



Archaeological Overview Survey – Addendum #3 to Technical Report New Jersey-New York Expansion Project Staten Island and Manhattan, New York

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Spectra Energy Corp (Spectra Energy) is proposing to expand its pipeline systems in the New Jersey-New York region to meet the immediate and future demand for natural gas in the largest United States metropolitan area. To accomplish this, Spectra Energy pipeline companies, Texas Eastern Transmission, LP (Texas Eastern) and Algonquin Gas Transmission, LLC (Algonquin) are seeking a Certificate of Public Convenience and Necessity (Certificate) from the Federal Energy Regulatory Commission (FERC) pursuant to Section 7(c) of the Natural Gas Act (NGA) authorizing the construction and operation of the New Jersey-New York Expansion Project (Project) located in New Jersey, New York, and Connecticut. The NJ-NY Project will create a new transportation path for 800,000 decatherms per day (Dth/d) of natural gas from multiple receipt points on the Spectra Energy systems to new delivery points in New Jersey and New York.

This addendum to *Archaeological Overview Survey, Texas Eastern Transmission, LP, New Jersey-New York Expansion Project, FERC Docket #CP11-56-000, Staten Island, Manhattan, and Ramapo, New York* presents the results of the archaeological sensitivity assessment and overview survey for the Project changes described below, and includes recommendations for any additional work. The methodology utilized for the archaeological overview survey of these Project changes is the same as outlined in the previous December filing report for this Project (Elquist et al. 2010a).

Project Changes since the December 2010 Filing

Texas Eastern has incorporated six route changes into the current pipeline, and one workspace revision in the Staten Island (Richmond County) and Manhattan (New York County) portion of the Project area (Figures 1 and 2). These changes are proposed in response to further consultation with property owners and other stakeholders. The route variations are described below with their corresponding milepost (MP) locations.

MPs 3.14R to 3.75R - Route Variation 80

Route Variation 80 is located in the City of Linden in Union County, New Jersey and the Borough of Staten Island in Richmond County, New York (Figures 3 through 6: New York portion on Alignment Sheets LD-A-1014 to 1015B). It is approximately 0.61 miles in length, deviates from

the proposed NJ-NY Expansion pipeline right-of-way (ROW) at MP 3.14R, and rejoins the ROW at MP 3.75R. The portion of Route Variation 80 that lies within New York begins after MP 3.30R at STA 182+36.5 within the Arthur Kill waterway (see Figures 3 through 6). Texas Eastern incorporated Route Variation 80 into the pipeline route because it eliminates the horizontal side bend along the Arthur Kill Horizontal Directional Drill (HDD), thereby allowing for more efficient constructability across and under the Arthur Kill. Route Variation 80 also lengthens the Arthur Kill HDD to accommodate a request from the landowner, 380 Development LLC (380 Development) at the exit point. 380 Development is in the process of redeveloping its property and has requested that either: (1) the exit point of the Arthur Kill HDD be adjusted to the south so that it would be on Texas Eastern's existing ROW or (2) ensure that the HDD will be at an elevation of -70 feet at the point where the pipeline alignment would cross a proposed future marine docking facility. Texas Eastern considered both options; however, the relocation of the HDD exit point was eliminated from further consideration because it increases the engineering risks associated with the crossing of an existing 12-inch oil pipeline owned by International-Matex Tank Terminal (IMTT). To avoid this risk, and accommodate 380 Development's request, Texas Eastern will extend the HDD exit point approximately 90 feet to the east to ensure that the depth of the drill will be at an elevation of -70 feet at the point where the pipeline alignment would cross a proposed future marine docking facility.

Route Variation 80 will not affect any new landowners. The proposed HDD workspace at the new exit point (MP 3.75R) will be reduced by 0.29 acres. This reduction will occur entirely within the "open land" category for land use. The majority of the workspace reduction (0.23 acres) occurs within Wetland SI-W1A. Because Route Variation 80 eliminates the horizontal side bend along the Arthur Kill HDD, will improve the constructability of this HDD crossing, addresses 380 Development's initial concerns, and will result in less land use and wetland impacts, Texas Eastern has incorporated it into the proposed pipeline route.

MPs 4.07R to 4.71R - Route Variation 74

Route Variation 74 is located in the Borough of Staten Island in Richmond County, New York (Figures 7 through 11: Alignment Sheets LD-A-1017A to 1020). It is approximately 0.64 miles in length, deviates from the proposed NJ-NY Expansion pipeline ROW at MP 4.07R, and rejoins the ROW at MP 4.71R. This route variation involves an adjustment to the alignment of the Goethals Bridge HDD. Texas Eastern incorporated Route Variation 74 into the pipeline route to minimize impacts on a wooded parcel of land at the HDD entry point at MP 4.71R that contains sensitive archaeological resources. This parcel is owned by Texas Eastern and is located southeast of Metering and Regulating (M&R) Station 058. To accomplish this route variation, Texas Eastern realigned the Goethals's Bridge HDD exit point approximately 100 feet west of the proposed exit point on said Texas Eastern property. In addition, Texas Eastern has maintained a 100-foot offset from the proposed bridge abutment for the new Goethals Bridge reconstruction. This route variation will reduce the workspace associated with the HDD by approximately 27 percent or 0.61 acres and will occur entirely within the "forest/woodland" category for land use. Because Route Variation 74 minimizes impacts on sensitive archaeological resources while still facilitating the completion of the Goethals Bridge HDD, Texas Eastern has incorporated it into the proposed pipeline route.

MPs 4.71R to 4.80R - Route Variation 58

Route Variation 58 is located in the Borough of Staten Island in Richmond County, New York (Figure 12: Alignment Sheet LD-A-1021). It is approximately 0.13 miles in length, deviates from the proposed NJ-NY Expansion pipeline ROW at MP 4.71R, and rejoins the ROW at MP 4.80R. Texas Eastern incorporated Route Variation 58 into the pipeline route to accommodate Consolidated Rail Corporation's (Conrail) request to avoid its existing rail switching equipment on the current pipeline route crossing location. An additional 0.25 acres of permanent easement and 0.06 acres of temporary construction workspace will be required to construct this route variation on a parcel already affected by the Project, as compared to the proposed route. These additional impacts will occur entirely within the "industrial/commercial" category for land use. Because Route Variation 58 accommodates Conrail's request to avoid impacting existing active rail switches, Texas Eastern has incorporated it into the proposed pipeline route.

MPs 4.80R to 5.27R - Route Variation 76

Route Variation 76 is located in the Borough of Staten Island in Richmond County, New York (Figures 13 through 15: Alignment Sheets LD-A-1021 to 1023). It is approximately 0.48 miles in length, deviates from the proposed NJ-NY Expansion pipeline ROW at MP 4.80R, and rejoins the ROW at MP 5.27R. Texas Eastern incorporated Route Variation 76 into the pipeline route after additional engineering work and field investigations revealed that there is insufficient area to construct the proposed route due to existing underground utilities within the roadway layout of Western Avenue. Texas Eastern determined that to construct the pipeline within the roadway would require the relocation of portions of the known existing infrastructure. Additionally, "Dig-Safe" marking along the roadway for ongoing construction indicated the presence of utilities of which no mapping is available. Utilizing the revised alignment will avoid both of these issues. As such, Texas Eastern relocated the pipeline alignment slightly east of Western Avenue and out of the roadway ROW as it crosses Port Authority property.

Route Variation 76 will not affect any new landowners or any additional environmental resources. Overall, Route Variation 76 requires an additional 2.3 acres of land to construct the pipeline. The additional impact will occur within the "industrial/commercial" category for land use. By moving outside of Western Avenue, the ROW configuration will now include a 50-foot permanent easement. Of the 2.3 acres of impact, 1.6 acres is attributable to the 50-foot permanent easement. Because Route Variation 76 provides a work area along Western Avenue that is not encumbered with underground utilities and avoids construction and operational impacts to the integrity of these facilities, Texas Eastern has incorporated the route variation into the proposed pipeline route.

MP 5.54R Workspace

The workspace at MP 5.54R (Figure 16) has been revised in order address concerns over impacts to wetland SI-W10 which encroaches onto the permanent ROW, and therefore cannot be completely avoided. Texas Eastern reviewed the workspace layout at this location and has determined that a 30-foot by 140-foot wide additional temporary workspace (ATWS) area on the west side of the ROW can be relocated to the east side of the ROW to avoid wetland impacts. By reconfiguring the ATWS at approximately MP 5.54R, wetland impacts within Arlington Marsh can be reduced.

MPs 17.85R to 19.85R - Route Variations 64/79

These route variations are located in the cities of Jersey City and Hoboken in Hudson County, New Jersey and Borough of Manhattan in New York County (Figures 17 through 19: New York portion on Alignment Sheets LD-A-1083 to 1085). They are approximately 2.0 miles in length, deviate from the proposed NJ-NY Expansion pipeline ROW at MP 17.85R, and rejoin the ROW at MP 19.85R. Texas Eastern incorporated Route Variations 64/79 into the pipeline route because making slight adjustments to the 18th Street/Long Slip HDD and the Hudson River HDD allows Texas Eastern to avoid conflicts with an existing 102-inch brick sewer outfall and can ensure that the property owned by Newport Associates Development Company (Newport) will not be affected by any permanent ROW.

To avoid the conflicts with the sewer outfall crossing, Texas Eastern relocated the exit point of the 18th Street/Long Slip HDD in Jersey City at Coles and 18th Streets, approximately 28 feet to the south. Texas Eastern adjusted the pipeline, permanent easement and temporary construction ROW at this location. The permanent ROW was reduced by 0.1 acres and the temporary construction ROW was reduced by 0.12 acres. This route variation will occur entirely within the “industrial/commercial” category for land use. No other workspace changes were required for these variations. In addition, no additional impacts to environmental resources will occur from these route variations. Because Route Variations 64/79 avoids conflicts between the 18th Street/Long Slip HDD and the existing 102-inch brick sewer outfall and removes any permanent easement from Newport’s property, Texas Eastern has incorporated it into the proposed pipeline route.

Route Variation 64 lies entirely within Jersey City and Hoboken, New Jersey and is not further considered here. However, Route Variation 79 lies within Manhattan, as well as Jersey City and Hoboken, New Jersey. The portion of Route Variation 79 that lies in Manhattan begins within the New York reach of the Hudson River STA 1019+20.4 and terminates at the southwest corner of the Gansevoort Peninsula (see Figures 17 through 19).

MPs 19.85R to 20.04R - Route Variation 75

Route Variation 75 is located in the Borough of Manhattan in New York County, New York (Figure 19: Alignment Sheet LD-A-1085). It is approximately 0.12 miles in length, deviates from the proposed NJ-NY Expansion pipeline ROW at MP 19.85R and terminates at MP 20.04R in Manhattan. Texas Eastern adjusted the pipeline alignment on the Gansevoort Peninsula currently utilized by the NYC Department of Sanitation on property owned by the State of New York and leased to the Hudson River Park Trust (HRPT), from the point where it makes landfall to the crossing of State Route 9A (West Street) to: (1) avoid having to relocate an existing 20-inch diameter water main located under the bike path parallel to State Route 9A, (2) allow sufficient room to install required new sewer manholes farther from State Route 9A, and (3) increase the safety of construction activities in the highly utilized area by offsetting the construction area adjacent to State Route 9A.

Route Variation 75 will not affect any new landowners or any additional environmental resources. An additional 0.01 acres of temporary construction workspace will be required to construct the pipeline and install the necessary cathodic protection equipment. These additional impacts will occur entirely within the “industrial/commercial” category for land use. It should also be noted that of the total construction ROW impact of 1.16 acres, 0.19 acres will be new permanent ROW.

Because Route Variation 75 avoids or minimizes impacts on existing and proposed infrastructure and reduces the proximity of construction adjacent to State Route 9A, Texas Eastern has incorporated them into the proposed pipeline route.

Results

MPs 3.14R to 3.75R - Route Variation 80

The portion of Route Variation 80 that lies within Staten Island, New York includes both a water crossing via HDD and a terrestrial section. The HDD continues from the New Jersey side across the Arthur Kill and onto the Staten Island shoreline exiting at MP 3.74R (see Figure 4). The pipeline then continues as a short section of open cut construction to the terminus of Route Variation 80 at MP 3.75R.

Previously identified cultural resources along Route Variation 80 are limited to the remains of a barge mooring rack used historically by the Gulf Oil Corporation, and which is visible on Project alignment sheets (see Figure 4 and 5). The barge mooring rack was identified during a previous shoreline investigation, which concluded that it was not considered eligible to the National Register (Raber et al. 1996:43).

The Arthur Kill HDD portion of Route Variation 80 in New York extends between ca. 0 and 160 feet (ft) in depth (Figure 20). It was concluded in the December filing report, the portion of the HDD between STA 195+00 and STA 197+41.9 that represents its exit point may have vertical impacts on sediments potentially containing archaeological deposits. This latter section of the HDD as well as the terrestrial open-cut portion of Route Variation 80 represents a minor variation from the December filing route. This area was previously assessed in the December filing archaeological overview survey report as having high sensitivity for pre-contact resources and no post-contact sensitivity (Elquist et al. 2010a). It was noted in this report that expected pre-contact resources pre-dating marine transgression could consist of isolated finds or campsites underlying documented marsh and fill deposits in this area (Elquist et al. 2010a:74). This same area was considered to lack any post-contact sensitivity due to the presence of extensive marshlands prior to mid-twentieth century filling associated with the oil refinery complex. Additional work in the form of soil borings were recommended for the archaeologically sensitive portions of this area (Elquist et al. 2010a). In comment letters regarding the December 2010 filing technical report, the New York State Office of Parks, Recreation and Historic Preservation, the Office of the State Historic Preservation Officer (SHPO) (Letter dated April 25, 2011) and the City of New York Landmarks Preservation Commission (LPC) (Letter dated Jan. 7, 2011) concurred with the December 2010 filing report assessment and recommendations for this area.

Since the completion of the December filing report, geotechnical boring B-1A (SI) for the Project (Universal No. IR-22-1-HDD-1) placed at the location of the HDD exit point was made available to PAL for review. The log for this boring indicates the presence of petroleum contaminated fill to a depth of 3 feet overlying organic silty clay likely representing estuarine conditions to a depth of 18 feet. The organic silty clay deposits are underlain by peat that extends to 22.5 feet in depth which overlies a grey fine to medium sand with a trace of silt to a depth of approximately 30 feet. This latter stratum is underlain by a coarser sand deposit with a trace to some silt to 36.5 feet that overlies decomposed rock and bedrock.

The deposit of fine to medium sand with a trace of silt underlying the peat between 22.5 and 30 feet below the surface may represent sediments that have the potential to contain archaeological resources, and PAL continues to assess this area as containing high sensitivity for pre-contact deposits that predate marine transgression of the area. These archaeologically sensitive sediments lie between approximately STA 195+50 and 197+00 which consists of a HDD that will pass upward through the archaeologically sensitive stratum between 22.5 and 30 feet below the surface to the HDD exit point (see Figure 4 and 5, 20). The remaining portions of Route Variation 80 between STA 195+00 and 195+50, and STA 197+00 and 198+00.5 are now considered to have no sensitivity for pre-contact resources as these portions of the Project APE will be placed in sediments (fill, organic silty clay, peat, or coarser sand deposits) that are not considered to have potential to contain significant archaeological resources.

While the proposed HDD will impact the archaeologically sensitive strata (22.5 to 30 ft below ground surface between approximately STA 195+50 and 197+00) of Route Variation 80, archaeological subsurface investigations are not considered to be practical or prudent at this location. This section of the pipeline route lies within a documented area of environmentally sensitive wetlands where ground disturbances are to be as minimal as possible. The project impact for the pipeline through the sensitive strata will be less than 4-ft in diameter, which is a much smaller area of disturbance than would be needed for archaeological subsurface excavations to expose and investigate such deeply buried sediments. In light of these mitigating factors, PAL recommends no further archaeological investigations (Table 1).

Route Variation 80 also includes a workspace for pull back heading east of this portion of the pipeline route (see Figures 5 and 6). Only minimal surface impacts to the filled wetland area containing the pull back area are proposed and no further investigations are recommended.

MPs 4.07R to 4.71R - Route Variation 74

Route Variation 74 includes the Goethals Bridge HDD between MP 4.07R and 4.71R, workspace for pullback, and a reduced workspace surrounding the HDD entry point at MP 4.71R (see Figures 6 through 10, Figure 21). The presently proposed route represents a relatively minor variation from the earlier proposed route (Route Variation 50), which was previously assessed for archaeological sensitivity (Elquist and Cherau 2011a). The previous assessment report noted that south of Old Place Creek no previously recorded archaeological sites were present, the area had low to no potential to contain post-contact cultural resources, and that with the exception of its exit point, the HDD was of sufficient depth that any potential pre-contact deposits at this location would not be impacted. Additional work in the form of soil borings was recommended at the HDD exit point, which only minimally varies from the presently proposed exit point for Route Variation 74 (see Figure 8).

Subsequent data from an environmental geotechnical boring undertaken in the immediate vicinity of the exit point was presented in a report summarizing the results of geoarchaeological borings undertaken for the Project to date (Cherau 2011). The geotechnical boring revealed 16 ft of petroleum contaminated sandy fill underlain by organic silty clay to 20 ft at which point a fibric peat was encountered. Given the presence of the deep fill and marsh deposits, this area was reassessed as having no archaeological sensitivity, and no further work was recommended (Cherau 2011:5-6). Comment letters from the New York SHPO (Letter dated June 16, 2011) and LPC

(Letter dated May 26, 2011) indicate both reviewing agencies concurred with the geoarchaeological boring report assessment and recommendations.

The portion of the Route Variation 74 HDD between Old Place Creek and the HDD workspace to the north is situated some 100 feet west of the previously proposed route between approximately STA 242+00 and STA 247+25 (see Figure 10). No previously recorded archaeological sites are present within the presently proposed Project route at this location, though historic maps (Beers 1874; Butler 1853; Dripps 1872; Hassler 1845; Walling 1860) indicate that the Old Place Mill and associated dwelling were present along or in the immediate vicinity of the route (Figure 22). Deposits associated with the previously recorded Old Place Site (A08501.0134 and A08501.2366) may be present in the vicinity. First reported by Alanson Skinner in the early twentieth century, the Old Place Site has subsequently been investigated by both avocational and professional archaeologists and has yielded evidence of Archaic, Woodland and Contact period components (Anderson 1964, 1967; HAA 2002; Payne and Baumgardt 1986; Ritchie and Funk 1971; Skinner 1909). Other recorded post-contact sites in the vicinity include seven house and outbuilding sites on the west side of Western Avenue identified during the 1986 Howland Hook Marine Terminal survey (Payne and Baumgardt 1986). These sites include several loci consisting of domestic and other associated structures ranging in date from the seventeenth through the twentieth centuries (A0815-01-2371, A085-01-2372, A085-01-2373, A085-01-2374, A085-01-2367, A085-01-2368, and A085-01-2369). Closest to Route Variation 74 is Tunissen's 1680 Domestic Structure Site (A085-01-2374) situated along the northwest corner of Western Avenue and what is now Goethals Road North according to Payne and Baumgardt's map (1986). Given the location of all these post-contact sites west of Western Avenue, the current Project route is not expected to impact these sites. In any case, the APE at this location extends between ca. 30 and 80 ft in depth and is not expected to impact any potential archaeological deposits at this location (see Figure 20).

The remaining portion of Route Variation 74, which includes the pipeline route within the HDD additional workspace and workspace itself mainly varies from the originally proposed route in that the size of the workspace has been reduced (see Figure 11). This area of Route Variation 74 lies entirely within the boundaries of the previously identified Old Place Neck Site (A08501.002971). The Old Place Neck Site contains both pre- and post-contact components and was identified and evaluated as part of the ongoing archaeological investigations for the Project (Elquist et al. 2011; Elquist and Cherau 2011b).

No additional work is recommended for the portion of Route Variation 74 between STA 215+00 and 247+25 as the route in this area either lacks archaeological sensitivity or is not expected to undergo impacts due to the depth of the Goethals Bridge HDD. The remaining portion of Route Variation 74 comprised of the HDD entry point workspace and route contained therein (STA 247+25 to STA 248+88) is considered to be archaeologically sensitive given the presence of the Old Place Neck Site (see Table 1). The results of the Phase II investigations at this site and recommendations for additional work regarding this latter area are summarized in the additional Phase IB and Phase II report for the Old Place Neck Site (Elquist and Cherau 2011b). Only minimal surface impacts to the filled wetland area containing the pullback area back heading southwest of the Goethals Bridge HDD exit point (see Figures 7 and 8) are proposed and no further investigations are recommended.

MPs 4.71R to 4.80R - Route Variation 58

Route Variation 58 extends the pipeline route about 200 feet east of the previously proposed route (see Figure 12), which was previously sensitized as having high sensitivity for pre-contact resources and moderate to low sensitivity for post-contact resources (Elquist et al. 2010a). Pre-contact sites recorded in the immediate area include the above-noted Old Place Site (A08501.0134 and A08501.2366), and the Mariner's Harbor Site area first reported by Skinner (Boesch 1994:No. 105; STD-MH), and Site 8505 (NYSM site files). Skinner additionally noted finds of projectile points (possibly related to Site 8505) along Western Avenue (Skinner 1898-1909). Post-contact sites documented south of the Staten Island Railroad Crossing include Revolutionary War Period burials related to a skirmish associated with the former Reverend Kinney property (documented as Site A085-01-2375) (Payne and Baumgardt 1986; Skinner 1909). North of the rail crossing, the route overlaps with the southernmost limit of the Proctor and Gamble Port Ivory Plant complex that by the 1920s occupied both sides of Western Avenue. The 1907 Robinson map indicates that a "Milliken Station" was present along a rail spur just north of the Staten Island rail line, which appears to have been torn down by 1937 (Bromley 1907, 1917; Sanborn 1937). By 1962, a manufactory building of the Proctor and Gamble complex for cake mixes was present near the former location of the rail station and appears on Sanborn maps as late as 1996, but is no longer present Sanborn 1962, 1977, 1981, 1983, 1986, 1987, 1988, 1989, 1990, 1992, 1993, 1994, 1995, 1996). However, neither the rail station or the Proctor and Gamble manufactory building lie within the direct alignment of Route Variation 58.

As with the previously proposed route, the presence of previously recorded pre-contact archaeological sites and artifact finds along Western Avenue indicate that Route Variation 58 has high sensitivity for pre-contact cultural resources in intact sediments that may lie below expected deposits of marsh sediments, fill and/or disturbed soils in this area. Expected pre-contact resources could consist of campsite or village components dating to the Archaic through contact periods. The portion of the route south of the Staten Island rail crossing is considered to have moderate sensitivity for eighteenth- and nineteenth-century resources related to the Revolutionary War period skirmish and burials, and/or the Reverend Kinney property, and low sensitivity for later historic resources. The portion of the route north of the rail crossing is considered to have low sensitivity for any significant post-contact period resources. Soil borings are recommended along Route Variation 58 between STA 248+57.7 and 255+66.5 to determine the presence and depth of ground disturbance, fill, or marsh deposits, and of any sediments potentially containing pre-contact and post-contact period resources within or below these deposits (see Table 1).

MPs 4.80R to 5.27R - Route Variation 76

Route Variation 76 reflects a very minor deviation from the originally proposed route assessed in the Pre-filing report (Elquist et al. 2010b). The Pre-filing route was largely contained within the Western Avenue roadbed, while the currently proposed route runs adjacent to the eastern edge of Western Avenue (see Figures 13 through 15). It was concluded in the Pre-filing report that this area contained high sensitivity for pre-contact resources given the presence of Archaic through Woodland finds associated with the Mariner's Harbor site area (Boesch 1994:No. 105; STD-MH), artifact finds along Western Avenue/Site 8505 (NYSM site files; Skinner 1898-1909), and deposits associated with the Bowman's Brook (NYSM 4594 and 7921) and Bowman's Brook North (A085-01-2364) sites to the north and east (Payne and Baumgardt 1986; Skinner 1909). The Pre-filing route was not assessed as having any sensitivity for post-contact resources as no structures,

buildings, or other features associated with the above-noted Proctor and Gamble complex are documented within or along the Western Avenue roadbed (Elquist et al. 2010b:84 and 86).

In comment letters regarding the August 2010 Pre-filing technical report, the New York SHPO (Letter dated Oct. 22, 2010) and the LPC (Letter dated Oct. 28, 2010) concurred with the August 2010 Pre-filing report assessment and recommendations for this area. PAL continues to assess this area as having high sensitivity for pre-contact cultural resources, and no sensitivity for post-contact resources, and additional work in the form of soil borings are recommended to determine the presence of any sediments potentially containing pre-contact deposits (see Table 1).

MP 5.54R Workspace

The additional temporary workspace at approximately MP 5.54R is contiguous with an area previously assessed in the December foiling report (Elquist et al. 2010a:85-86). Previously recorded archaeological sites in the area include the Bowman's Brook (NYSM 4594 and 7921), Bowman's Brook North (A085-01-2364), and Mariner's Harbor site areas (Boesch 1994:No. 105; STD-MH). Post-contact deposits in this same area could include Revolutionary War period burials (Kardas and Larrabee 1982:7, citing Skinner 1926) that could be located on either side of Richmond Terrace south of the workspace, and remains of the Milliken Brothers foundry/Downey Shipbuilding complex that were situated on either side of the Richmond Terrace roadway. Previous cultural resource investigations of the area, however, concluded that the remnants of the industrial complex north of Richmond Terrace do not contain any historical significance (Flagg 1991a, 1991b). It was concluded in the report that this area contained high sensitivity for Archaic and Woodland period remains associated with the Bowman's Brook and Bowman's Brook North Sites, including human remains. Portions of the area were also considered to contain modern sensitivity for Revolutionary War Period burials (Elquist et al. 2010a:86).

In comment letters regarding the December 2010 filing technical report, the New York SHPO (Letter dated April 25, 2011) and the LPC (Letter dated Jan. 7, 2011) concurred with the December 2010 report assessment and recommendations for this area (Elquist et al. 2010a). PAL continues to recommend additional investigations in the form of soil borings for this area to determine the presence of any sediments that have the potential to contain pre- or post-contact deposits (see Table 1).

MPs 17.85R to 19.85R - Route Variations 64 and 79

Route Variation 64 is entirely situated within New Jersey and is not considered further here. The New York portion of Route Variation 79 lies between STA 1019+20.4 and STA 1052+07.9 and is contained entirely within the New York reach of the Hudson River terminating at the southwest corner of the Gansevoort Peninsula (see Figures 17 through 19). It consists of the Hudson River HDD located containing the HDD route, entry point, and associated workspace. The alignment of the HDD route, associated offshore workspace, and entry point is similar to the originally proposed route. The area containing the offshore workspace and HDD entry point was previously surveyed in a separate marine archaeological assessment, which concluded that the potential for submerged archaeological resources was low and that no additional investigations in the form of a remote sensing survey were necessary (SEARCH 2010:5 – Appendix E in Elquist et al. 2010a). No previously identified archaeological resources are present along the remaining portion of the HDD route within the New York reach of the Hudson River. In addition, the HDD along this portion of

the route is expected to be of sufficient depths that no impacts will occur (Figure 23). As such, no further archaeological investigations are recommended for this portion of Route Variation 79.

MPs 19.85R to 20.04R - Route Variations 75

Route Variation 75 is located in Manhattan on made land between STA 1052+07.9 and 1058+43.6 and occupies the exact same footprint of the terrestrial portion of previously assessed Route Variation 54. (see Figure 19). It was concluded in the previous assessment that this footprint contained no to low sensitivity for pre- and post-contact cultural resources, and no further work was recommended (Elquist and Cherau 2011c). In comment letters regarding the previous assessment report for Route Variation 54, the New York SHPO (Letter dated June 16, 2011) and the LPC (Letter dated May 26, 2011) concurred with the assessment and recommendations for this area. PAL continues to assess this area as containing no to low sensitivity for archaeological resources and, no further work is recommended for Route Variation 75 (see Table 1).

Summary

No additional archaeological investigations are recommended for all or portions of Route Variations 80, 74, 64/79 and 75 as these are areas that have no to low sensitivity for archaeological deposits and/or are HDDs of sufficient depth that no impacts are expected. Due to the high sensitivity for pre-contact archaeological resources, additional investigations in the form of soil borings are recommended for the archaeologically sensitive portions of Route Variations 80, 74, 58, 76 and the revised workspace configuration at MP 5.54R (see Table 1). Route Variation 58 and the MP 5.54R workspace are also moderately sensitive for post-contact resources. The proposed maximum boring interval for archaeologically sensitive areas is 200 feet wherever possible. Identifying areas of disturbance and characterizing/dating sediment deposits through a soil boring program will be crucial in determining whether or not an archaeologically sensitive area of the Project APE will require additional investigations, including but not limited to hand and/or machine-assisted subsurface investigations for pre-contact and/or post-contact period resources.

Table 1. Summary of Archaeological Sensitivity and Recommendations

Borough	Route Variation No.	Facility/ Mile Post Location	STA No. Location	Figure	Pre-contact Sensitivity	Post-contact Sensitivity	Recommendations
Staten Island	80	MP 3.14R to 3.75R	STA 182+36.5 to 195+50	3-5	None	None	No further archaeological investigations.
			STA 195+50 to 197+00	3-5	High	None	No further archaeological investigations, as any such investigations neither prudent nor practical.
			STA 197+00 to 198+00.5	4-5, 20	None	None	No further archaeological investigations.

Borough	Route Variation No.	Facility/ Mile Post Location	STA No. Location	Figure	Pre-contact Sensitivity	Post-contact Sensitivity	Recommendations
Staten Island	74	MP 4.07R to 4.71R	STA 215+00 to 247+25	7-11	High	None	Area of HDD. No impacts expected. No further archaeological investigations.
			STA 247+25 to 248+88	11	High	See Elquist and Cherau 2011b	Further work recommended. See recommendations in Elquist and Cherau 2011b.
	58	MP 4.71R to 4.80R	STA 248+57.7 to 251+50	12	High	Moderate	Soil borings.
			STA 251+50 to 255+66.5	12	High	Low	Soil borings.
	76	MP 4.80R to 5.27R	STA 253+67.1 to 278+45.5	13-15	High	None	Soil borings.
	MP 5.54R Workspace	MP 5.54R	N/A	16	High	Moderate	Soil borings.
Manhattan	64/79	MP 17.85R to 19.85R	STA 1019+20.4 to 1052+07.9	17-19	None	None	Offshore HDD area, and no expected impacts. No further archaeological investigations.
	75	MP 19.85R to 20.04R	STA 1052+07.9 to 1058+43.6	19	Low	Low	No further archaeological investigations.

References

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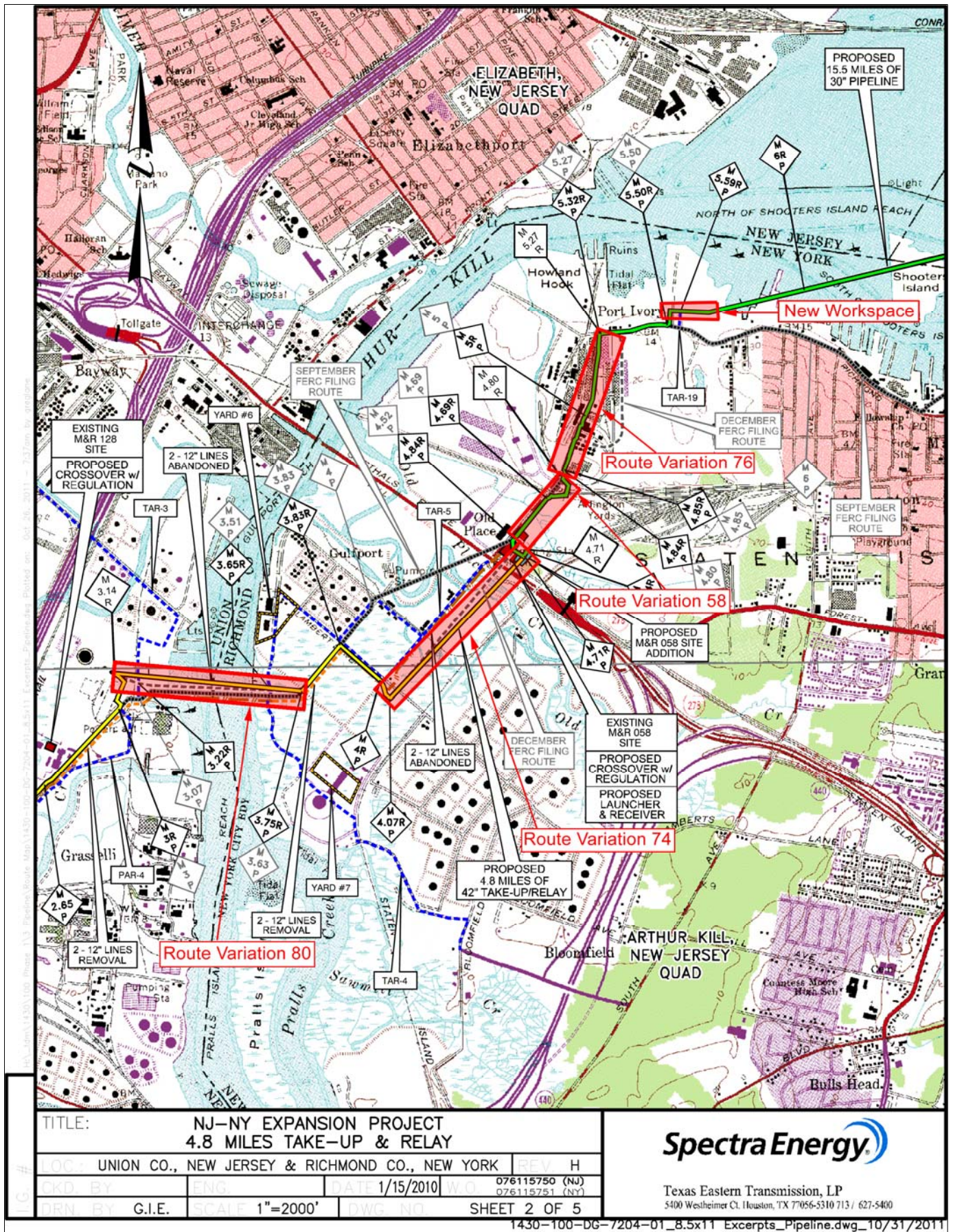
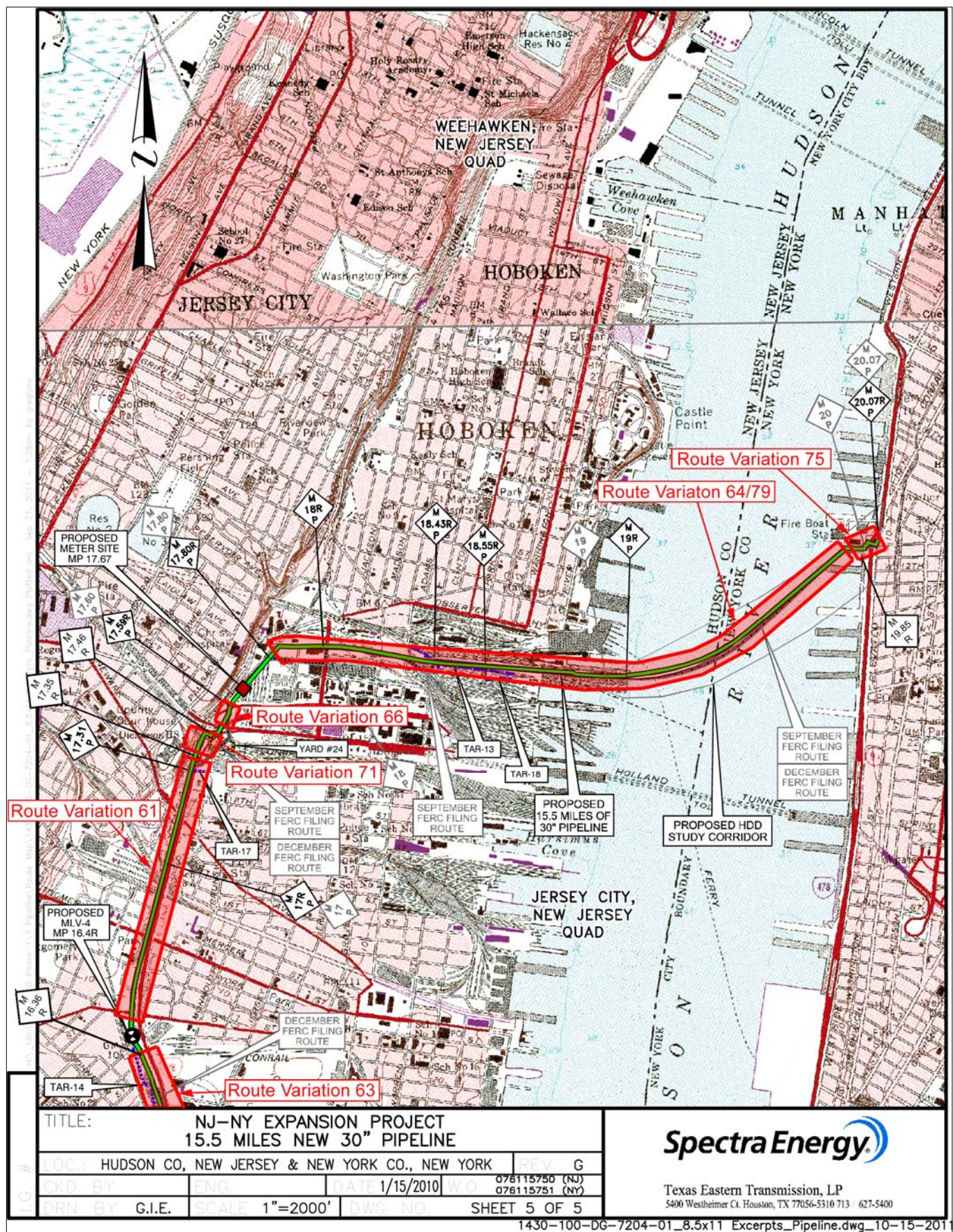


Figure 1. Location of the NJ-NY Expansion Project area, showing the location of the Project changes on the Arthur Kill, NJ and Elizabeth, NJ USGS topographic quadrangles, 7.5 minute series.



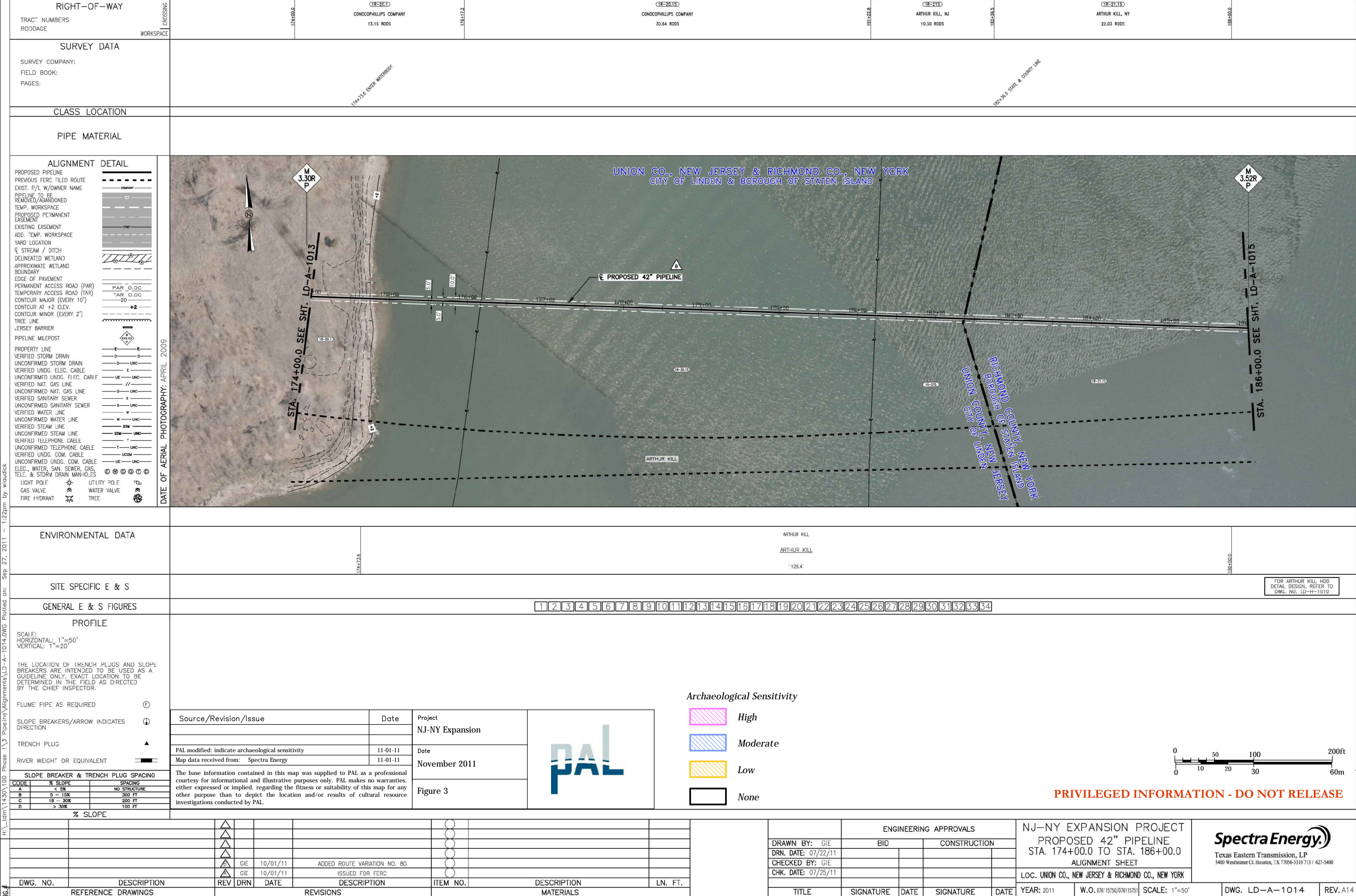


Figure 3. Map of Route Variation 80, showing archaeological sensitivity.

RIGHT-OF-WAY		CROSSING		(18-21.1S)	(18-22)	(18-22.1)																			
TRACT NUMBERS RODDAGE		WORKSPACE	186+00.0	ARTHUR KILL, NY 27.33 RODS	188+50.0 380 DEVELOPMENT, LLC 7.49 RODS	191+74.6 380 DEVELOPMENT, LLC 38.72 RODS	194+00.0																		
SURVEY DATA		SURVEY COMPANY: FIELD BOOK: PAGES:																							
CLASS LOCATION																									
PIPE MATERIAL																									
ALIGNMENT DETAIL																									
ENVIRONMENTAL DATA		<table border="1"><thead><tr><th>ENVIRONMENTAL DATA</th><th>ARTHUR KILL</th><th>SI-W1A</th><th>SI-W1A</th></tr></thead><tbody><tr><td></td><td>ARTHUR KILL</td><td>SI-W1A</td><td>SI-W1A</td></tr><tr><td></td><td>617.1'</td><td>35.3'</td><td>264.0'</td></tr></tbody></table>						ENVIRONMENTAL DATA	ARTHUR KILL	SI-W1A	SI-W1A		ARTHUR KILL	SI-W1A	SI-W1A		617.1'	35.3'	264.0'						
ENVIRONMENTAL DATA	ARTHUR KILL	SI-W1A	SI-W1A																						
	ARTHUR KILL	SI-W1A	SI-W1A																						
	617.1'	35.3'	264.0'																						
SITE SPECIFIC E & S		[6]																							
GENERAL E & S FIGURES		[1][2][3][4][5][6][7][8][9][10][11][12][13][14][15][16][17][18][19][20][21][22][23][24][25][26][27][28][29][30][31][32][33][34]																							
PROFILE		<p>SCALE: HORIZONTAL: 1"=50' VERTICAL: 1"=20'</p> <p>THE LOCATION OF TRENCH PLUGS AND SLOPE BREAKERS ARE INTENDED TO BE USED AS A GUIDELINE ONLY. EXACT LOCATION TO BE DETERMINED IN THE FIELD AS DIRECTED BY THE CHIEF INSPECTOR.</p> <p>FLUME PIPE AS REQUIRED</p> <p>SLOPE BREAKERS/ARROW INDICATES DIRECTION</p> <p>TRENCH PLUG</p> <p>RIVER WEIGHT OR EQUIVALENT</p> <table border="1"><thead><tr><th colspan="3">SLOPE BREAKER & TRENCH PLUG SPACING</th></tr><tr><th>CODE</th><th>% SLOPE</th><th>SPACING</th></tr></thead><tbody><tr><td>A</td><td>< 5%</td><td>NO STRUCTURE</td></tr><tr><td>B</td><td>5 - 15%</td><td>300 FT</td></tr><tr><td>C</td><td>15 - 30%</td><td>200 FT</td></tr><tr><td>D</td><td>> 30%</td><td>100 FT</td></tr></tbody></table>						SLOPE BREAKER & TRENCH PLUG SPACING			CODE	% SLOPE	SPACING	A	< 5%	NO STRUCTURE	B	5 - 15%	300 FT	C	15 - 30%	200 FT	D	> 30%	100 FT
SLOPE BREAKER & TRENCH PLUG SPACING																									
CODE	% SLOPE	SPACING																							
A	< 5%	NO STRUCTURE																							
B	5 - 15%	300 FT																							
C	15 - 30%	200 FT																							
D	> 30%	100 FT																							
Source/Revision/Issue		Date	Project	NJ-NY Expansion																					
PAL modified: indicate archaeological sensitivity		11-01-11	Date	November 2011																					
Map data received from: Spectra Energy		11-01-11	Figure 4	Archaeological Sensitivity																					
The base information contained in this map was supplied to PAL as a professional courtesy for informational and illustrative purposes only. PAL makes no warranties, either expressed or implied, regarding the fitness or suitability of this map for any other purpose than to depict the location and/or results of cultural resource investigations conducted by PAL.																									
DWG. NO.		DESCRIPTION	REV	DRN	DATE	ITEM NO.	DESCRIPTION	MATERIALS	LN.	FT.															
REFERENCE DRAWINGS		REVISIONS																							
ENGINEERING APPROVALS		DRAWN BY: GIE		BID		CONSTRUCTION		NJ-NY EXPANSION PROJECT																	
DRN. DATE: 07/22/11		CHECKED BY: GIE		CHK. DATE: 07/25/11		YEAR: 2011		W.O. 076115751		SCALE: 1"=50'															
TITLE		SIGNATURE		DATE		SIGNATURE		DATE		DWG. LD-A-1015															
ARCHITECTURAL DESIGN, REFER TO DWG. NO. LD-H-1010		FOR PULLBACK WORKSPACE SEE DWG. LD-A-1015A AND LD-A-1015B		END VARIATION NO. 80		AKIHUK KILL HOD EXIT POINT 197+41.9		STA. 192+00.0 SEE SHT. LD-A-1016		REV. A14															

Figure 4. Map of Route Variation 80, showing archaeological sensitivity.

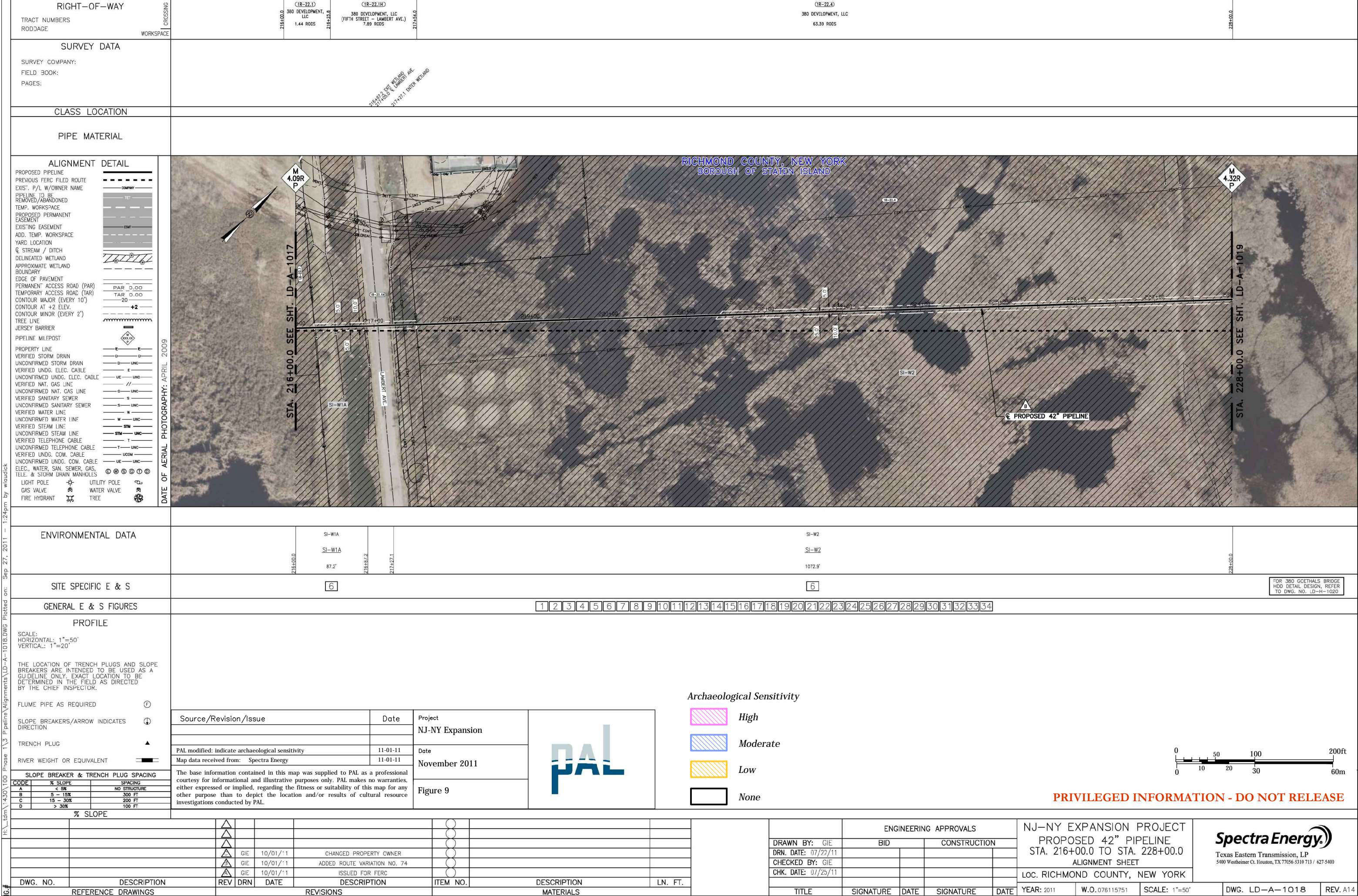
CLASS LOCATION	
PIPE MATERIAL	

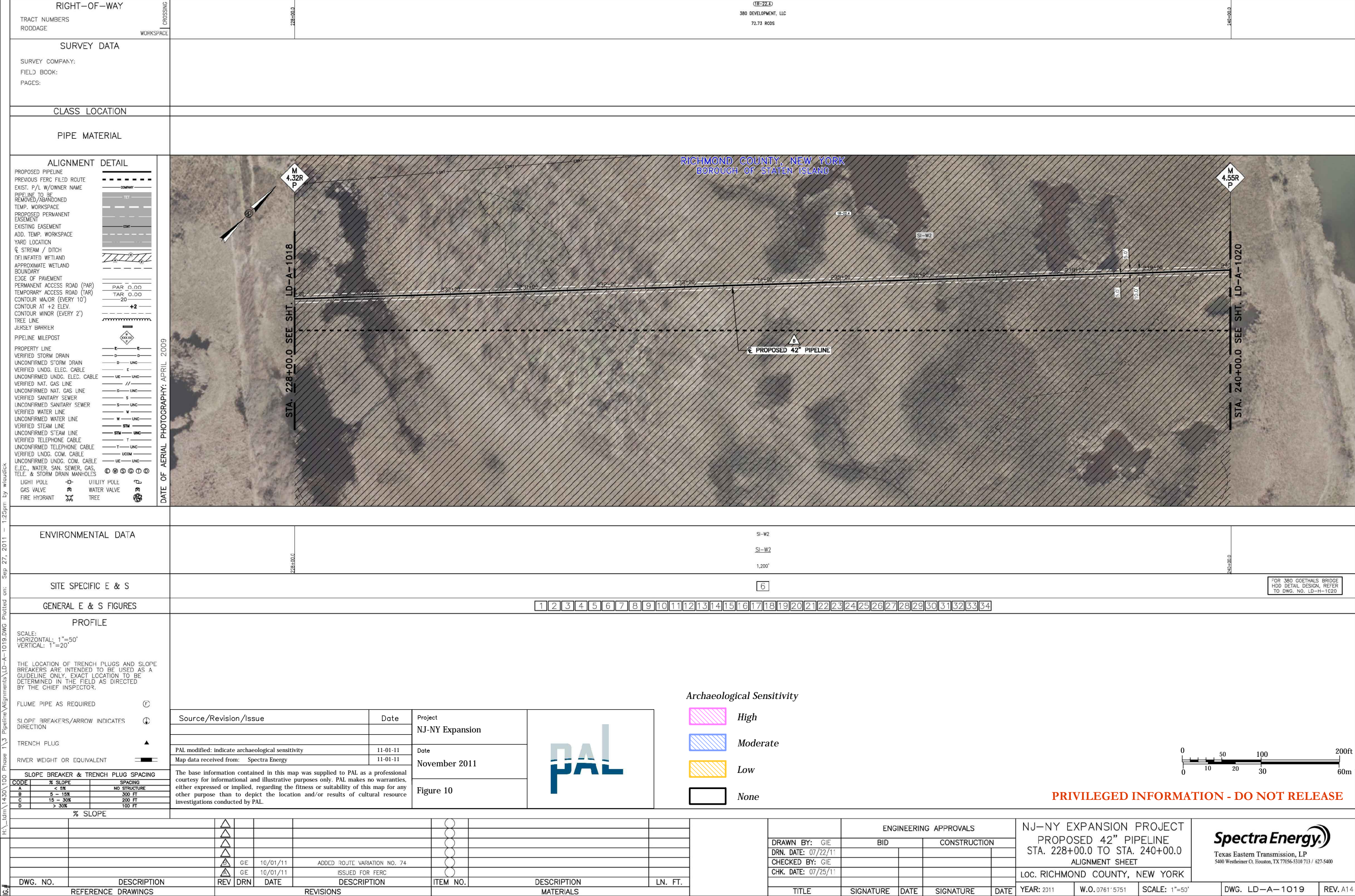
ENVIRONMENTAL DATA	
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GENERAL E & S FIGURES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
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[illegible]

Figure 7. Map of Route Variation 74 workspace for pull back, showing archaeological sensitivity.

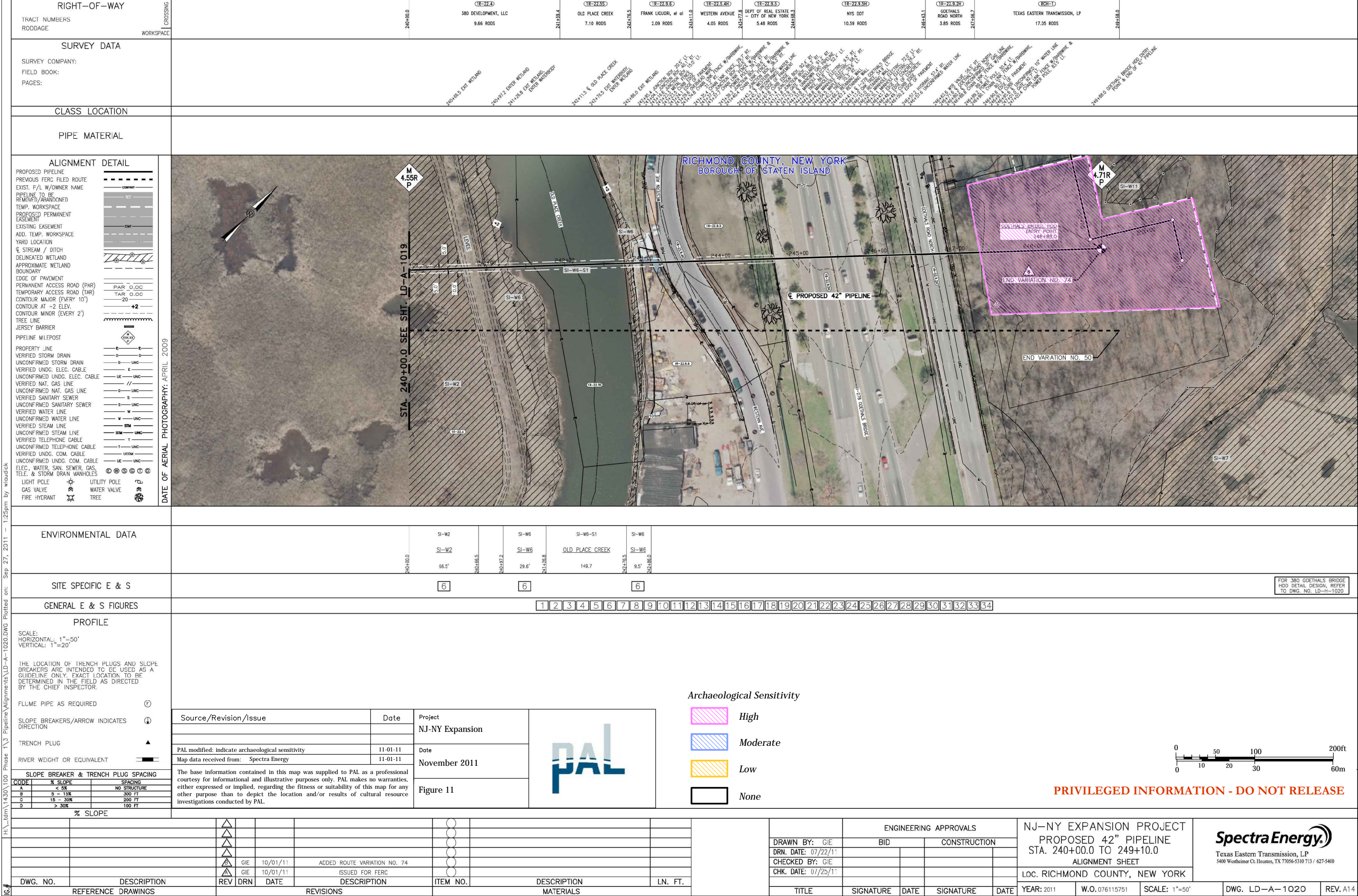




H:_drn\1430\100 Phase 1\3 Pipeline\Alignments\LD-A-1019.DWG Plotted on: Sep 27, 2011 - 1:25pm by wlaudick

06/

Figure 10. Map of Route Variation 74, showing archaeological sensitivity.



H:_tdm\1430\100 Phase 1\3 Pipeline\Alignments\LD-A-1020.DWG Plotted on: Sep 27, 2011 - 1:25pm by wiaudick

6

Figure 11. Map of Route Variation 74, showing archaeological sensitivity.

ALIGNMENT DETAIL


PROPOSED PIPELINE
 PREVIOUS FERC FILED ROUTE
 EXIST. P/L w/ OWNER NAME
 PIPELINE TO BE REMOVED/ABANDONED
 TEMP. WORKSPACE
 PROPOSED PERMANENT EASEMENT
 EXISTING EASEMENT
 ADD. TEMP. WORKSPACE
 YARD LOCATION
 © WATERS OF THE U.S.
 DELINEATED WATERS OF THE U.S.
 APPROXIMATE WATERS OF THE U.S. BOUNDARIES
 EDGE OF PAVEMENT
 PERMANENT ACCESS ROAD (PAR)
 TEMPORARY ACCESS ROAD (TAR)
 CONTOUR MAJOR (EVERY 10')
 CONTOUR A' +2 ELEV.
 CONTOUR MINOR (EVERY 2')
 TREE / BRUSH LINE
 JERSEY BARRIER
 PIPELINE MILEPOST


PROPERTY LINE
 VERIFIED STORM DRAIN
 UNCONFIRMED STORM DRAIN
 VERIFIED UNGD. ELEC. CABLE
 UNCONFIRMED UNGD. ELEC. CABLE
 VERIFIED NAT. GAS LINE
 UNCONFIRMED NAT. GAS LINE
 VERIFIED SANITARY SEWER
 UNCONFIRMED SANITARY SEWER
 VERIFIED WATER LINE
 UNCONFIRMED WATER LINE
 VERIFIED STEAM LINE
 UNCONFIRMED STEAM LINE
 VERIFIED TELEPHONE CABLE
 UNCONFIRMED TELEPHONE CABLE
 VERIFIED UNGD. COM. CABLE
 UNCONFIRMED UNGD. COM. CABLE
 ELEC., WATER, SAN. SEWER, GAS, TELE. & STORM DRAIN MANHOLES


LIGHT POLE
 GAS VALVE
 FIRE HYDRANT


UTILITY POLE
 WATER VALVE
 TREE

Archaeological Sensitivity

 *High*

 *Moderate*

 *Low*

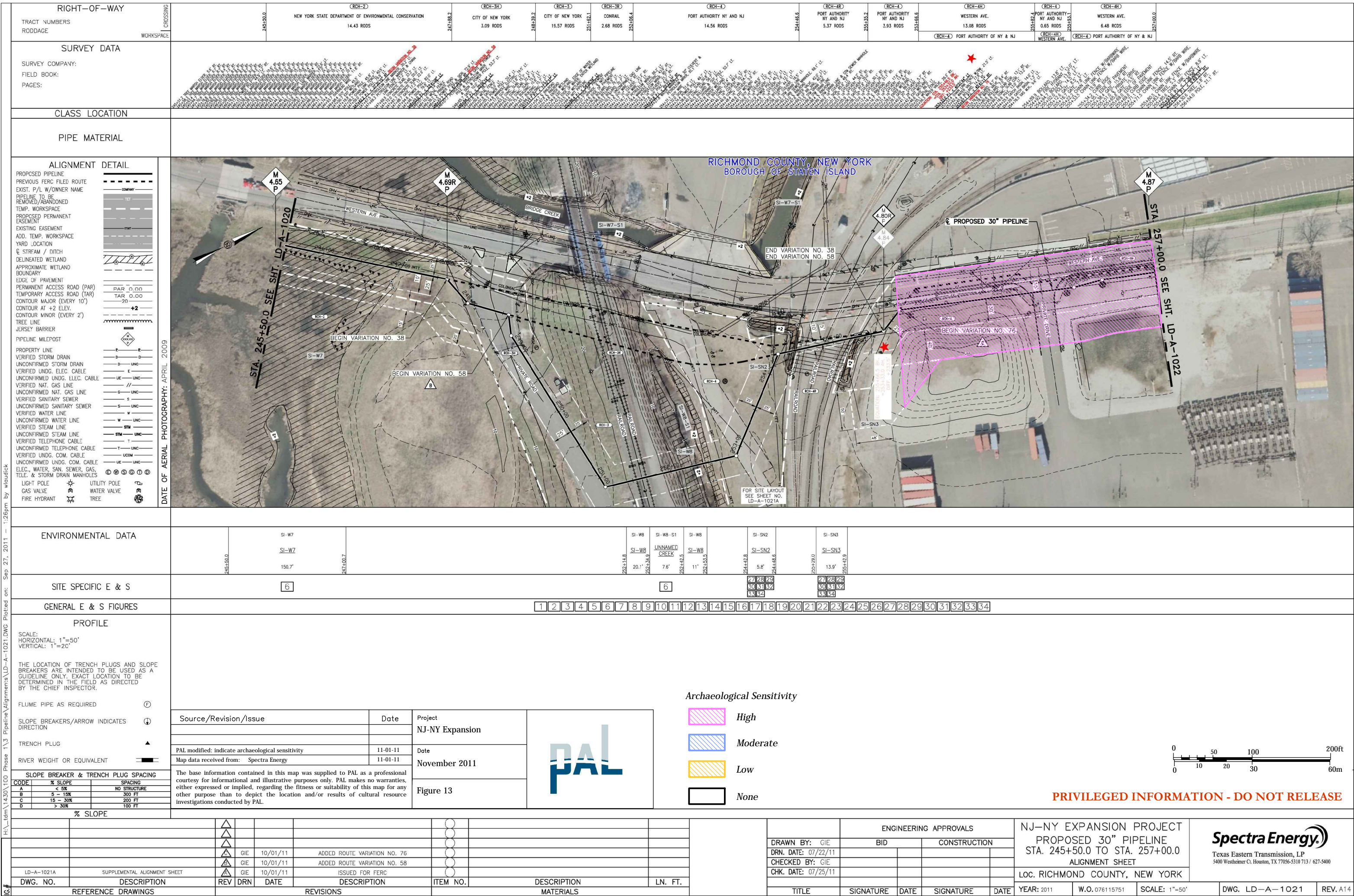
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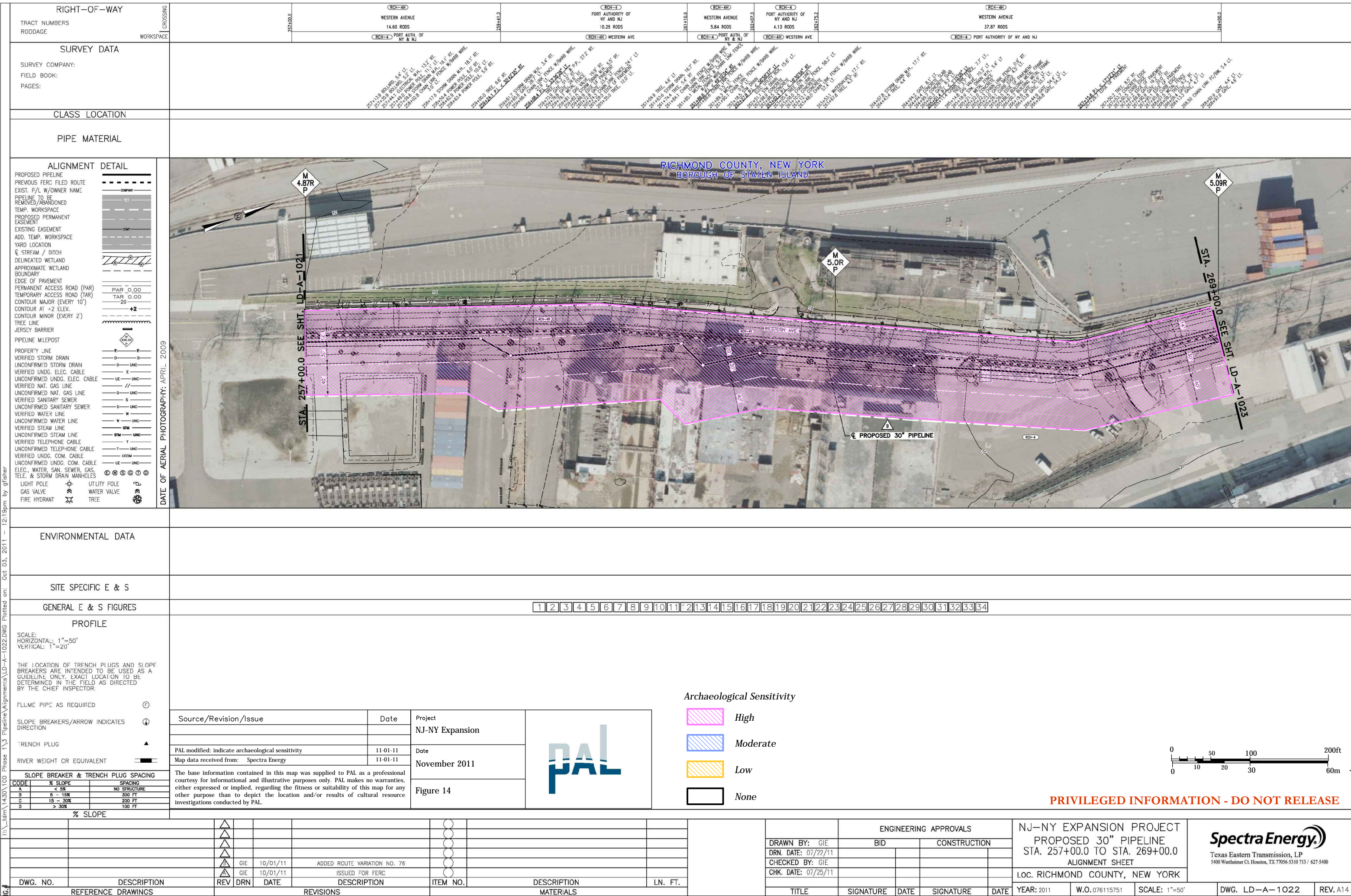
COMPANY
 TEL
 CMV
 PAR 0.00
 TAR 0.00
 20
 1 +2
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 D D
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 UCOM
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PRIVILEGED INFORMATION - DO NOT RELEASE

Figure 12. Map of Route Variation 58, showing archaeological sensitivity.





RIGHT-OF-WAY

TRACT NUMBERS
RODDAGE

CROSSING

WORKSPACE

289+00.0

WESTERN AVENUE
4.09 RODS

289+67.5

PORT AUTHORITY
OF NY & NJ

CRCH-4H

PORT AUTHORITY OF NY AND NJ
51.39 RODS

CRCH-4H

WESTERN AVENUE

278+115.5

RICHMOND TERRACE
10.90 RODS

280+00.0

SURVEY DATA

SURVEY COMPANY:

FIELD BOOK:

PAGES:

CLASS LOCATION

PIPE MATERIAL

ALIGNMENT DETAIL

PROPOSED PIPELINE
PREVIOUS FERC FILED ROUTE
EXIST. P/L W/OWNER NAME
PIPELINE TO BE
REMOVED/ABANDONED
TEMP. WORKSPACE
PROPOSED PERMANENT
EASEMENT
EXISTING EASEMENT
ADD. TEMP. WORKSPACE
YARD LOCATION
C. STREAM / DITCH
DELINEATED WETLAND
APPROXIMATE WETLAND
BOUNDARY
EDGE OF PAVEMENT
PERMANENT ACCESS ROAD (PAR)
TEMPORARY ACCESS ROAD (TAR)
CONTOUR MAJOR (EVERY 10')
CONTOUR AT +2 ELEV.
CONTOUR MINOR (EVERY 2')
TREE LINE
JERSEY BARRIER
PIPELINE MILEPOST
PROPERTY LINE
VERIFIED STORM DRAIN
UNCONFIRMED STORM DRAIN
VERIFIED UNG. ELEC. CABLE
UNCONFIRMED UNG. ELEC. CABLE
VERIFIED NAT. GAS LINE
UNCONFIRMED NAT. GAS LINE
VERIFIED SANITARY SEWER
UNCONFIRMED SANITARY SEWER
VERIFIED WATER LINE
UNCONFIRMED WATER LINE
VERIFIED STEAM LINE
UNCONFIRMED STEAM LINE
VERIFIED TELEPHONE CABLE
UNCONFIRMED TELEPHONE CABLE
VERIFIED UNG. COM. CABLE
UNCONFIRMED UNG. COM. CABLE
ELEC., WATER, SAN. SEWER, GAS,
TELE. & STORM DRAIN MANHOLES
LIGHT POLE
GAS VALVE
FIRE HYDRANT
UTILITY POLE
WATER VALVE
TREE

DATE OF AERIAL PHOTOGRAPHY: APRIL 2009

RICHMOND COUNTY, NEW YORK
BOROUGH OF STATEN ISLAND

WESTERN AVE.

EDGE OF BUILDING

PROPOSED 30" PIPELINE

EDGE OF BUILDING

STA. 269+00.0 SEE SHT. LD-A-1022

STA. 280+00.0 SEE SHT. LD-A-1024

END VARIATION NO. 76

ENVIRONMENTAL DATA

SITE SPECIFIC E & S

GENERAL E & S FIGURES

PROFILE

SCALE:
HORIZONTAL: 1"=50'
VERTICAL: 1"=20'

THE LOCATION OF TRENCH PLUGS AND SLOPE
BREAKERS ARE INTENDED TO BE USED AS A
GUIDELINE ONLY. EXACT LOCATION TO BE
DETERMINED IN THE FIELD AS DIRECTED
BY THE CHIEF INSPECTOR.

FLUME PIPE AS REQUIRED

SLOPE BREAKERS/ARROW INDICATES
DIRECTION

TRENCH PLUG

RIVER WEIGHT OR EQUIVALENT

SLOPE BREAKER & TRENCH PLUG SPACING

CODE

% SLOPE

SPACING

NO STRUCTURE

300 FT

200 FT

100 FT

% SLOPE

Source/Revision/Issue

Date

Project

NJ-NY Expansion

Date

November 2011

Figure 15

PAL

Archaeological Sensitivity

High

Moderate

Low

None

0 50 100 200ft
0 10 20 30 60m

PRIVILEGED INFORMATION - DO NOT RELEASE

ENGINEERING APPROVALS

BID

CONSTRUCTION

NJ-NY EXPANSION PROJECT
PROPOSED 30" PIPELINE
STA. 269+00.0 TO STA. 280+00.0
ALIGNMENT SHEET
LOC. RICHMOND COUNTY, NEW YORK

YEAR: 2011

W.O. 076115751

SCALE: 1"=50'

DWG. LD-A-1023

REV. A14

TEXAS EASTERN TRANSMISSION, LP
5400 WESTHEIMER CT. HOUSTON, TX 77055-5310 713 / 627-5400

DRAWN BY: GIE

DRN. DATE: 07/22/11

CHECKED BY: GIE

CHK. DATE: 07/25/11

TITLE

SIGNATURE

DATE

SIGNATURE

DATE

DESCRIPTION

REV

DRN

DATE

DESCRIPTION

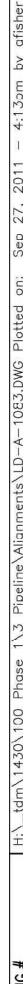
ITEM NO.

DESCRIPTION

MATERIALS

LN. FT.

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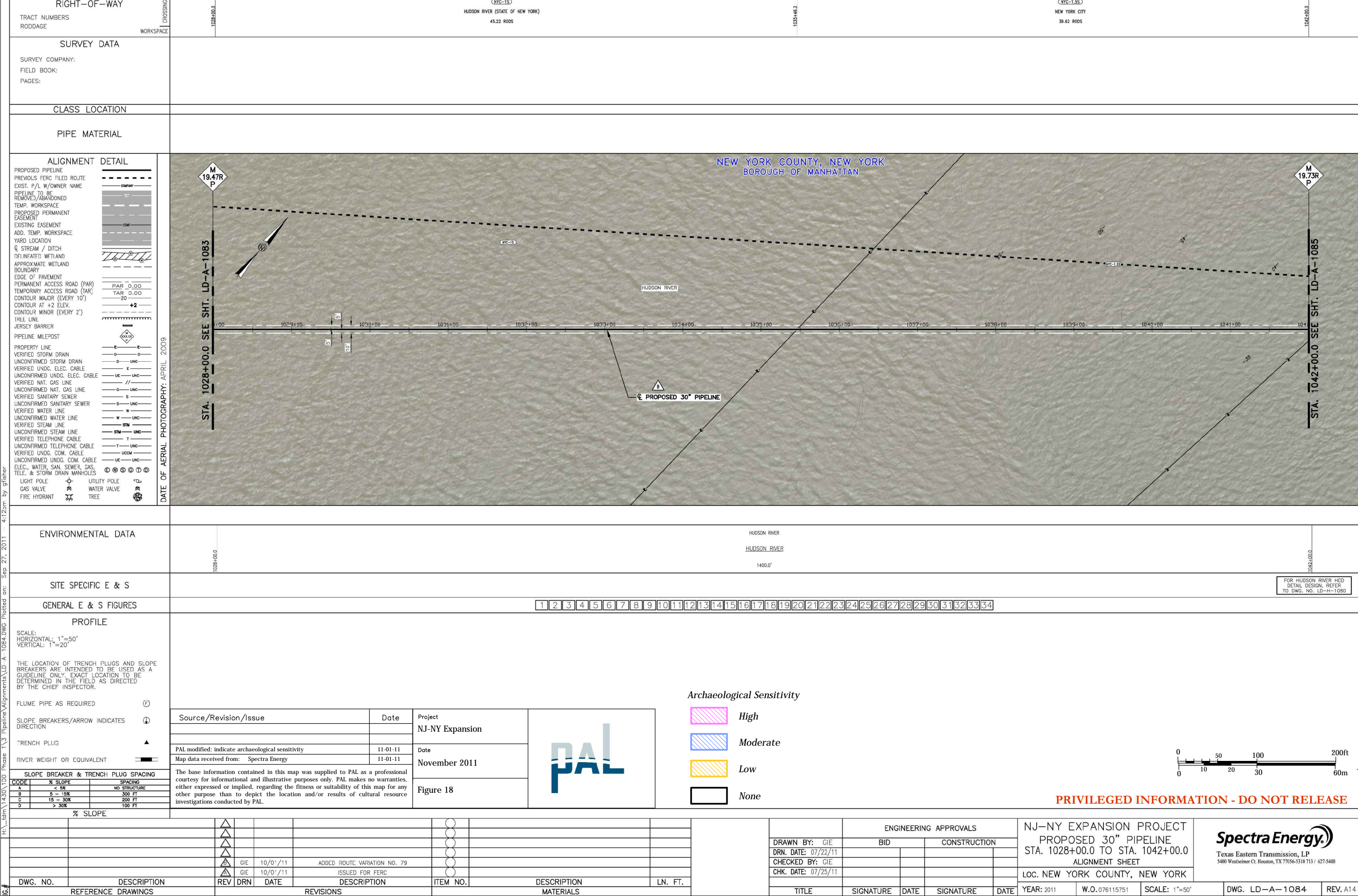
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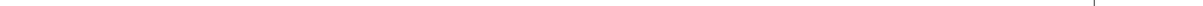
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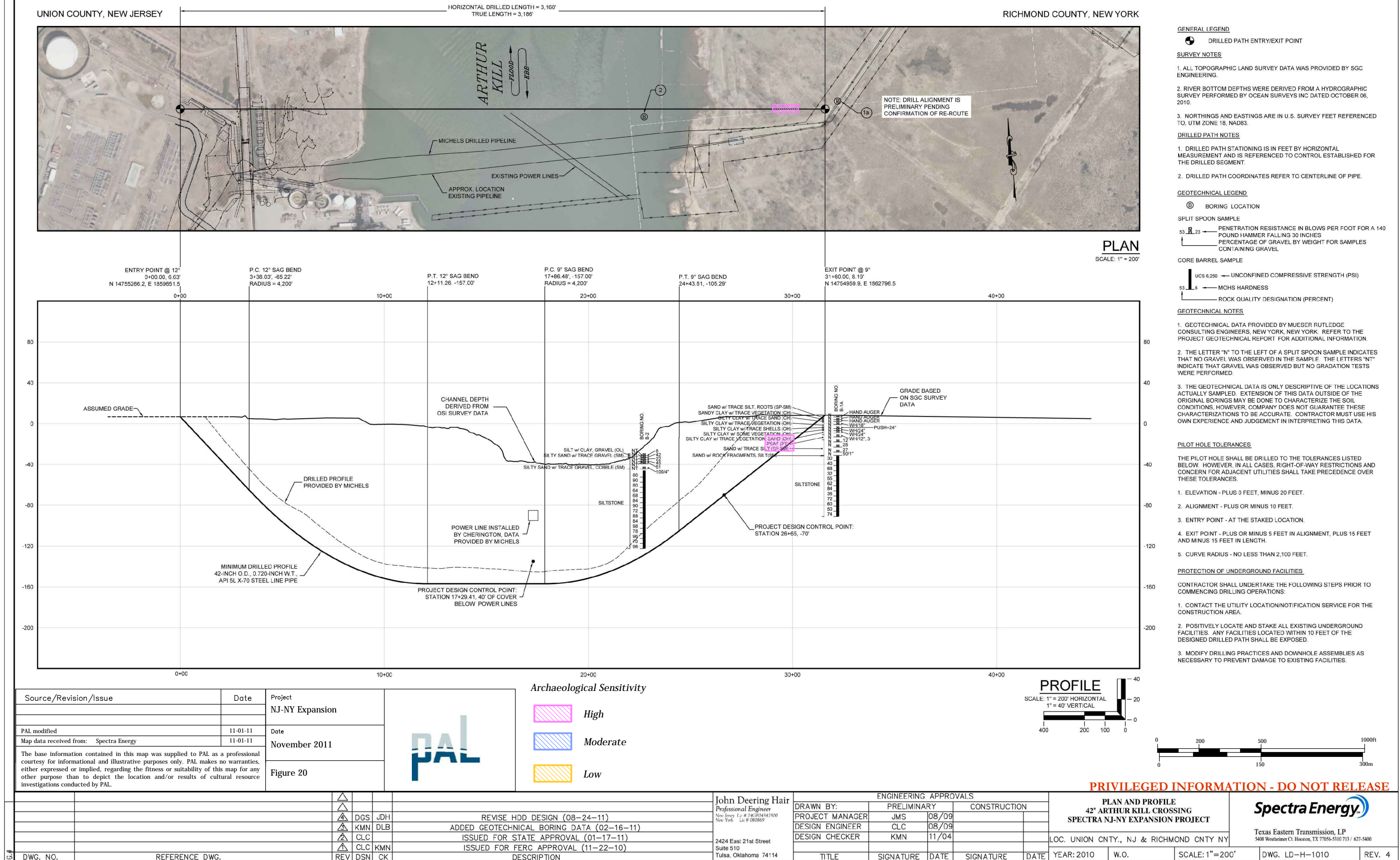


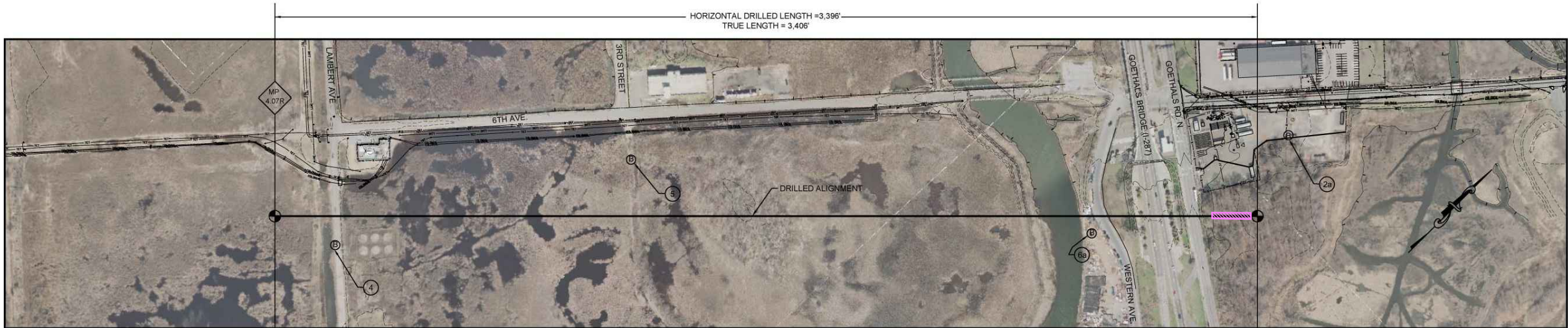


Archaeological Sensitivity

		<div>PRIVILEGED INFORMATION - DO NOT RELEASE</div>			
	A	C	A		

[illegible]





GENERAL LEGEND

- DRILLED PATH ENTRY/EXIT POINT

SURVEY NOTES

- ALL TOPOGRAPHIC LAND SURVEY DATA WAS PROVIDED BY SGC ENGINEERING.
- NORTHINGS AND EASTINGS ARE IN U.S. SURVEY FEET REFERENCED TO, UTM ZONE 18, NAD83.

DRILLED PATH NOTES

- DRILLED PATH STATIONING IS IN FEET BY HORIZONTAL MEASUREMENT AND IS REFERENCED TO CONTROL ESTABLISHED FOR THE DRILLED SEGMENT.
- DRILLED PATH COORDINATES REFER TO CENTERLINE OF PIPE.

GEOTECHNICAL LEGEND

- BORING LOCATION

SPLIT SPOON SAMPLE

- 53 PENETRATION RESISTANCE IN BLOWS PER FOOT FOR A 140 POUND HAMMER FALLING 30 INCHES

- PERCENTAGE OF GRAVEL BY WEIGHT FOR SAMPLES CONTAINING GRAVEL

SHELBY TUBE OR PUSH SAMPLE



CORE BARREL SAMPLE

- UCS 6,250 UNCONFINED COMPRESSIVE STRENGTH (PSI)

- TSS 1,350 TENSILE SPLITTING STRENGTH (PSI)

- 53 MOHS HARDNESS

- ROCK QUALITY DESIGNATION (PERCENT)

GEOTECHNICAL NOTES

- GEOTECHNICAL DATA PROVIDED BY MUESER RUTLEDGE CONSULTING ENGINEERS, NEW YORK, NEW YORK. REFER TO THE PROJECT GEOTECHNICAL REPORT FOR ADDITIONAL INFORMATION.
- THE LETTER 'N' TO THE LEFT OF A SPLIT SPOON SAMPLE INDICATES THAT NO GRAVEL WAS OBSERVED IN THE SAMPLE. THE LETTERS 'NT' INDICATE THAT GRAVEL WAS OBSERVED BUT NO GRADATION TESTS WERE PERFORMED.
- THE GEOTECHNICAL DATA IS ONLY DESCRIPTIVE OF THE LOCATIONS ACTUALLY SAMPLED. EXTENSION OF THIS DATA OUTSIDE OF THE ORIGINAL BORINGS MAY BE DONE TO CHARACTERIZE THE SOIL CONDITIONS. HOWEVER, COMPANY DOES NOT GUARANTEE THESE CHARACTERIZATIONS TO BE ACCURATE. CONTRACTOR MUST USE HIS OWN EXPERIENCE AND JUDGEMENT IN INTERPRETING THIS DATA.

PILOT HOLE TOLERANCES

THE PILOT HOLE SHALL BE DRILLED TO THE TOLERANCES LISTED BELOW. HOWEVER, IN ALL CASES, RIGHT-OF-WAY RESTRICTIONS AND CONCERN FOR ADJACENT UTILITIES SHALL TAKE PRECEDENCE OVER THESE TOLERANCES.

- ELEVATION - PLUS 0, MINUS 20 FEET.
- ALIGNMENT - PLUS OR MINUS 10 FEET.
- ENTRY POINT - AT THE STAKED LOCATION.
- EXIT POINT - PLUS OR MINUS 5 FEET IN ALIGNMENT, PLUS 25 FEET AND MINUS 0 FEET IN LENGTH.
- CURVE RADIUS - NO LESS THAN 2,100 FEET.

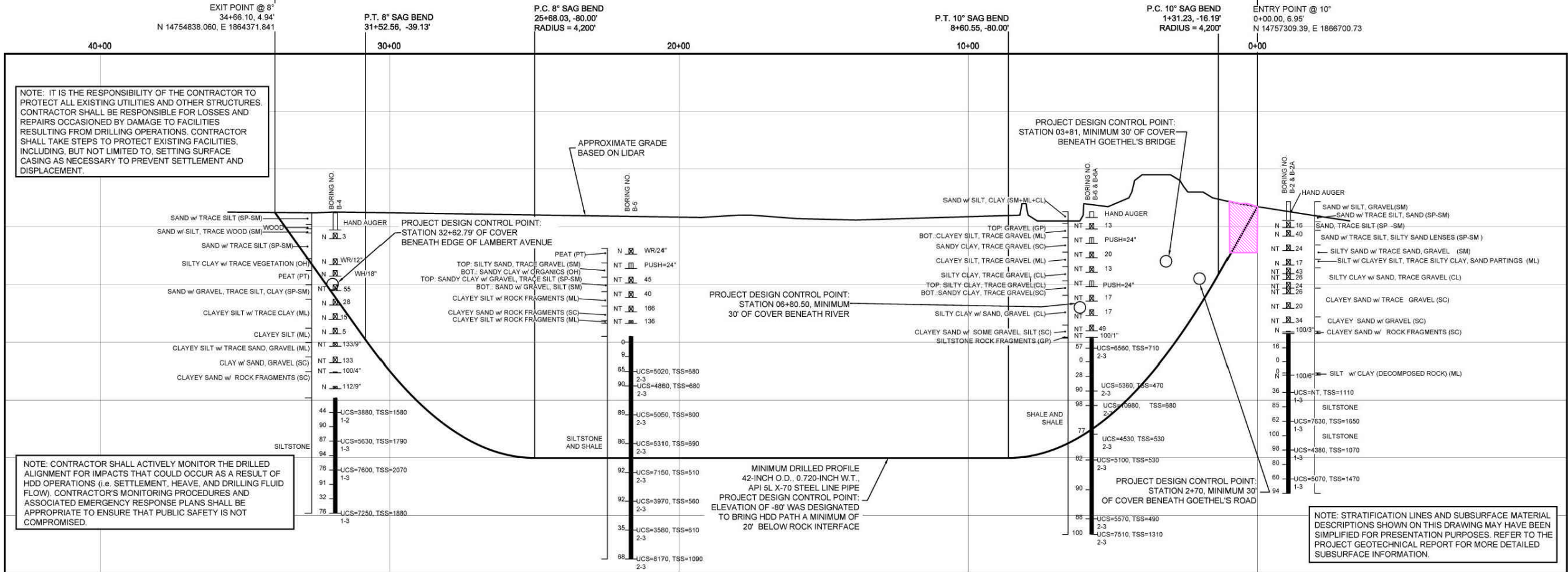
PROTECTION OF UNDERGROUND FACILITIES

CONTRACTOR SHALL UNDERTAKE THE FOLLOWING STEPS PRIOR TO COMMENCING DRILLING OPERATIONS:

- CONTACT THE UTILITY LOCATION/NOTIFICATION SERVICE FOR THE CONSTRUCTION AREA.
- POSITIVELY LOCATE AND STAKE ALL EXISTING UNDERGROUND FACILITIES. ANY FACILITIES LOCATED WITHIN 10 FEET OF THE DESIGNED DRILLED PATH SHALL BE EXPOSED.
- MODIFY DRILLING PRACTICES AND DOWNHOLE ASSEMBLIES AS NECESSARY TO PREVENT DAMAGE TO EXISTING FACILITIES.

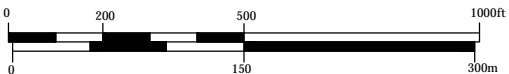
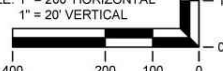
PLAN

SCALE: 1" = 200'



PROFILE

SCALE: 1" = 20' HORIZONTAL
1" = 20' VERTICAL



PRIVILEGED INFORMATION - DO NOT RELEASE

Source/Revision/Issue	Date	Project
		NJ-NY Expansion
		Date
PAL modified	11-01-11	November 2011
Map data received from: Spectra Energy	11-01-11	
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Figure 21		

Archaeological Sensitivity

High

Moderate

Low



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Figure 21. Plan and profile Goethals Bridge HDD, Route Variation 74, showing archaeological sensitivity.

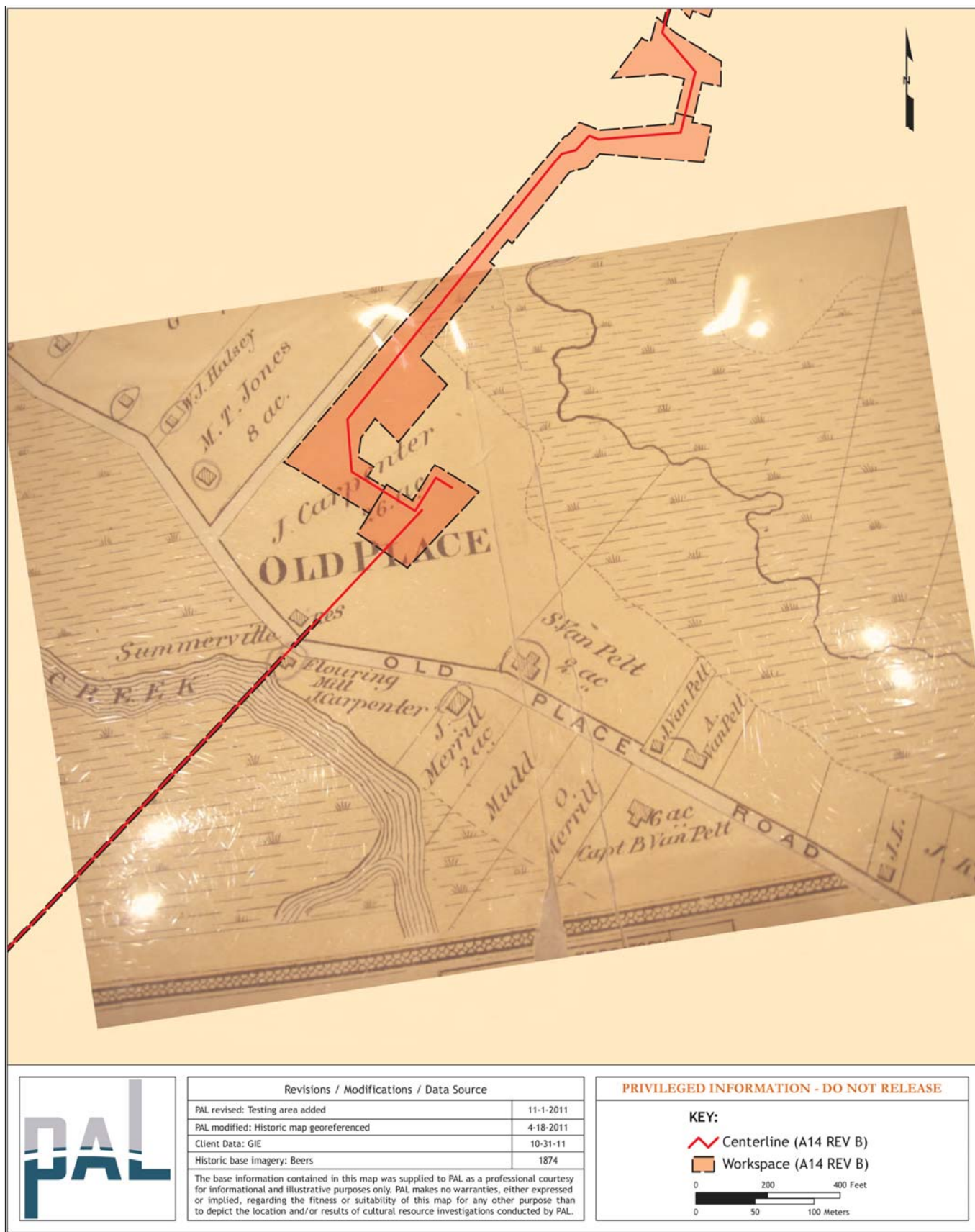
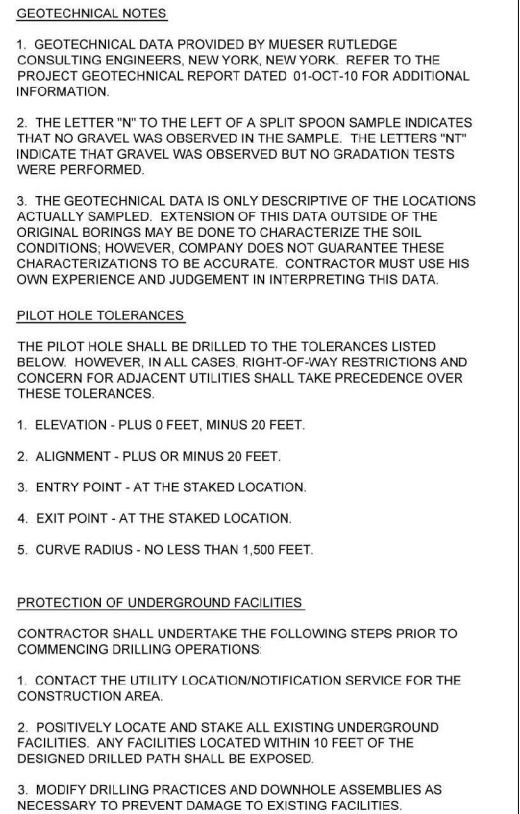
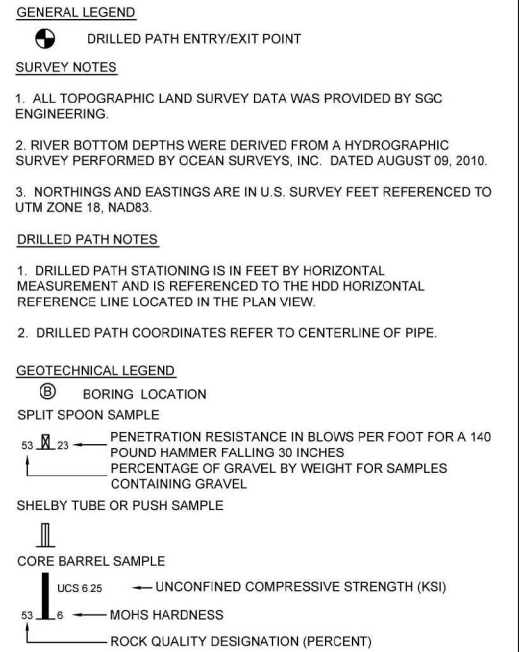





Figure 22. 1874 Beers map with the location of Route Variation 74.

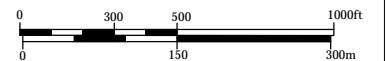


Archaeological Sensitivity

 *High*

 *Moderate*

 *Low*



PRIVILEGED INFORMATION - DO NOT RELEASE

[illegible]

Figure 23. Plan and profile Hudson River HDD, Route Variation 79, showing archaeological sensitivity.