PSEG LONG ISLAND LLC

on Behalf of and as Agent for the

LONG ISLAND LIGHTING COMPANY d/b/a LIPA

Western Nassau Transmission Project

EM&CP – APPENDIX D

WNTP Tree Management Plan

Appendix D: WNTP Tree Management Plan

1.0 INTRODUCTION

1.1 Objectives

This plan has been prepared to evaluate and address potential impacts to trees from construction of the Western Nassau Transmission Project (WNTP). The WNTP is the construction of a second circuit between the East Garden City Substation and the Valley Stream Substation, both in the Town of Hempstead. The WNTP will traverse the Villages of Garden City, Malverne, and Lynbrook. This plan describes the methods used for and results obtained from a project area tree inventory comprising approximately 400 trees. Potential impacts to the tree resources are identified and evaluated, and impact avoidance and minimization measures are described. Construction-phase practices to further reduce potential tree impacts are discussed, and potential mitigation measures are provided.

1.2 Proposed Project

The WNTP will be installed primarily within municipal public roadway rights-of-way (ROW) for a total distance of approximately seven miles.

Construction activities will primarily consist of excavation and installation of the conduit, the cable and splice vaults within the Project ROW. The electric line will be bundled in three 12-inch conduits that will connect to a regular series of 23 splice vaults at approximately 1,600-foot intervals. The bundle will be installed with a minimum depth of three feet, six inches of cover material over the cable conduit. This will require an excavated trench that is at least three feet wide and may occasionally range to five or six feet in width to accommodate shoring or clearance for other utilities. The splice vaults will require a larger area of excavation - approximately 12 feet deep, 20 feet long, and 12 feet wide.

Open trench excavation will be completed with a rubber-tired backhoe or tracked excavator. Pavement debris and trench spoils will be stockpiled on the roadway surface and not on the adjacent sidewalks or tree lawn areas. Typical splice vault installation equipment will include a crane, excavator, payloader, digging box, tractor trailer low-boy, assemblies, and various fittings and accessories.

At five locations, involving ten separate work areas, the electric line will be installed by tunneling underneath such features as railroad crossings or busy intersections. This method involves horizontal directional drilling (HDD) with a mechanized auger and requires the development of a temporary work area of up to 10,000 sq. ft at the tunnel entry and exit points. The tunnel entrance and exit points at these locations require pits that are about 15 feet wide and 15 feet long. Typical HDD installation equipment includes drilling and pipe-fusing machinery and the capacity for storage of slurry materials is necessary.

The duct bank trench will be excavated to the design depths as subsurface conditions allow. Unknown features and characteristics may force field modifications to the duct bank design. Generally, the cable wil l be buried at the depths specified in the Plan and Profile drawings. The Project Work Area includes the area within the PSEG Long Island ROW that will contain all construction activities. The Project Work Area is limited and bounded by a Limit of Disturbance depicted on the Plan and Profile drawings. The LOD defines the authorized limit of all construction activity, soil disturbance, and alteration to vegetation. This limit confines all activities including access, parking of vehicles, staging of construction materials.

2.0 METHODS

2.1 Project Area Tree Inventory

All trees were inventoried and numbered by a certified arborist/forester between September 2018 and January 2019. The Project Area Tree Inventory is included as Appendix D-1 and includes all trees along the roadside and between the sidewalk and curb (i.e. the tree lawn), as well as the few very large trees on private property that overhang the roadway, and trees identified within the work area locations for the HDD crossings.

For each tree tallied, diameter at breast height (dbh) was measured to the tenth of an inch with a dbh tape. The radius of crown spread in feet over the roadway was either measured directly with a retractable tape for smaller trees or estimated by pacing. The height of each tree in feet was estimated using a Merritt hypsometer and pacing. The station and offset were determined for each tree using the WNTP Plan & Profile drawings.

In addition to an ID number, each tree was assigned a subjective condition status of Good, Fair, Poor, or Dead. Significant damage to the tree (e.g., vehicular damage to the trunk) or decay features (e.g., exposed heartwood, bracket fungi) were noted. A majority of the trees were photographed using Theodolite photograph annotation software that records site information such as date, location, and tree ID number.

During the inventory about one dozen particularly notable trees were identified. These are typically large, mature trees that are conspicuous due to their size, healthy condition, and good form.

2.2 Coordination and Meeting with Municipal Officials

As the inventoried trees are maintained by the municipalities, meetings were conducted with municipal officials in Garden City on March 28, 2019 and Malverne on May 31, 2019. During these meetings the tree inventory process was described, and a discussion of tree management activities was initiated. Tree protection requested by municipalities is detailed below.

3.0 RESULTS

3.1 Project Area Street Tree Characteristics

Results of the Project Area Tree Inventory are detailed in Appendix D-1.

The Project Area Street Tree Inventory included a total inventory of 391trees. The majority of these trees were along roadways. 243 trees were identified along roadways (here and after referred to as the “trunk line”) and an additional 148 trees were identified in the HDD work areas.

The tree lawns of the Project vary in width between three feet and 12 feet but are typically about six feet wide. It is evident in many locations that the root crowns of older trees have been pruned to accommodate or repair sidewalks, or that the root crown is limited by the roadside curbing. Occasionally, such as points along Hempstead Avenue or in the Village of Malverne, small to medium-sized trees are installed in planting cells represented by approximate four feet X four feet openings in the pavement. A few trees (Trees 33, 74, and 75) were identified on private property overhanging the ROW.

Twenty different species were identified along the trunk line and an additional four species found in the HDD work areas for a total of 24 species observed in the Project area. The three most common trees along the trunk line are little-leaf linden (*Tilia cordata*), Norway maple (*Acer plantanoides*), and red oak (*Quercus rubra*).

Little leaf linden is native to Europe and has been widely planted in the United States as an ornamental shade tree, especially as a street tree, because of its (a) attractive foliage, (b) dense, low-branched, pyramidal to ovate form and (c) tolerance for urban conditions. Ornamental features include fragrant pale-yellow flowers in late spring. Little leaf linden is a medium to large deciduous tree, typically growing to 50-70 feet (less frequently to 100 feet) tall.

Norway maple is also native to Europe and has been widely planted in urban areas throughout much of the United States. It is a medium-sized deciduous shade tree typically growing 40-50 feet tall with a dense, symmetrical, rounded crown. Leaves resemble those of sugar maple. Leaf stems exude a milky sap when cut. The tree produces samara seeds up to two inches long. While the tree is known to be resilient to disease and insects, it is susceptible to verticillium wilt which is usually fatal. Further, Norway maple have shallow root systems that can crack or heave nearby driveways or sidewalks. The thick canopy of leaves and shallow roots severely limits what can be grown within the drip line of the tree. Because of the prolific number of seed the tree produces, Norway maple is considered invasive. Although once widely planted as a street tree, this use is not generally recommended in many areas now.

Red oak is a medium sized, deciduous tree with a rounded to broad-spreading, often irregular crown. Red oak typically grows at a moderate-to-fast rate to a height of 50-75 feet. Dark, lustrous green leaves (grayish-white beneath) with 7-11, toothed lobes which are sharply pointed at the tips. Leaves turn brownish-red in autumn. Fruits are acorns (with flat, saucer-shaped cups) which mature in early fall. An abundant crop of acorns may not occur before this tree reaches 40 years old. A Missouri native tree which typically occurs on northern- and eastern-facing wooded slopes throughout the State.

Many trees inventoried exhibit large scars from vehicular damage– these are at the base of the tree toward the side of oncoming traffic and usually about two feet wide by three feet high. Many trees also exhibit typical utility pruning forms as a result of a history of pruning for electric distribution lines. Frequently these trees have lopsided or V-notched crowns because the utility lines are directly above the tree lawn area.

The street trees on the northern part of the project are larger and older than elsewhere on the Project. Sixty percent of the trees larger than 18 inches in diameter are found on the northern limb of the alignment between Ninth Street in Garden City and the East Garden City Substation. In particular, the eastern end of Stewart Avenue exhibits a gallery of 39 mature oak trees on either side of the avenue ranging from 14 to 37 inches in diameter. These include 32 large red oaks (mean diameter 26.9 inches) and seven pin oaks (mean diameter 19.4 inches). Impacts to these trees will be reduced with the use of tree protection fencing.

The median on Stewart Avenue between Clinton and Franklin supports two rows of (approximately 200) even-aged sugar maples. These correspond to similar-sized trees along both sides of the avenue forming a long gallery or promenade along the avenue. The trees in this area are predominantly sugar maples, but also include red maple, white ash, little-leaf linden, red oak, pin oak, and an occasional Norway maple.

The vicinity of the Police and Fire Headquarters in Garden City - and extending to the west through Hudson and Ninth Streets - supports many high-quality and well-formed street and park trees. Several notable trees were identified in the work area at this location, including a large pin oak (Tree 268), a red oak (Tree 291), and an ornamental English oak cultivar (Tree 251) marked with a dedication plaque. None of these trees are likely to be impacted by construction.

Cherry Valley Avenue supports six well-formed and healthy little-leaf lindens on the east side of the avenue between Ninth Street and Cathedral Avenue. These trees are 14 to 17 inches in diameter and an estimated 45 feet in height. There is approximately an eight-foot offset of the duct bank from these little-leaf lindens. Additionally, a notable red oak is located here south of the entrance to The Wyndham West condominiums.

Street trees along Rockaway Avenue and Westminster Road may be characterized as a common suburban street tree assemblage comprising Norway maples, lindens, and an occasional Callery pear or flowering cherry. These are mostly medium-sized trees and although most trees are in good condition, many, especially the Norway maples, exhibit signs of age or stress-related decline. Many have been V-pruned for utility clearance.

Hempstead Avenue does not have an extensive street tree resource. A total of 37 street trees are present in proximity to the Project between Westminster Street and Cornwell Avenue. These are mostly small trees (mean diameter seven inches, median diameter approximately four inches) and approximately half are in fair to poor condition. The species present include Callery pear, Japanese flowering cherries, Japanese zelkova, Norway maple, sweet gum, and Japanese elm.

There is a very large London planetree at the intersection of Hempstead Avenue and Lester Court that is identified as a notable tree. Although this tree is located within the yard of a private residence, its limbs span the entire width of the adjacent roadway.

The Village of Malverne exhibits a diversity of species such as golden raintree and tree lilac. These are young trees, typically three to five inches in diameter, and installed in four feet by four feet sidewalk planting cells.

There is a notable red oak at the Fireman's Memorial Park in Malverne at the intersection of Broadway and Eimer Avenue. This tree is nearly 40 inches in diameter with a total estimated crown spread of about 80 feet. The conduit trench is within the dripline of the tree, however the duct bank is greater than 30 feet away from the trunk.

The section of Franklin Avenue between Broadway and Whitehall Street supports 12 trees including London planetree, Callery pear, and sycamore. These are in good condition, provide a shaded avenue, and range from 20 to 50 feet in height.

Whitehall Street has only five trees in proximity to the Project and, like Hempstead Avenue, these are small and mostly in poor condition. There are numerous small to medium trees on the west side of

Whitehall Street between Stuart Street and Winthrop Street, but none on the east side of Whitehall in the vicinity of the proposed transmission line.

3.2 Proximity to Proposed Work

Trunk Line: For the open cut trench installation portion of the Project area, the edge of the trench, which represents the closest point of disturbance to tree roots, is proposed to normally be no more than 18 inches from the centerline of the trench (I.e., the trench excavation is 36 inches wide). However, in some locations (e.g., where there are conflicting utilities present), the trench may need to be wider to allow for working space around the other facilities. For the installation of splice vaults, the edge of the excavation will exceed the dimensions of the vault by at least two feet.

Analysis of the inventory data relative to the line alignment indicates that trench excavation in the trunk line will occur inside of the dripline of 158 of the inventoried trees. Furthermore, trench excavation will occur within six multiples of the trunk diameter of the trunk of 58 of these trees.

The potential effect of a trenching encroachment within a tree's dripline can be further refined and quantified by two methods for the purpose of assessing impacts:

- Calculation of the percent encroachment into the crown radius measured as a straight line toward the trunk from the dripline. This measurement can then be used to derive, by simple geometry, the percentage area of the root system circle that may be impacted or separated from the main root architecture.

- Calculation of the distance from the trunk of the tree to the closest point of disturbance expressed as a multiple of the trunk diameter (dbh).

Calculation of the percent encroachment into the crown radius reveals that 158 trees along the trunk route will have some level of trench excavation encroachment under the canopy.

The potential significance of these encroachments is discussed further in Section 4.1.2 below.

HDD Laydown Areas: In addition to the impacted trees along the trunk route, approximately 128 trees are located in the ten delineated work areas for the five HDD trenchless crossings.

4.0 DISCUSSION

4.1 Impact Assessment

Direct tree impacts as a result of construction will be assessed in two categories – potential overhead impacts to limbs and branches and impacts to roots as a result of trench excavation. Limbs and branches are visible, and impact avoidance is basically a matter of avoiding contact. Assessing impacts to root systems is more complex because roots are not visible and root geometry is often somewhat irregular and opportunistic.

Potential indirect impacts to trees can also occur as a result of altering hydrology, soil chemistry, and soil structure. These effects are difficult to predict and normally become evident post-construction and are visible as a slow decline in tree vigor and health. Assessment and mitigation of potential indirect impacts are discussed in Section 4.2.3.

4.1.1 Anticipated Root Configurations

Within the root system there are normally structural roots, which serve to anchor the tree, and feeder roots. Structural roots keep the tree from tipping over due to the weight of an unbalanced crown or the lateral forces of wind, snow, or ice loading. The structural roots may or may not include a tap root depending on tree species and soil characteristics.

Feeder roots are finer and more ubiquitous than structural roots and form a more extensive network. They are normally located within the top 12 to 18 inches below the soil surface and extend in a branching pattern radially from the trunk under the canopy. This component of the root system is susceptible to the effects of soil compaction under adverse conditions as can arise during construction practice.

Many people suspect that tree roots are not commonly found under pavement. To the contrary, tree roots may benefit from soil conditions under pavement due to greater availability of water and seasonably warmer temperatures. The fact that sidewalks and paved roadways are cracked or heaved by roots evidences their presence.

Published data on the extent of tree roots indicate that the roots extend outward from the trunk to a distance that is approximately equal to tree height (Costello et al., 2017; Watson et al., 2014). This distance is often a greater distance than the dripline, which is the outer circumference of the tree's crown projected onto the ground below. Nevertheless, the anticipated extent of roots for the practical purpose of impact avoidance is typically based on the dripline of the canopy.

4.1.2 Root Cutting Impacts due to Trench Excavation

Root loss from trenching can affect both tree health and stability (Watson et al., 2014) but the magnitude of the effect depends on the proximity to the trunk, the age of the tree, and the type of tree. Younger trees are more resilient to root loss. Trees such as red maple and honey locust are considered more tolerant of root pruning impacts than, for example, the lindens which are considered to have a poor tolerance (Matheny and Clark, 1998).

It is commonly thought (Harris 1992) that a healthy tree can tolerate removal of approximately one-third of its roots. Furthermore, young vigorous trees can withstand removal of up to 50 percent of their roots without dying (Helliwell, 1985, as cited in Matheny & Clark, 1998), although there may be severe stability problems if all the roots on one side are severed.

Costello et al. (2017) state that cutting roots at a distance greater than six times the trunk diameter (dbh) minimizes the likelihood of affecting both health and stability. Cutting roots any closer to the tree is more likely to compromise stability. They add that linear cuts on one side of a tree can reduce stability when the cut is made at a distance from the trunk that is less than three times the trunk diameter, and severe loss of stability is common when cuts are made at a distance that is less than 1 to 1.5 times the trunk diameter.

As stated above (Section 3.2), 58 trees along the trunk route will have trench excavation disturbance within six multiples of the trunk diameter which may affect stability. Seventeen of these trees will have disturbance within three multiples of the trunk diameter which will likely reduce stability. Fourteen of these trees will have excavation impacts within 1.5 multiples of the trunk diameter, possibly resulting in severe loss of stability.

To relate the above measurements to the root system area, when a root impact occurs at a distance of six times the trunk diameter, an estimated 25 percent of the root system would be lost in a normally proportioned tree (Costello et al., 2017). A more accurate way to calculate the percentage area of root system loss is to consider the geometric relationship of a chord (e.g., representing the trench excavation) that is bisecting a circle (e.g., representing the tree canopy)[1]. Using this method, the following generalizations can be made:

- A 25 percent encroachment into the radius of the tree canopy will result in a loss of 7-10 percent of the root system area.
- A 50 percent encroachment into the radius of the tree canopy will result in a loss of approximately 20 percent of the root system area.
- A 67 percent encroachment into the radius of the tree canopy will result in a loss of approximately 30 percent of the root system area.
- A 75 percent encroachment into the radius of the tree canopy will result in a loss of approximately 35 percent of the root system area.
- A 90 percent encroachment into the radius of the tree canopy will result in a loss of approximately 45 percent of the root system area.

As such, and following Harris (1992), encroachment of up to 67 percent along the crown radius (representing the loss of 30 percent of the root system area) may be tolerated by a healthy tree. Thirty seven trees will have trench line encroachment of greater than 67 percent into the crown radius, and 13 trees will have trench line encroachment of greater than 90 percent.

The majority of the impacted trees are located along Ninth Street, and to the east of Clinton Road along the south side of Stewart Avenue where it is necessary to align the trench excavation immediately adjacent to the curb and tree lawn area.

Tree removal (as it is known at this time) will occur at just two locations:

- Pines Stream -- Two trees (an Elm and a Sycamore) along the streambank
- Franklin Avenue Jack and Bore -- five London planetrees

4.1.3 Additional Impacts

Where excavation or machinery work is proposed underneath the tree canopy (i.e., within the dripline of the trees) the typical height of the overhanging branches above the paved surface of the roadways is 14 feet or more. As such, the boom arms of backhoes or other equipment will need to operate below this height to avoid damage to lower branches.

4.1.4 Avoidance and Minimization Measures

The majority of impacts to trees have been minimized by aligning the conduit in the middle of roadways and as far away from the tree line as possible. Although trees are likely to be impacted, they will be

[1] Technically, calculation of Circle Segment Area (https://www.mathopenref.com/segmentarea.html)

monitored during construction. If direct impacts to trees are observed by the WNTP Environmental Monitor, it will be noted in daily environmental inspection reports.

4.1.4.1 Tree Protection Zones

The primary strategy for avoiding unnecessary impacts to trees will be by the establishment of Tree Protection Zones (TPZs). A Tree Protection Zone is a prior-specified area that is delineated in the work area by the installation of protective fencing before construction. There are several methods of delineating these zones (e.g., Miller et al., 1993; Coder, 1995; Harris, 1992; BSI, 1991), most of which are based on basically protecting the area under the canopy or within the dripline of the tree. This approach effectively minimizes direct impact to roots, trunk and canopy, and avoids indirect impacts to feeder roots as a result of soil compaction.

Matheny and Clark (1998) have adapted the BSI method to include an estimate of the tolerance of different species to impacts. In their method, the tree protection zone is derived from a combination of the tree age and the species tolerance and is specified as an offset from the tree's trunk expressed as a multiple of the trunk diameter.

Following the BSI method adapted by Matheny & Clark (1998), Tree Protection Zones were determined for all trees throughout the Project area and will be the basis for tree protection during construction.

4.1.5 Construction Measures

Construction installation sections for the Project anticipate the use of rubber-red backhoe for mainline conduit trench excavation, loading into a 10-wheel dump truck. The backhoe will typically be located curbside with the dump truck positioned toward the middle of the street. In areas where there is canopy encroachment, the backhoe will operate under overhanging branches.

Excavation at splice vault locations may require the use of larger equipment such as an excavator rather than a backhoe due to the size and depth requirement of the excavation. Use of a small rubber-tired boom crane is anticipated to offload the splice vault from the delivery vehicle and place the unit in the excavation.

4.1.5.1 Aerial Pruning

When overhead trimming (i.e., crown elevation pruning) is needed, lateral branches will be cut back to a branch union and to a branch at least one-third the diameter of the removed lateral. Cuts to remove lateral branches will be made just beyond the branch collar.

4.1.5.2 Root Cutting

Root pruning, which is the selective removal of roots to promote a desired growth pattern, is different than root cutting, which is the non-selective cutting of roots to exclude them from an area.

Trench excavation will be accomplished with a rubber-tired backhoe or tracked excavator creating a vertical trench face. The excavation process will likely result in shearing the roots of trees where present under the pavement. Where observed, roots greater than 1-inch diameter will be trimmed back to a clean, square cut. The final trimming cut is intended to result in a flat surface with the adjacent bark firmly attached.

4.1.6 Post-construction Monitoring

Trees along the Project route that have had dripline encroachment will be monitored periodically by a qualified arborist for a year following construction. It is recommended that monitoring occur in the late spring during leaf out and late summer to look for signs of stress relative to other nearby trees.

Monitoring may include photo logs to check for yellowing, dieback, wilt or flagging. If these features are observed, appropriate arboricultural remedial measures will be performed. These may include a watering (irrigation) or fertilization program, diagnostic surveys and/or structural risk assessments.

4.1.6.1 Planting

Compensatory tree planting and species selection will occur at the same location where trees were removed unless otherwise coordinated with the governing municipality or village. Planting will occur in accordance with ANSI A300 (Part 6) (2012). Planting will occur during the proper season for the species selected and will be overseen by a qualified arborist.

5.0 SUMMARY

A comprehensive tree inventory in the proposed project area revealed the excavation route would encroach within the dripline of 158 street trees. Other trees that have significant canopy or root encroachment will be assessed at the time of construction.

Trees that are removed will be replaced on location after collaboration with the municipalities and in accordance with municipal requirements.

6.0 LITERATURE CITED

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7.0 APPENDICES

D-1: Project Area Tree Inventory