES
NTS

FIGURE 3

Figure 4 | Overhead Contact System Vertical Clearance



NON OCS CONDUCTOR CLEARANCES ABOVE CONTACT



OCS WIRE CLEARANCES ABOVE GROUND OR RAILS

NOTE:

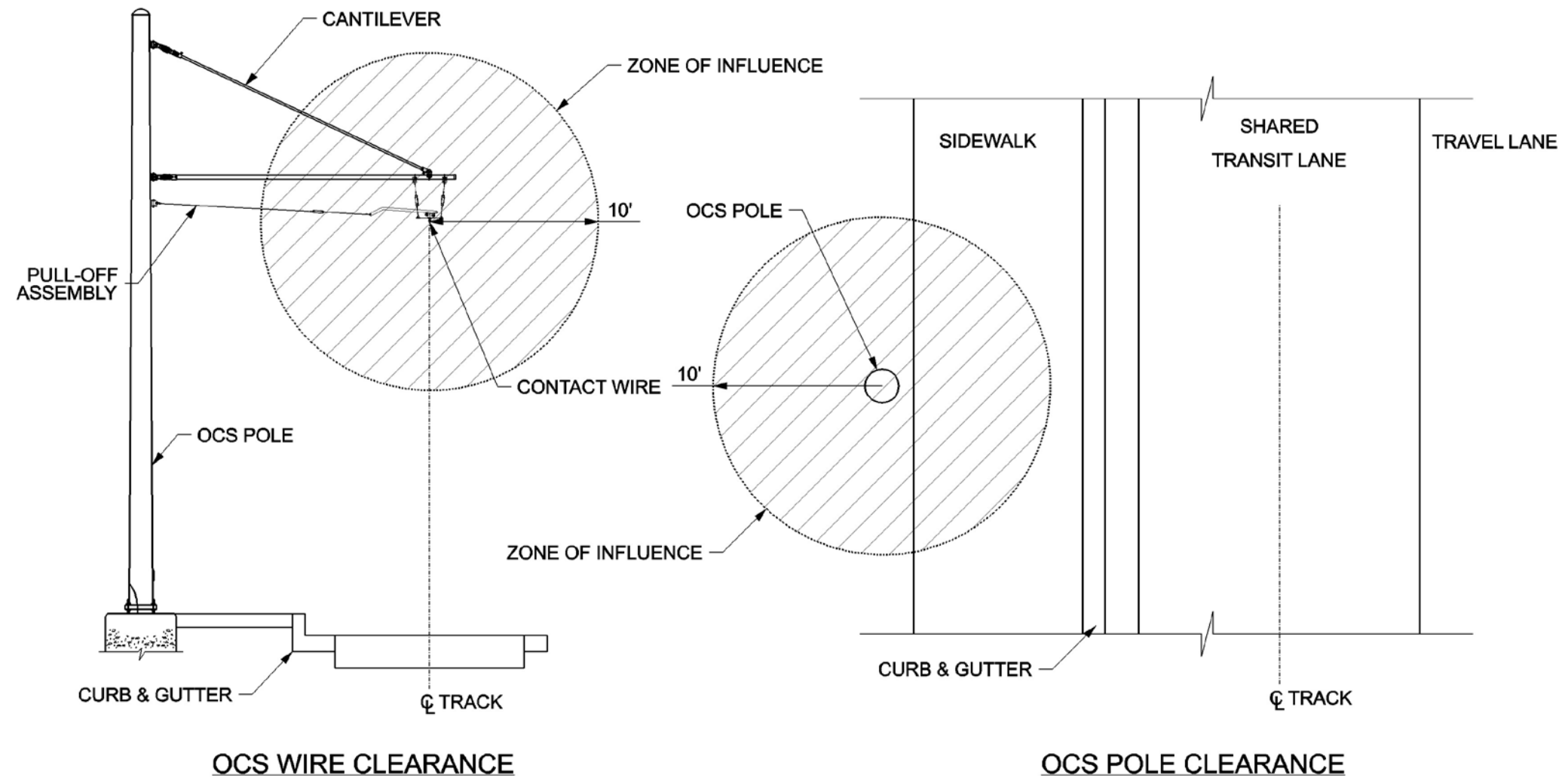
1. MINIMUM DISTANCES ARE SHOWN.
2. FOR ADDITIONAL NOTES AND DIMENSIONS TO FEATURES NOT SHOWN SEE DDOT STREETCAR STANDARD DRAWINGS OCT-4 AND OCT-05.

OVERHEAD CONTACT SYSTEM VERTICAL CLEARANCE

NTS

FIGURE 4

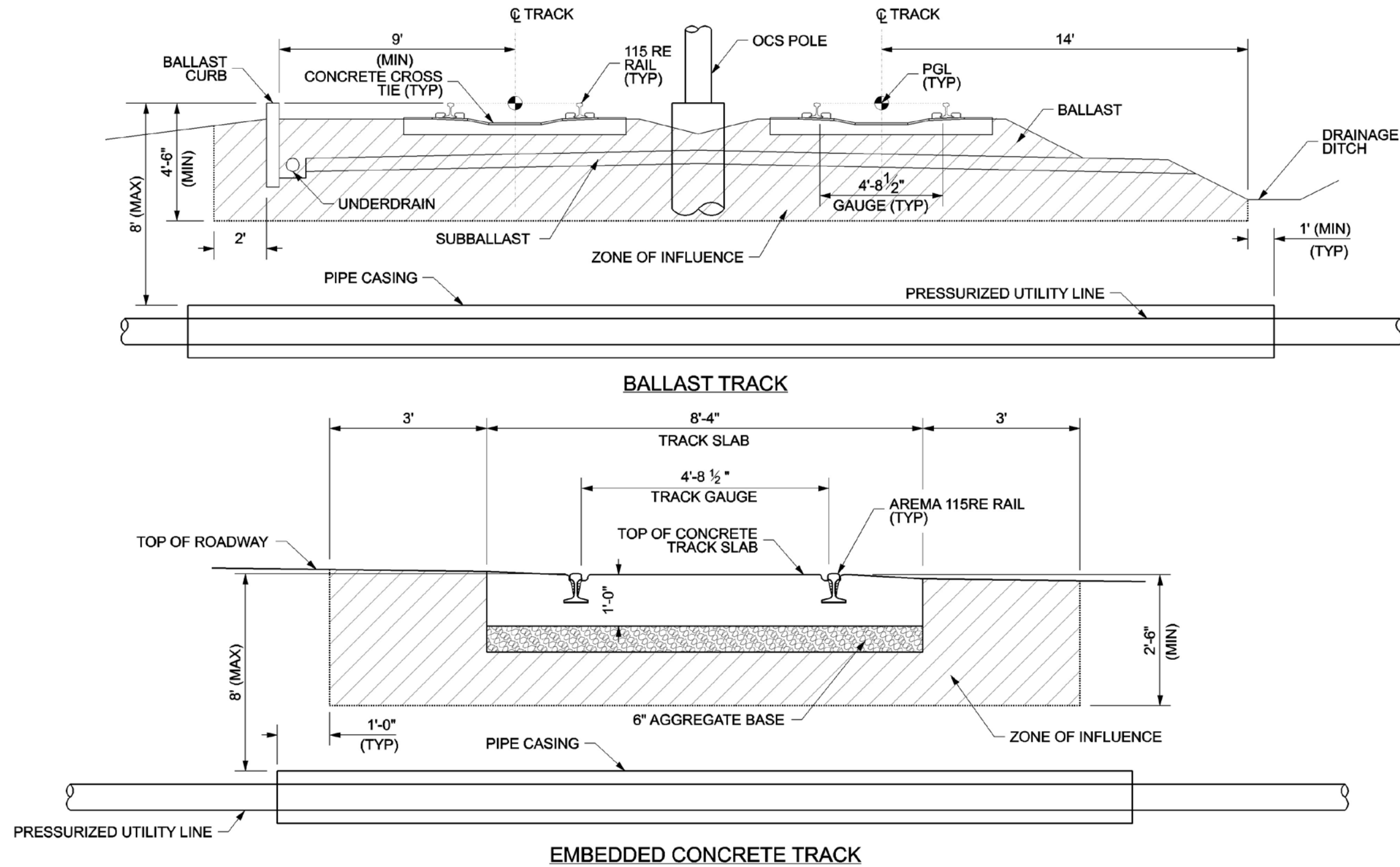
Figure 5 | Zone of Influence - Overhead



ZONE OF INFLUENCE - OVERHEAD
NTS

FIGURE 5

Figure 6 | Utility Encasement

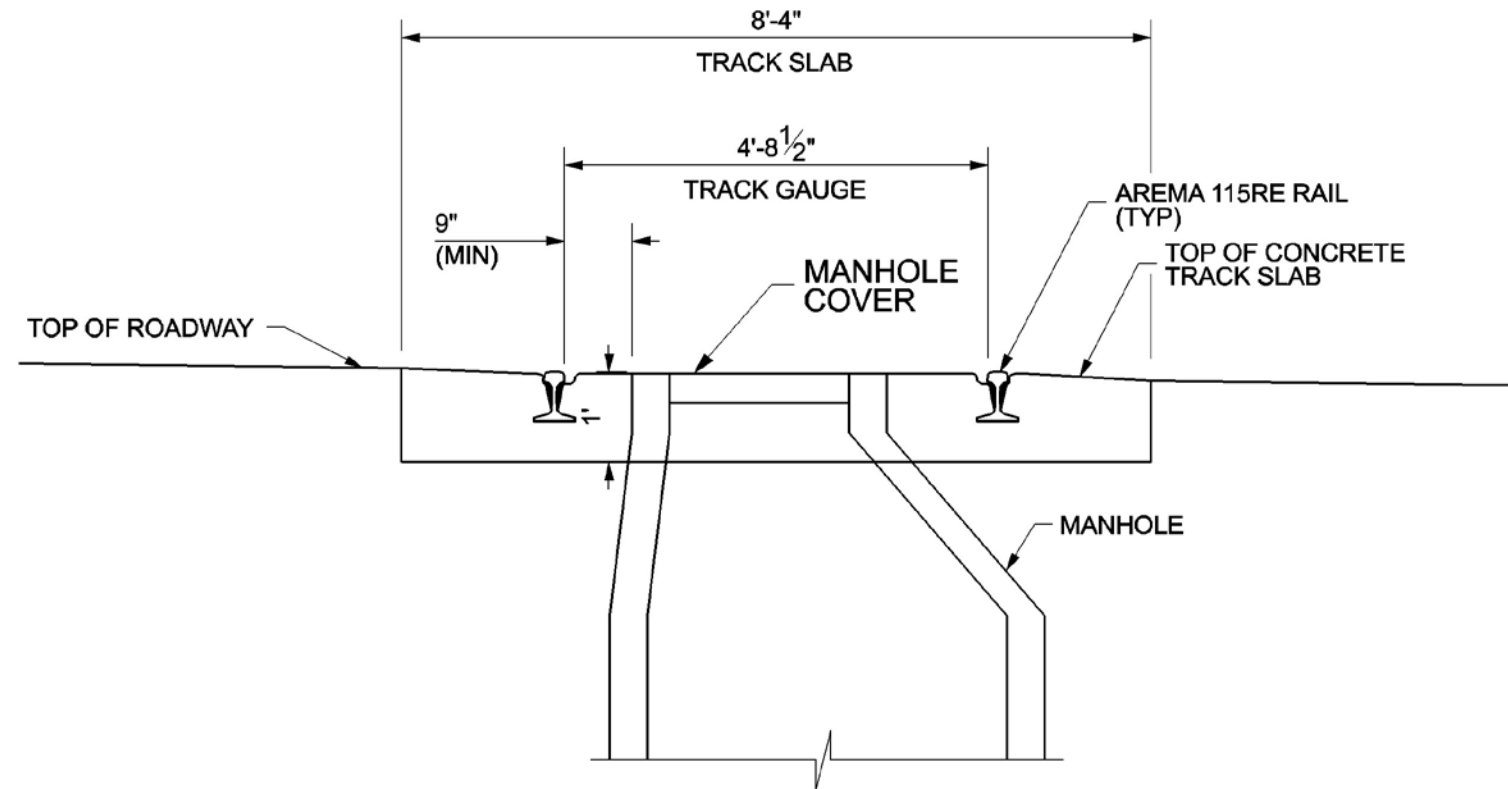


UTILITY ENCASEMENT
NTS

NOTE:
CASING DIAMETER AND MATERIAL TO MEET
REQUIREMENTS OF UTILITY OWNER.

FIGURE 6

Figure 7 | Manhole in Embedded Concrete Track



MANHOLE IN EMBEDDED CONCRETE TRACK
NTS

NOTE:

1. APPLIES TO ANY MANHOLE WITHIN THE TRACK SLAB.
2. MANHOLES ALLOWED WITHIN TRACK SLAB WITH DDOT APPROVAL ONLY.

FIGURE 7

Figure 8 | Catch Basin at Embedded Concrete Track

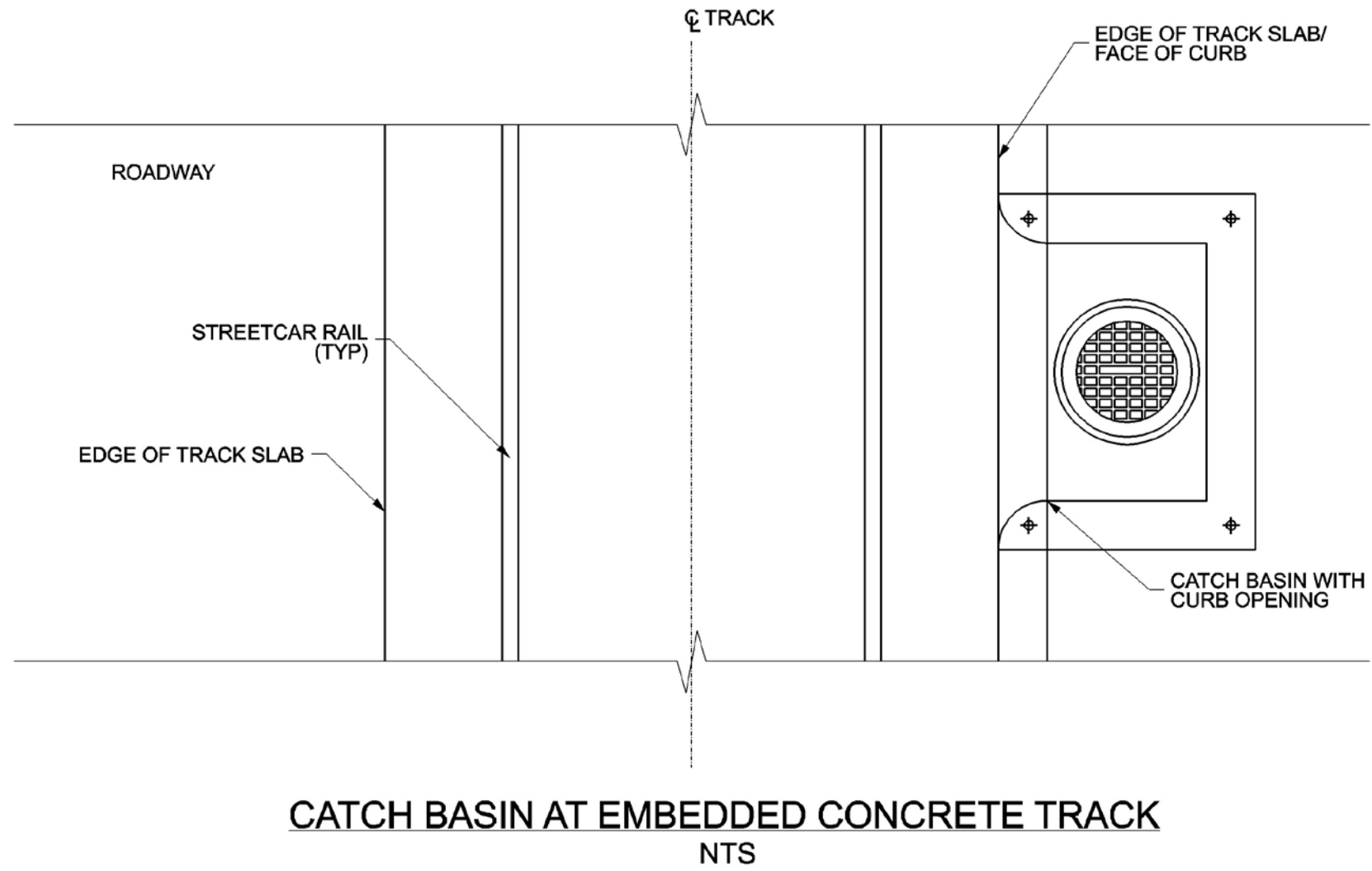
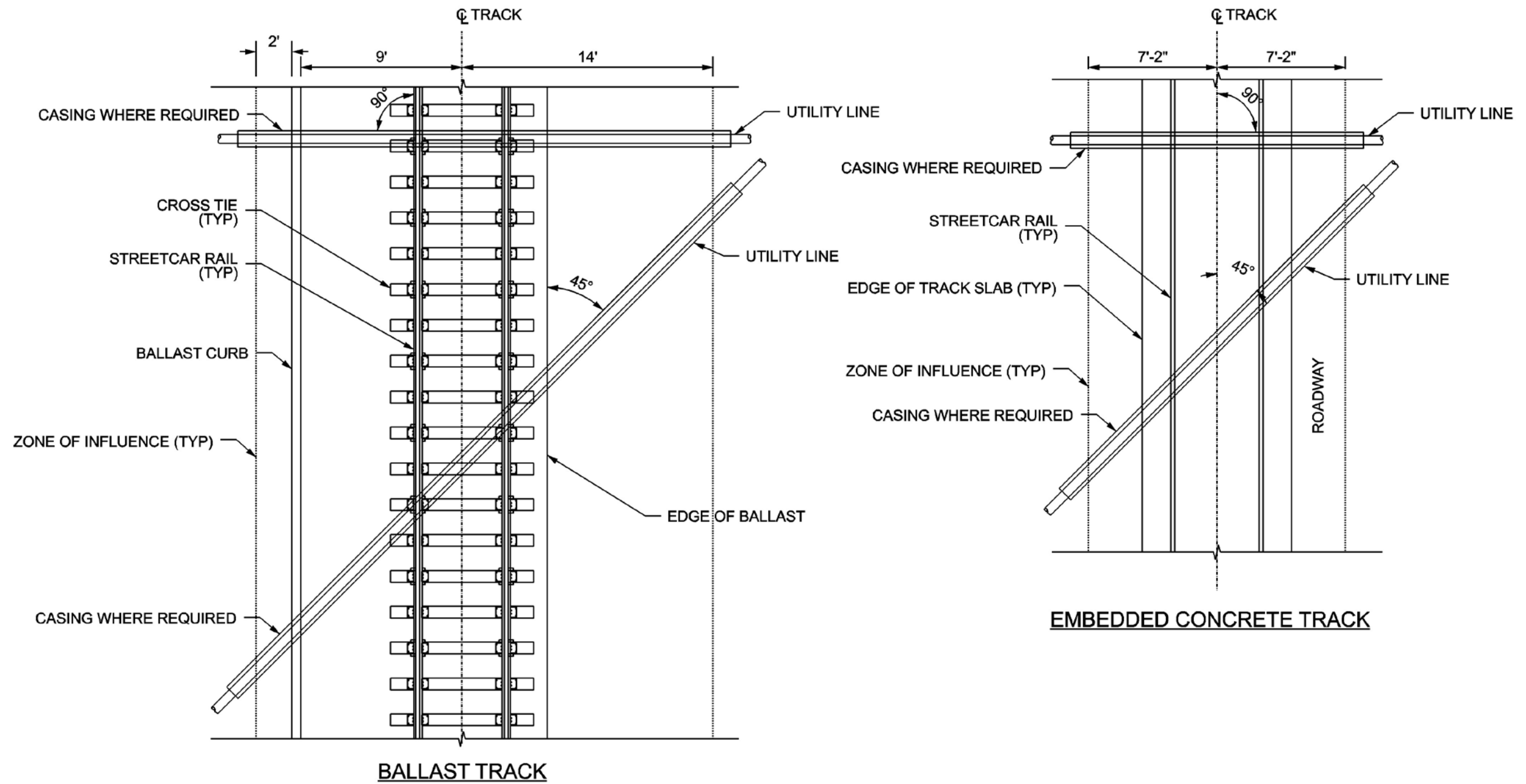


FIGURE 8

Figure 9 | Utility Line Crossing Track



NOTE:

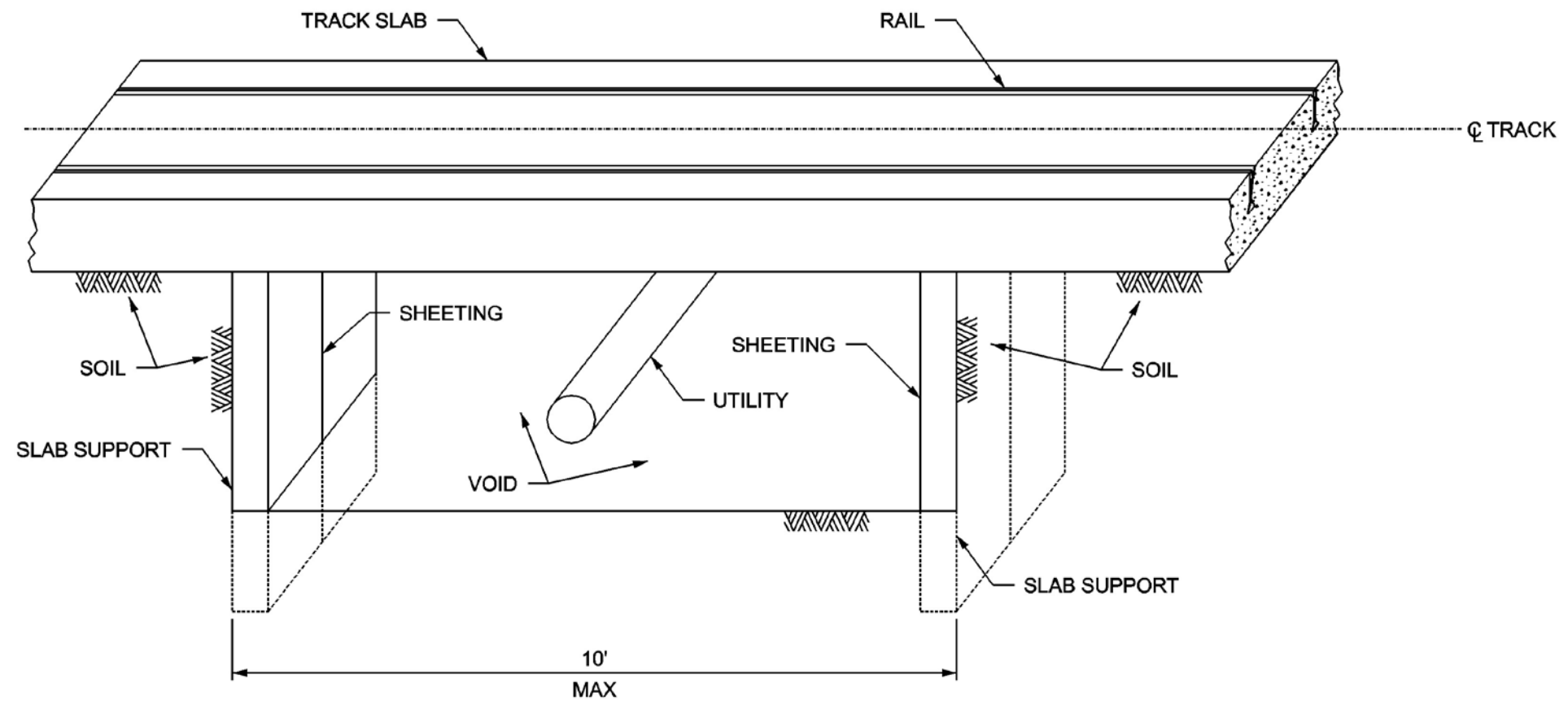
1. ALL UTILITIES ARE TO CROSS THE TRACK AT A MINIMUM ANGLE OF 45 DEGREES. THE PREFERRED CROSSING ANGLE IS 90 DEGREES TO MINIMIZE THE LENGTH UNDER THE TRACK.
2. UTILITY CROSSINGS MAY BE PIPES OR CONDUIT.
3. ALL PRESSURIZED LINES EIGHT FEET (8') OR LESS FROM THE GROUND SURFACE SHALL BE ENCASED. SEE FIGURE 6. CASING DIAMETER AND MATERIAL TO MEET REQUIREMENTS OF UTILITY OWNER.

UTILITY LINE CROSSING TRACK

NTS

FIGURE 9

Figure 10 | Utility Excavation below Track Slab



UTILITY EXCAVATION BELOW TRACK SLAB
NTS

FIGURE 10