APPENDIX A: SUPPORTING MATERIALS TO PURPOSE AND NEED (SECTION 2.0)

A.1 Structural Inspection Report
A.2 Assessment of Bridge Rehabilitation Needs and Maintenance Costs to Extend the Life of the Existing Bridge for Life Span Comparable to Design Life for Proposed Replacement Bridge
A.3 Goethals Transportation Model (GTM) – Model Development and Travel Demand Forecast Report

Appendix A.1
Structural Inspection Report

TASK B – STRUCTURAL INSPECTION REPORT

FINAL

GOETHALS BRIDGE MODERNIZATION PROGRAM (GBMP)
ENVIRONMENTAL IMPACT STATEMENT (EIS)

The Louis Berger Group, Inc. /Parsons Brinckerhoff JV

July 28, 2004

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Task B – Structural Inspection Report

1.0 Structural Data

The Goethals Bridge was constructed from 1926 to 1928, and carries Route I-278 over the Arthur Kill between Elizabeth, New Jersey, and Staten Island, New York. The structure currently carries two lanes of traffic in each direction and each lane is approximately 10 feet wide. In the early 1970s a 2-foot wide concrete median barrier was installed between the eastbound and westbound roadways for the full length of the bridge. There are no shoulders on the structure, and the total length of the Goethals Bridge is 7,413 feet or 1.40 miles.

The main crossing over the Arthur Kill is comprised of a three-span, continuous, through truss superstructure that has a total length of 1,152 feet. The navigation channel below the main continuous spans has a width of approximately 350 feet, and the vertical clearance above mean high water measures about 135 feet. The continuous main spans consist of two anchor spans that are each 240 feet in length; two cantilever arms that are each 168 feet in length; and a center suspended span that measures 336 feet. The truss floor system that supports the 9 ½" thick concrete deck slab consists of built-up steel floorbeams spaced 40 feet apart in the anchor spans, and spaced 42 feet apart in the cantilever arms and the suspended span. Each floorbeam spans a distance of 47 feet between the center of the truss chords. Thirteen simply supported, rolled steel stringers span between the floorbeams, with two stringers supporting each sidewalk and spanning between the cantilevered extensions of the floorbeams. The north and south sidewalks in the truss spans are 5 feet wide, but pedestrian traffic has been prohibited on the bridge for about 5 years due to the deteriorated condition of the sidewalk slabs.

The New York, or east, approach spans range in length from 57 feet to 112 feet each, and their cumulative length measures 3,126 feet across a total of 37 spans. The New Jersey, or west, approach spans range in length from 50 feet to 115.5 feet each, and their cumulative length measures 2,831 feet across a total of 35 spans. The superstructure framing in most approach spans consists of two simply supported, built-up deck girders with built-up floorbeams that have a cantilevered segment at each fascia. The floorbeams span a distance of 32 feet between the deck girders, and are spaced between 14'-9" and 20'-0" apart. The width of the approach sidewalks was reduced to 3'-4" in the mid-1960s when a 1'-6" high reinforced concrete barrier curb was installed 9" behind the existing curb on all approach spans.

The New Jersey approach span framing is noticeably different in Span 28W, which carries the westbound roadway over Conrail. Here the superstructure consists of two simply supported, built-up through girders with built-up floorbeams that span 47 feet between the through girders, and which are spaced approximately 5'-4" apart. The original gunite encasement has been removed from all steel members in this span, but still covers the superstructure steel beneath the eastbound and westbound roadways in New Jersey Approach Spans 17W, 18W and 19W where railroad tracks were planned to be built at the time the Goethals Bridge was being constructed.

The superstructure framing is also different in the west approach spans over the New Jersey Turnpike (Span 29W through Span 35W) where modifications were made in the late 1960s to accommodate the widening of the Turnpike below, and a separate eastbound approach ramp was

constructed to merge into the original west approach structure. This required the construction of new piers, the erection of new longitudinal fascia girders and the installation of new cross girders to connect to the original framing. The new eastbound superstructure in New Jersey Approach Spans 120W through 125W consists of welded I-deck girders with rolled floorbeams, while in Spans 126W through 135W the new framing consists of either four or five simply supported rolled stringers. In addition, pin and hanger assemblies are found in the original west approach spans that carry the westbound roadway over the Turnpike.

Hollow abutments are located at the east and west ends of the Goethals Bridge. The New York hollow abutment consists of six stringer spans with a total length of 126 feet, while the New Jersey hollow abutment has 19 deck spans (no stringers) with a total length of 178 feet.

Eastbound On-Ramp No. 6 is located to the west of the New Jersey hollow abutment and has an overall length of 117'-0" and an overall width of 34'-4". The structure was built in 1966 and carries eastbound Route I-278 over westbound Route I-278. The bridge has a two-span, continuously supported, composite steel superstructure with five cover plated, rolled steel stringers in each span and full height abutments at each approach.

Eastbound On-Ramp No. 7 is located adjacent to On-Ramp No. 6, and was also intended to carry eastbound Route I-278 over westbound Route I-278, but the structure is not in use and has been abandoned. The bridge was built in 1966 and has an overall length of 154 feet and an overall width of 28 feet. Eastbound On-Ramp No. 7 has a two-span, continuously supported, composite steel superstructure with four cover plated, rolled steel stringers in each span. The substructure consists of a full height south abutment and two piers, but there is no north abutment because construction of the bridge was never completed.

2.0 Inspection Procedures

The structural verification inspection of the Goethals Bridge and its approach structures was conducted as part of the Goethals Bridge Modernization Program Environmental Impact Statement (EIS) in order to determine the overall structural integrity of the bridge.[1] The inspection was performed from May 17, 2004, through May 26, 2004, by a single team of two licensed professional engineers, with the assistance of a third structural engineer during the second week. The inspection was not a hands-on inspection, but a visual inspection effort to observe the general condition of the structure and to verify the existence of previously noted defects, as described in the *2002 Biennial Inspection Report* by Lichtenstein Consulting Engineers (December 2, 2002). The inspectors updated the detailed Deficiency Plans from the previous report during the current inspection by noting those defects that were still observed, as well as any new defects that were encountered. Close access was provided to most of the areas being inspected, but a hands-on evaluation of every structural element was not conducted. The inspection was focused primarily on assessing the overall structural condition of the bridge and observing whether previously noted deterioration is still ongoing; the inspection was not intended to be a substitute for the detailed biennial inspection that typically requires four to five months to complete. The inspection and evaluation of the structure conformed to generally recognized and established principles, standards, and procedures within reasonable limits of time and cost. However, confirmation cannot be given that all latent or other defects were or could have been disclosed in the course of this two-week inspection.

The fieldwork began on Monday May 17, 2004, with the inspection of the top of deck areas in the New York approach spans from Pier D to Pier 37E with visual observations being made of the existing asphalt wearing surface, concrete median barrier, deck joints, drainage systems, sidewalks and parapets. The top of deck inspections were performed from the sidewalk areas with no interference to traffic or the need to close a lane. Inspection of the below deck areas in the New York approach spans was then conducted from an extensive timber work platform that had recently been installed by contractors as part of an ongoing rehabilitation contract. The timber platform extends the full width of the structure and hangs about 1 foot below the bottom flange of the two main girders, thus eliminating the need for any special equipment, and providing close access to the underside of deck slab and deck joints. Superstructure elements such as the girders, floorbeams and stringers were also inspected from the platform, and this included the cantilevered areas beneath the north and south sidewalks, as well as the interior areas between the two main girders. Access to the platform was made by way of a ladder at Pier 35E or an enclosed stairway at Pier 25E. Underdeck areas could not be inspected from Pier 35E to Pier 37E beneath the New York approach spans because the contractor had installed timber shielding between the stringer bottom flanges in these areas. Therefore, the contractor's operations in the last two spans made them inaccessible for field verification of the previously noted defects at the time of the inspection.

Inspection of the New York approach spans was completed on Wednesday May 19, 2004 and the interior of the New Jersey hollow abutment was then inspected beneath the west approach

[1] The Goethals Bridge's structural integrity was not specifically evaluated during the preparation of the previous EIS prepared for the Staten Island Bridges Program – Modernization and Capacity Enhancement Project EIS (1997).

roadway. The full length of the abutment interior was inspected from Pier 35W to Pier 56W to evaluate the existing condition of the concrete roof slab, concrete cap beams, side walls and piers. Eastbound On-Ramp No. 6 and Eastbound On-Ramp No. 7 were then inspected a short distance west of the New Jersey hollow abutment. Inspection of these structures verified the previously noted defects, including the top of deck and approach roadway features, and also the below deck superstructure and substructure elements.

The underside of the deck slab and the superstructure members in the main truss spans of the Goethals Bridge were inspected from Pier A to Pier D on Thursday May 20, 2004 and Friday May 21, 2004. The inspection of the cantilevered and interior underdeck areas was made possible by a wire fence platform that had been installed a couple of years earlier by the contractor who had repainted the main spans over the waterway. The wire fence platform extends the full width of the structure and hangs about 1 foot below the underside of the truss bottom chords, thus allowing the inspectors close access to the underside of the deck slab and superstructure steel. The platform was reached by existing ladders that extend down from hatches in the bridge sidewalks, so no special equipment was required to complete the inspection. The stringers, floorbeams, diaphragms, cross bracing, and truss bottom chords were inspected from the wire fence platform, as well as the underside of deck slab and joint areas. Inspection of the top of deck components in the main spans from Pier A to Pier D was performed from the north and south sidewalks on Thursday May 20, 2004. Inspection of these areas included verification of previously noted defects related to the existing asphalt wearing surface, concrete median barrier, deck joints, drainage systems, sidewalks and parapets. The above deck truss superstructure elements were inspected on Friday, May 21, 2004 from the north and south sidewalks using binoculars to assess the condition of the members in the main spans from Pier A to Pier D. The inspectors did not walk along the top chord above the roadway since previously noted defects in this area were not considered to be of a serious nature, although the upper part of the truss was accessed on occasion by climbing up a ladder at one of the pier towers.

Inspection of the top of deck areas in the New Jersey approach spans was performed from the north and south sidewalks on Thursday, May 20, 2004 and Friday, May 21, 2004 from Pier A to Pier 35W in the westbound roadway, and from Pier A to Pier 135W in the eastbound roadway. Observations were made to verify the condition of the existing asphalt wearing surface, concrete median barrier, deck joints, drainage systems, sidewalks and parapets. These top of deck inspections in the eastbound and westbound roadways were performed from the sidewalk areas during daylight hours, as opposed to working at night in the contractor's double westbound lane closure to verify the top of deck deficiencies in the westbound roadway. A catwalk system located beneath the westbound roadway of the New Jersey approach spans was used to inspect the superstructure steel between the two main girders from Pier A to Pier 28W on Friday, May 21, 2004. The catwalk was reached by climbing down a ladder from a hatch in the north sidewalk at Pier A.

The underside of the north and south cantilevered portions of the New Jersey approach spans were inspected from an underbridge inspection vehicle (UB60) using the contractor's nightly closure of the entire westbound roadway on the Goethals Bridge. Defects concerning the superstructure steel and the underside of the deck slab were verified beneath the north and south sidewalks during the night of Monday, May 24 and the early morning of Tuesday, May 25, 2004

from Pier A to Pier 27W using the UB60. Traffic protection in the form of a truck-mounted attenuator (TMA) was not required due to the contractor's complete closure of the westbound roadway.

Underdeck areas of the New Jersey approach spans were inspected from Pier 28W to the New Jersey hollow abutment on Wednesday, May 26, 2004 by closing the shoulders along the NJ Turnpike with a truck-mounted attenuator (TMA), cones and signing. Previously noted defects in the underside of the deck slab and the superstructure steel were verified beneath the eastbound and westbound approach spans over the toll road during this time. The underside of the deck slab was then inspected between the two main girders in the New Jersey approach spans from Pier A to Pier 28W from the existing catwalk that had been used to inspect the superstructure steel in the same area on Friday, May 21, 2004. The New York hollow abutment was inspected beneath the east approach roadway on Wednesday, May 26, 2004 from Pier 37E to Pier 42E. The structural elements that were inspected in the abutment interior included the concrete roof slab, concrete cap beams, side walls and piers.

3.0 Summary of Existing Conditions

The following summarizes the existing condition of the various structural elements that comprise the Goethals Bridge Main Spans, the New York Approach Spans, the New Jersey Approach Spans, the New York and New Jersey Hollow Abutments, Eastbound On-Ramp No. 6, and Eastbound On-Ramp No. 7. Areas of particular concern are highlighted in each of the bridge units listed above, as well as any new defect or finding that was encountered during the verification inspection. Deficiencies that were mentioned in previous reports and which were found to still be present during the current inspection are also noted.

3.1 Goethals Bridge Main Spans

The main spans of the Goethals Bridge from Pier A to Pier D are considered to be in satisfactory condition, although the overall evaluation given in the previous two biennial inspection reports of 2000 and 2002 considered the main spans to be in fair condition. In general, the condition of the paint system for the main span structural elements has significantly improved since the previous inspections since the entire superstructure was repainted in 2002, and there is now much less active corrosion than was noted in the earlier reports. Rusting of the stringer or diaphragm top flanges with associated section loss continues to occur at random locations, however, but is now most noticeable at areas where water leakage through the deck has also resulted in spalls on the underside of the concrete slab (Photo 16). A lattice bar on the underside of the north bottom chord exhibits a 2” x 4” hole that was not mentioned in earlier reports (Photo 19), and three rivets are missing at the connection of a truss diagonal to a gusset plate along the north edge of the south bottom chord near Panel Point L4’ (Photo 21). Previous pitting and minor section loss are still found at several random members, particularly on the inner gusset plates at the connection of the floorbeams to the truss bottom chords where up to 40% loss is noted to the rivet heads and 1/8” loss is found on the plates (Photo 23). At some of these areas of previous heavy corrosion the deteriorated rivets have been replaced with bolts (Photo 22).

A common defect that is noted at several cantilevered floorbeam members involves the development of holes in the floorbeam top flanges beneath the edge of the deck slab overhang where water has apparently been dripping onto the steelwork over the course of many years (Photo 20). Pack rust is typically observed between the top flanges of the stringers and floorbeams and the underside of the deck slab, and a gap is often found between the top flanges of the sidewalk stringers and the underside of the sidewalk slab beneath the north and south cantilevers. Previously noted missing sections of the bottom rail along the top chord safety railing were not observed during the inspection and appear to have been replaced. The cracked intermittent fillet welds that were previously observed between the bearing plate and the I-beam of the dummy chords at Panel Point U10’ in the north and south trusses could not be verified during this inspection. However, this defect is not considered to be a critical concern even if it does still exist, since the dummy chord is not a primary load carrying member for the structure.

The asphalt wearing surface is in fair to poor condition throughout the main spans, and the underside of the deck slab between the truss chords exhibits random areas of spalled and fractured concrete, but to a lesser extent than what is observed in the approach spans. The sidewalk slabs along the north and south sides of the bridge are in poor condition and remain

closed to pedestrians due to extensive concrete deterioration (Photo 12). Large areas of the undersides of the sidewalk slabs, however, were observed to be covered by timber formwork/shielding beneath the north and south cantilevers at the time of this inspection, as part of an ongoing rehabilitation contract. Timber shoring was also installed along the sidewalks by a previous painting contract to support the workers and their equipment, and was left in place until the sidewalk slabs could be replaced/reconstructed by ongoing rehabilitation contract AKG-274.094. There is a 6" diameter hole through the south sidewalk slab on the east side of Panel Point L10 that was not previously noted (Photo 5), and most bridge scuppers and drainage downspouts remain clogged. The south parapet exhibits increased deterioration with exposed rebar, severe spalling, and extensive concrete disintegration noted at two locations (Photo 6). The previously noted vertical misalignment of the finger joints at Panel Points L10 and L10' appear to have been repaired, although misalignment is still noted along the finger joint at Panel Point L0'. A steel plate has been installed over the joint at Panel Point L0 in an attempt to correct the same deficiency there. Several missing rivets continue to be observed along the underside of the finger joints at Panel Points L0, L10 and L10' where the deck joint armor is connected to the floorbeam top flange (Photo 9).

3.2 New York Approach Spans

The New York approach spans from Pier D to Pier 37E are considered to be in overall good condition, and this evaluation remains unchanged from the previous two biennial inspection reports of 2000 and 2002. In general, no significant changes were noted in the condition of the superstructure elements throughout the New York approach spans during the current inspection. The superstructure steel was last painted in September 2000 and shows only a few areas of significant active corrosion. Previous metal loss to the steel members is most noticeable along the top flanges of the cantilevered sections of the end floorbeams where holes up to 4" x 5" have typically formed beneath the edge of the concrete deck slab overhangs from long-term water seepage beneath the north and south sidewalks at deck joint locations (Photo 17). This problem is currently being corrected by an ongoing rehabilitation contract that is replacing all cantilevered floorbeam members at deck joint locations beneath both sidewalks (Photo 18). Minor section loss from previous corrosion is also still found between the two main girders of the New York approach spans along the floorbeam top flanges at several deck joint locations. Active corrosion of the steel members, however, is generally limited to the top flanges of median Stringer S5 where light to moderate rust is noted in most spans, apparently due to water leakage from an assumed longitudinal construction joint located beneath the median barrier along the centerline of the bridge. At a few areas, such as in Span 8E, minor section loss is beginning to develop along the top flange and web areas of Stringer S5, and also along the top flanges of the adjacent floorbeams due to this continuing problem.

The asphalt wearing surface is in fair to poor condition due to an uneven riding surface that has resulted from continual bituminous patching which tends to deteriorate and form shallow potholes over time (Photos 1 and 3). The underside of deck slab exhibits several areas of spalled and fractured concrete between the truss chords, often with exposed rebar. Areas of delaminated concrete and locations with fine transverse cracks and moisture contamination are also observed to a lesser extent (Photo 10). The majority of the existing underdeck deterioration, including the heavily deteriorated areas along the undersides of the sidewalk slabs, will be repaired by an

ongoing rehabilitation contract that was performing localized deck slab reconstruction at the time of this inspection (Photo 11). Presently, the sidewalk slabs along the north and south sides of the bridge are closed to pedestrians, and remain in poor condition with several holed-through areas still covered over with large steel plates. A few of the bridge scuppers and drainage downspouts are clogged or partially clogged, and occasional spalls with exposed rebar are noted along the concrete median barrier that separates the eastbound and westbound roadways (Photo 1). The base of the steel parapet section was found to be severely corroded on the north side of Span 27E (Photo 4). During the inspection, water was observed to be leaking from a water main stand pipe on the south sidewalk at Pier 4E, and the Port Authority maintenance department was notified of the defect on May 18, 2004.

The deck joints in the New York approach spans are in poor condition and remain a continual maintenance problem. Up to 1" of vertical misalignment is noted along the finger joints at Piers 4E, 8E, 12E, 16E, 20E, 24E, 30E and 35E (Photo 3). In the westbound roadway, some of these deck joints were in the process of being removed and reconstructed at the time of the inspection (Photo 2). The ends of the concrete deck slabs along the joint areas are often deteriorated due to joint leakage, and exhibit large spalls with exposed rebar (Photo 7). A 2-foot length of joint armor had broken off near the north end of the compression seal deck joint at Pier 11E, leaving sharp metal edges exposed at either end (Photo 8). The Port Authority maintenance department was notified that a loose piece of deck joint armor was heard to make a loud noise when traffic passed over it near the south curb at Pier 8E on May 18, 2004**.**

3.3 New Jersey Approach Spans

The New Jersey approach spans from Pier A to Pier 35W in the westbound roadway, and from Pier A to Pier 135W in the eastbound roadway are considered to be in overall good condition. This evaluation remains unchanged from the previous two biennial inspection reports of 2000 and 2002, since no significant changes were noted in the condition of the superstructure elements during the current inspection. The superstructure steel was last painted in September 2000 and shows only a few areas of significant active corrosion. As was noted for the New York approach spans, active corrosion of the steel members is generally limited to the top flanges of median Stringer S5 and adjacent floorbeam top flanges where light to moderate rust is noted in most spans, apparently due to water leakage from an assumed longitudinal construction joint located beneath the median barrier along the centerline of the bridge (Photo 26). Metal loss in the steel members is most frequently observed along the top flanges or web areas of the cantilevered sections of the end floorbeams where holes have occasionally formed beneath the edge of the concrete deck slab overhangs from long-term water seepage beneath the north and south sidewalks at deck joint locations (Photo 25). The largest hole that was found in a floorbeam top flange measured 3" x 9" at Pier 2W in the north cantilevered section near Stringer S8. This problem is scheduled to be corrected by an ongoing rehabilitation contract that is replacing all cantilevered floorbeam members at deck joint locations beneath both sidewalks in the New York approach spans at the time of the inspection (Photo 18).

Minor section loss from previous corrosion still exists along the floorbeam top flanges between the two main girders at several deck joint locations in the New Jersey approach spans. As noted in other areas of the bridge, pack rust is observed at random locations between the top flanges of

the stringers and floorbeams and the underside of the deck slab. Occasionally a gap is also found between the top flanges of the stringers, floorbeams or girders and the underside of the concrete slab between these areas of pack rust. Sidewalk bracing angles are missing at a few locations along the north and south cantilevered areas in the original portion of the New Jersey approach spans (Photo 24), and small spalls are noted in the grout pads beneath the bearing masonry plates at three piers in the newer eastbound approach spans over the New Jersey Turnpike.

The above-deck areas show similar defects to those found in the New York approach spans, such as a deteriorated and uneven asphalt wearing surface due to the periodic repatching of potholes. Spalled and delaminated areas are observed across the top surface of the north and south sidewalk slabs, with large steel plates still covering the worst areas of concrete deterioration and holed-through locations in several spans. At Pier 11W, a large hole in the south sidewalk slab is allowing water leakage to corrode the superstructure steel below (Photo 13). The current inspection found a noticeable increase in the number of clogged or partially clogged drainage scuppers throughout the New Jersey approach spans when compared with the number shown in the previous biennial inspection report. In addition, the concrete median barrier was found to show greater levels of deterioration than was found in the New York approach spans, including areas of medium to wide longitudinal cracks, missing and/or loose anchor bolts, and areas of spalled and delaminated concrete. The amount of spalls with exposed rebar that were found on the underside of deck slab beneath the New Jersey approach spans is considered to be a slightly greater quantity than was observed in other areas of the bridge (Photo 14). However, it appears that the rebar is exposed at several of these locations due to a lack of sufficient rebar cover, and not due to moisture contamination and concrete deterioration (Photo 15). The finger joints continue to exhibit up to 1” of vertical misalignment at Piers 25W, 29W and 35W in the westbound roadway, and at Pier 128W in the eastbound roadway. Similar defects are noted in both roadways at Piers 4W, 8W, and 21W, but steel plates have been installed over the joints at Piers 12W and 16W in an attempt to correct the same deficiencies there.

Notable substructure defects beneath the New Jersey approach spans include a large spalled area with exposed rebar along the east side of the base of Pier 29W (Photo 27), and a large spall with exposed rebar in the bearing pedestal beneath the south through girder at Pier 28W (Photo 28). These areas of deteriorated substructure concrete both occur beneath the westbound roadway in the original portion of the approach spans.

3.4 New York and New Jersey Hollow Abutments

The New York hollow abutment is considered to be in overall good condition from Pier 37E to Pier 43E beneath the east approach roadway. However, a few spalled areas with exposed rebar were observed on the underside of the roof slab near the south side wall between Piers 38E and 40E. Active water leakage, which was previously mentioned in the 2002 biennial inspection report, was not noted in this area but fiber board filler material was found to be protruding from the centerline longitudinal joint in the roof slab between Piers 40E and 41E. Water leakage and rust stains were noted during the inspection, extending down the north side of a concrete beam near the north side wall just west of Pier 41E (Photo 30).

The New Jersey hollow abutment is also considered to be in overall good condition beneath the west approach roadway from Pier 35W to Pier 56W, although more spalls with exposed rebar were noted on the pier columns, cap beams and underside of roof slab. These areas of concrete deterioration were found predominately near the south side wall from Pier 50W to 54W, although exposed rebar was also noted at a few other random locations in the cellular abutment. Medium longitudinal cracks with rust stains were observed on the underside of the cap beam near the north end of Pier 41W, and water leakage with moderate to heavy efflorescence was noted in the longitudinal joint of the roof slab between Piers 45W and 46W (Photo 29).

3.5 Eastbound On-Ramp No. 6

The on-ramp structure is considered to be in overall good condition, and this evaluation remains unchanged from the previous two biennial inspection reports of 2000 and 2002. The most notable defect observed during the course of this inspection involved two areas of spalled and delaminated concrete near the west end of the south abutment breastwall that totaled about 10 SF. Most of the previously noted defects still remain, and the majority of these are considered to be minor in nature, such as missing access covers at the base of four light standards, settlement of the approach curb and safetywalk, spalling of the safetywalk at isolated locations, a broken light fixture at the south abutment and random areas of light rust on the SIP formwork. Previously noted minor collision scrape marks on the stringer bottom flanges and a missing portion of the underdeck SIP formwork were not observed during the inspection, which indicates that repairs may have been performed or the defects were very minor. No new defects of a significant nature were reported during the inspection.

3.6 Eastbound On-Ramp No. 7

This on-ramp structure is also considered to be in overall good condition, with no significant changes noted from the previous biennial inspection report of 2002. All previously noted defects were found to still exist, and no new deficiencies were observed that could be considered significant. Existing defects include wide cracks in the asphalt wearing surface on the top of deck and south approach, a spall with exposed rebar near the east end of the north pier cap, and missing access covers at the base of two light standards. The bridge was never open to traffic and carries no live load because an adjacent structure (On-Ramp No. 8) was not constructed.

4.0 Bridge Repair History

A review of the past repair contracts and the anticipated repair contracts pertaining to the Goethals Bridge and its facilities during the time period from 1987 to 2005, as revealed by data supplied by the Port Authority of New York and New Jersey, indicates that a total of $120,965,998 will have been spent, or approximating $6.7 million per year. However, a substantial portion of the total $121 million (about $93 million) has been spent just since 2001 to repaint the entire structure, replace the existing sidewalks, and perform miscellaneous structural and deck repairs.

Contract Number	Contract Title	Award Date	Award Price
AKG-165	Rigid Pavement Repairs	Oct-87	$69,932
AKG-110.025	Landscape Installation in Concrete Planters at the old Toll Plaza	May-88	$140,000
AKG-110.026	Toll Plaza Westbound Canopy Ceiling Replacement	Jun-91	$317,938
AKG-180	Repr of Mod lateral brace &Mortar pads/paint stl	Sep-91	$190,000
AKG-166	NY Appr So Sidewalk Rehab	Mar-92	$522,000
AKG-110.027	Paving and Title Wetlands Restoration and Enhancement	Jun-92	$57,107
AKG-181A	Rehabilitation of Main Span Piers A Through D and the Piers to the NJ Turnpike Ramp	Sep-92	$284,920
AKG-186	Eastbound Paving	Sep-92	$350,000
AKG-197	Engineering Inspection Beneath the Median Barrier	Apr-93	$87,000
AKG-274.022	NY&NJ Viaducts Lead Based Paint Removal and Repainting	May-93	$12,291,000
AKG-191	Rehab of Sign Structures and Light Structures	Aug-93	$134,000
AKG-196	Replace CLF under NY Approach	May-94	$79,445
AKG-110.031	Toll Plaza Pavement Rehabilitation	Aug-94	$2,520,101
AKG-274.011	Pin and Hangar Redundant Support System	Oct-95	$196,630
AKG-274.006	Deck and Steel Rehabilitation at Median Barrier	Dec-95	$2,896,170
AKG-190	Rehab of Hollow Abutments on the Approach Spans	Mar-96	$845,300
AKG-994.901 (WO#5)	Miscellaneous Priority Repairs	Sep-96	$736,000
AKG-212	Sidewalk Repairs	Apr-97	$500,000
AKG-274.063	NY Toll Plaza Slab Replacement and Waterline Installation	Jun-97	$1,978,000
AKG-213	Replacement of Toll Booth Door Assemblies	Jul-97	$169,000
AKG-214	Miscellaneous Concrete Repairs to the Maintenance and Administration Buildings	Sep-97	$119,000
AKG-220	Repaving Westbound NJ Ramps and NY Approach Roadway	Nov-97	$834,810
AKG-227	Microsurfacing of the Goethals Bridge	Aug-98	$647,500
AKG-221	Rehabilitation of Eastbound New Jersey Approach Roadway	Sep-98	$798,286
AKG-211A	Modifications to the New York Abutment Garage	Apr-99	$167,200
AKG-229	Westbound New York Approach Roadway Resurfacing	Jun-99	$122,125
AKG-218	Structural Repairs of Pier D	Oct-99	$1,006,260
AK-154	Maintenance Pavement Repairs Via Work Order	May-00	$100,000
AKG-235	Wetland and Mitigation planting and Maintenance at Pier D	May-01	$239,000

Contract Number	Contract Title	Award Date	Award Price
AKG-274.068	Removal of Lead Based Paint and Repainting Truss Span and Structural Steel Rehabilitation	Jun-01	$18,425,000
AK-155	Rehabilitation of Bridge Lighting Systems, CCTV Feeders and Miscellaneous Structures (Goethals portion)	Sep-01	$10,000,000
AKG-184	Rehabilitation of Span 28 on the NJ Approach Span	Apr-04	$175,000
AKG-274.094	Rehabilitation of Deck, Structural Steel and Replacement of Sidewalk	Jul-04	$63,212,000
AK-162	Maintenance Pavement Repairs Via Work Order	Oct-04	$200,000
AKG-172	Repairs and Waterproofing of Piers Repair of Mortar Pad and Replacement of Sidewalk Hatch Covers	Jun-05	$555,274

Based on these data, it is apparent that repair costs associated with the Goethals Bridge can be expected to continue to increase in future years, in spite of the work that is being performed under the current major rehabilitation contract. The design life for the current rehabilitation contract is only 7 to 10 years, after which time additional repair contracts will most likely be needed to maintain the structure at the same level of service.

In addition, the Port Authority has indicated that in 2003, 15 deck joint failures at the Goethals Bridge required emergency repairs, although no costs were provided for this work. Interim repairs were also performed at several other joints last year, following a condition assessment performed by a consultant, and these repairs consisted of the removal of part of the joint and the installation of steel plates flush with the roadway riding surface. Eventually all these repaired joints will be replaced under major rehabilitation Contract AKG-274.094.

The contracts listed above reflect close to a 20-year cycle of work that has been performed on the Goethals Bridge and associated facilities. Similar type contracts will continue to be required every 20 to 25 years. In addition, in accordance with the 1997 Deck Condition Assessment, interim deck repair contracts will be required ranging from $10 to $15 million until a complete deck replacement is performed. The *Goethals Bridge Replacement Study for Roadway and Sidewalk Slabs* from March 2002 stated that complete deck replacement could cost as much as $226 million.

5.0 Conclusions and Recommendations

This section discusses future repair needs and recommendations related to improving the existing condition of the various structural elements that comprise the Goethals Bridge Main Spans, the New York Approach Spans, the New Jersey Approach Spans, the New York and New Jersey Hollow Abutments, Eastbound On-Ramp No. 6, and Eastbound On-Ramp No. 7. In general, the structures evaluated during this inspection remain in overall good to satisfactory condition, and exhibited no defects or deficiencies that were considered to be of a serious nature requiring priority repairs. The generally good condition of the structures can be attributed in large part to the extensive maintenance work and ongoing construction contracts that have been performed over the past 20 to 30 years by the Port Authority to enable this important crossing to continue to function in the capacity for which it was intended.

As part of the field verification/inspection undertaken for the Goethals Bridge Modernization Program EIS, the inspection team found that the previous defects noted on bridge sketches and framing plans from the 2002 *In-depth Inspection Report* that depicted the locations and type of defects still existed during this inspection. These bridge sketches and framing plans have been marked up and are included in Appendix B of this report with clouds confirming that the defect still exists and with boxes around new deficiencies noted during the inspection. The overall structural condition is unchanged since the 2002 *In-depth Inspection Report*, with the exception that many of the recommended repair and defect items shown in that report will be repaired under Contract AKG-274.094, which is presently being performed.

Contract AKG-274.094 is a major rehabilitation and repair contract with a contract value of $63 million dollars. The work involves the extensive repair of spalled, delaminated and cracked areas of concrete in the deck slab, median barrier and curbs. A waterproofing membrane and new asphalt overlay will be applied across the entire top of deck after the existing bituminous wearing surface is removed and the original drainage scuppers are replaced. The existing granite curb and concrete curb wall will be removed from along both sides of all spans and replaced with a New Jersey-style bridge parapet with metal bridge railing. The existing north and south sidewalk slabs are being removed and reconstructed in all spans in order to re-open both sidewalks to pedestrian traffic. This contract will also remove the existing finger joints at Piers A, D, 4E, 4W and 8E and replace them in kind. Existing finger joints are scheduled to be removed and replaced with new strip seal deck joints at Piers 8W, 12W, 16W, 21W, 25W, 29W, 36W, 12E, 16E, 20E, 24E, 30E, 35E, 128 and 136 in the approach spans, and similar deck joint replacement will be performed at Panel Points L10 and L10’ in the main spans.

Extensive superstructure repairs will also be completed by this contract, including complete replacement of the north and south cantilevered floorbeam brackets at all deck joint locations, and replacement of top flange angles and rivets at numerous floorbeam locations between the deck joints. Floorbeam top and bottom flange areas will be replaced or strengthened between the two main girders at several piers, and missing cross bracing angles will be replaced beneath the sidewalk slabs. Existing channel diaphragms will be replaced in kind beneath the sidewalks in Spans 1E through 37E, and stringer repairs will be made at numerous locations. Areas of impact rust will be cleaned and repainted, and deteriorated rivets will be replaced throughout the structure. Superstructure repairs will also be made to the truss members in the main spans,

including the replacement of deteriorated lacing bars. In addition, repairs planned at both hollow abutments are expected to correct all previously noted deficiencies there, as well.

The extensive repairs currently being performed under Contract AKG-274.094 are interim repairs that are expected to extend the life of the structure another 7 to 10 years. While it may be feasible to re-open the bridge walkway to pedestrians following the completion of repairs, safety/security issues may preclude reopening the sidewalks or, at minimum, implementation of safety-security-related modifications at additional cost. In 7 to 10 years, a complete deck replacement with seismic retrofit will most likely be required to keep the bridge in service. The concrete deck slab is presently considered to be in fair to poor condition for both the approach spans and the main spans of the structure. This does not take into account the asphalt riding surface, which is in fair to poor condition, and the random joints throughout the structure that are in poor condition. Again, full depth and partial depth spall repairs are to be performed under Contract AKG-274.094 and the deck will be resurfaced with a new asphalt riding surface and numerous deck joints will be replaced/reconstructed. However, based on the history and age of the existing deck slab, continuing repairs will be needed to maintain traffic and a new deck slab will be needed in the near future. In addition, various superstructure and substructure maintenance repairs, such as repainting and replacement of the median stringers, may also be required at that time.

The *Goethals Bridge Deck Condition Assessment* produced by the Port Authority of NY & NJ Engineering Department in March 1997 found the overall condition of the concrete deck to be fair, based on field observations and material testing. The assessment also found the overall condition of the deck support members to be fair to good, and the only severe deficiency that was noted involved water leakage through the transverse deck joints that are located over the floorbeams at 40-foot intervals, and water leakage through the longitudinal deck joint along the bridge centerline. However, the following moderate deficiencies related to the deck were also noted in the report:

- Deterioration of the concrete deck and steel support members were observed in the vicinity of the transverse and longitudinal deck joints due to water leakage through the joints.
- A high chloride content of more than 1.3 pounds per cubic yard was found in the top 3 to 5 inches of approximately 60 percent of the 9.5" thick concrete deck slab.
- The freeze-thaw resistance of the deck was found to be fair to poor at most locations, which makes the deck very dependant on an effective waterproofing system for protection.
- Cracks and patches were observed in the asphalt overlay, and efflorescence was noted on the underside of the deck slab, along with the presence of moisture immediately after a rainfall.

The 1997 report also listed favorable results of the investigation that included a high concrete compressive strength of 6,400 psi and no signs of active corrosion in the steel rebar. The assessment concluded by recommending that the concrete deck slab on the Goethals Bridge be replaced within the next 10 to 15 years (2007 to 2012), and costs were provided for two deck replacement alternatives. However, these costs were later revised and superceded by a replacement study in 2002. Contract AKG-274.094 is currently underway to perform deck slab repairs and resurfacing in the interim before the time, in 7 to 10 years, when the deck replacement will likely be required.

In addition, a separate *Goethals Bridge Deck Condition Assessment* was performed under Port Authority Maintenance Contract AK-994.901 in November and December of 2002, which found the following similar results as the earlier deck survey:

- 129 chloride samples were taken at 1-inch intervals to a depth of three inches, and 77.5 percent of the samples taken were found to have chloride levels that were above the threshold of probable corrosive activity (1.5 pounds per cubic yard);
- delamination testing found that approximately 25 percent of the exposed concrete deck that was tested showed signs of delaminated and deteriorated concrete; and
- average compressive strength values were again found to be high, and ranged from a minimum average value of 6,832 psi to a maximum average value of 7,812 psi in a total of 29 core samples.

No specific conclusions or recommendations were given with the test results from this 2002 deck condition assessment, which was performed for ongoing major deck rehabilitation Contract AKG-274.094.

A *Goethals Bridge Replacement Study for Roadway and Sidewalk Decks* was produced by the Port Authority of NY & NJ Engineering Department in April 2001 and was re-issued in March 2002. The cost of the deck slab replacement was estimated to vary from between $104 million and $226 million, based on an assessment of six different deck systems, four traffic staging schemes and four deck replacement schemes. The study recommended replacing the deck with the use of Traffic Staging Plan 1A that would involve nightly closures of two lanes, plus an additional lane for three hours. This recommended option would use Precast deck panels or exodermic deck panels and would require between seven and eight years to complete, and cost between $174 million and $226 million. The use of Traffic Staging Plans 2 or 2A that do not require night work would reduce the construction duration to between 4.5 and 5.5 years, and would reduce the total cost to between $125 million and $150 million with the use of cast-in-place concrete. However, full-time day closures of two lanes of traffic on the bridge, as required by Plans 2 or 2A, may not be feasible due to the severe impact that would have on the traveling public for the length of the construction.

In addition to the aging deck slab, one of the most significant detrimental features of this structure that is not being addressed as part of the current contract is the deficient deck geometry of this structure. The existing curb-to-curb width in each direction of traffic is 20 feet for two lanes. There are no shoulders on the structure and the narrow lanes at times require large tractor trailers or trucks to ride down the middle of the roadway instead of staying in their own lane of traffic. This effectively reduces the structure to a single lane of traffic in one direction. Due to the length of the structure (close to 1.5 miles long), the absence of a shoulder is also a safety and operational concern for vehicle breakdowns on the bridge. In addition, the lack of shoulders also leads to increased maintenance and construction costs since premium time is payed for work that is performed at night. The narrow width of roadway with no shoulders classifies the bridge as functionally obsolete.

In conclusion, the Goethals Bridge was built in the late 1920s, and was designed to accommodate lighter volumes of traffic and vehicle weights than it is presently experiencing

today. The traffic demands on this structure have increased substantially over the past 80 years, and are anticipated to further increase in the future, with larger weight vehicles and more traffic volumes. This increase in volume and weight of the vehicles has had a significant effect on the condition of the riding surface, deck slab and deck joints of the structure, and has required extensive maintenance-related expenditures over the past 20 to 30 years. In addition, long-term deterioration from salts and deicing agents at the joint locations and drainage areas have caused the Port Authority to award construction contracts to replace structural steel members and maintain the structure in a safe operational condition.

Keeping in mind the age of the structure, the possible need for seismic retrofit to code, and the functionally obsolete deck geometry of the structure, it is recommended that a detailed life study analysis, which is beyond the scope of this project, be performed in the near future to accurately estimate the costs of maintaining the existing bridge through continual rehabilitation and repair contracts, recognizing that the existing structure would still not satisfy current geometric standards.

6.0 Photographs

8125 May 17, 2004

Photo 1: Deteriorating asphalt patches and shallow potholes are typically found throughout the wearing surface of the eastbound roadway in the New York approach spans, looking northeast at Spans 36E and 37E. Note the spalled areas along the base of the concrete median barrier near Pier 36E.

2766 May 17, 2004

Photo 2: The previous tooth joint has been removed from over Pier 12E in the westbound roadway of the New York approach spans, looking south. Deck joint reconstruction was being performed at several pier locations in the westbound roadway at the time of the inspection.

2759 May 17, 2004

Photo 3: A 3-foot long pothole has formed in the asphalt wearing surface along the west side of the Pier 4E deck joint in the westbound roadway of the New York approach spans, looking south. The finger joint shows a vertical misalignment of up to 1 inch, which is noted at several other piers in the New York and New Jersey approach spans.

2772 May 17, 2004

Photo 4: Large holes are observed at the base of the steel parapet section on the north side of Span 27E in the westbound roadway of the New York approach spans, looking southwest near Pier 27E.

8153 May 20, 2004

Photo 5: The south sidewalk slab exhibits a spalled area with a 6 inch diameter hole on the south side of Stringer S2, just east of Panel Point L10 in the main suspended span of the Goethals Bridge, looking west.

8155 May 20, 2004

Photo 6: The south parapet is severely deteriorated in the main suspended span near Panel Point L11, looking northwest. Note the extensive areas of exposed rebar and crumbling concrete.

8131 May 18, 2004

Photo 7: Large spalls with exposed rebar and severe concrete deterioration are noted beneath the south sidewalk along the compression seal deck joint at Pier 32E in the eastbound roadway of the New York approach spans, looking north.

2765 May 17, 2004

Photo 8: There is a 2-foot length of missing joint armor with sharp edges at either end along the compression seal deck joint near the north end of Pier 11E in the westbound roadway of the New York approach spans, looking south.

2852 May 21, 2004

Photo 9: Five rivets are missing at the connection of the deck joint angle to the top flange of the floorbeam at Panel Point L10' beneath the finger joint that separates the suspended main span from the east cantilever arm, looking up and north between Stringers S4 and S5 below the eastbound roadway.

2793 May 18, 2004

Photo 10: The underside of deck slab exhibits fine transverse cracks with efflorescence and moisture contamination between Stringers S5 and S6 on the west side of Pier 2E in the New York approach spans, looking east. This defect is observed at random locations throughout the bridge.

2802 May 19, 2004

Photo 11: Large underdeck spalls with exposed rebar are marked for repair by the ongoing rehabilitation contract on either side of Stringer S7 near Pier 22E beneath the eastbound roadway of the New York approach spans, looking west.

2826 May 20, 2004

Photo 12: The underside of the south sidewalk slab has a large spalled area where the exposed rebar is corroded through (100% section loss) between Panel Points L5 and L6 in the anchor arm above the south bottom chord, looking west.

2888 May 24, 2004

Photo 13: A large hole has formed on the underside of the south sidewalk slab in a heavily spalled location at Pier 11W where rebar is exposed beneath the eastbound roadway of the New Jersey approach spans, looking west. Water leakage from this deteriorated area is causing the steelwork to corrode.

2902 May 26, 2004

Photo 14: Looking east beneath the westbound roadway of the New Jersey approach spans at concrete that has fallen out of a previously hollow area on the underside of deck slab, and which is now resting on the gusset plate and cross bracing on the west side of Pier A just south of the north girder (G2).

2904 May 26, 2004

Photo 15: Rebar is often exposed on the underside of the deck slab as a result of insufficient concrete cover having been provided during the original bridge construction, looking north along the south side of the north girder (G2) just east of Pier 25W beneath the westbound roadway of the New Jersey approach spans.

2851 May 21, 2004

Photo 16: The end diaphragm top flange exhibits 1/16” to 1/8” section loss due to water seepage through the deck slab that has also produced a large underdeck spall with exposed rebar between Stringers S12 and S13 on the west side of Panel Point L14 in the main suspended span, looking east.

2776 May 17, 2004

Photo 17: A 4" x 5" hole is observed in the top flange of the north cantilevered portion of the end floorbeam on the east side of Pier 3E between Stringers S1 and S2 below the westbound roadway of the New York approach spans, looking west. Note the large spall with exposed rebar on the underside of the north sidewalk slab above the deteriorated steelwork.

2790 May 18, 2004

Photo 18: The north cantilevered portions of the end floorbeams at Pier 33E have been recently replaced by an ongoing rehabilitation contract below the westbound roadway of the New York approach spans, looking west. The cantilevered portions of the end floorbeams are scheduled to be replaced at all expansion joint locations.

2821 May 20, 2004

Photo 19: A 2" x 4" hole is noted in one of the lacing bar members on the bottom surface of the north bottom chord, located just east of Panel Point L14 in the main suspended span of the Goethals Bridge.

2817 May 20, 2004

Photo 20: A 1-1/4" x 12" hole extends along the east edge of the top flange of the north cantilevered section of the floorbeam at Panel Point L4' in the east anchor arm, looking west. This defect is observed at several floorbeam locations throughout the structure.

2835 May 21, 2004

Photo 21: Three rivets are missing at the connection of a truss diagonal member to a gusset plate on the east side of Panel Point L4' over the north edge of the south bottom chord in the east anchor arm, looking northwest.

2846 May 21, 2004

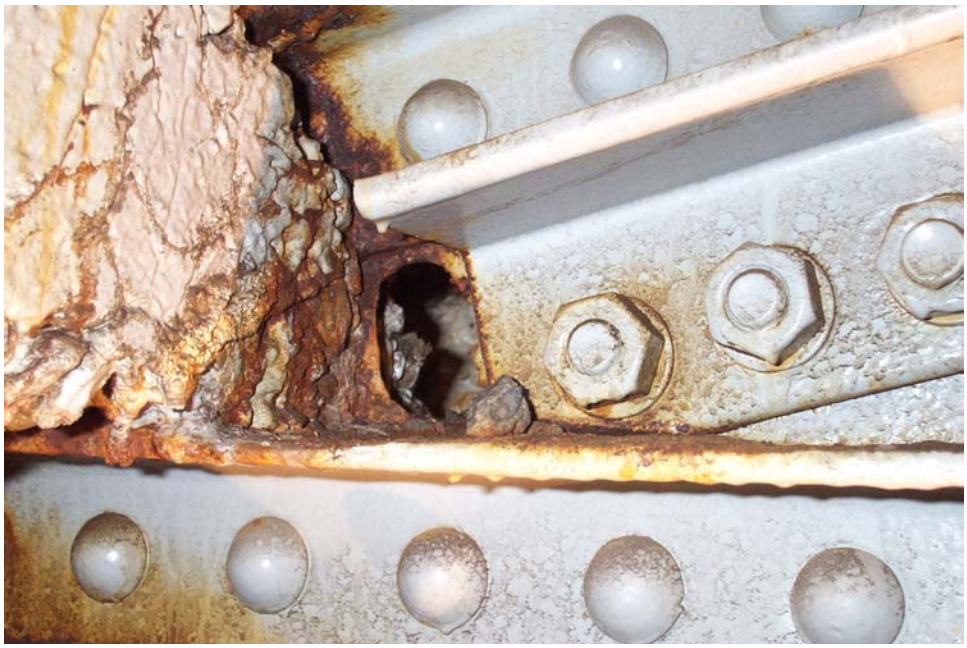
Photo 22: The inner gusset plate and connecting rivet heads exhibit section loss from arrested corrosion on the south side of the north bottom chord just west of Panel Point L12 in the main suspended span of the Goethals Bridge, looking northeast. Note that several previously deteriorated rivets have been replaced with bolts.

2853 May 21, 2004

Photo 23: Significant section loss is noted on the rivet heads and on the gusset plate at the connection to the south side of the north bottom chord located on the east side of Panel Point L6' in the east anchor arm. Note that one rivet is missing, looking northeast.

2885 May 25, 2004

Photo 24: A cross brace angle section is missing from the north sidewalk framing on the east side of Pier 6W beneath the westbound roadway of the New Jersey approach spans, looking northwest.



2889 May 25, 2004

Photo 25: There is a 1" x 2" hole in the web plate of the north cantilevered section of the end floorbeam at Pier 11W beneath the westbound roadway of the New Jersey approach spans, looking west.

2908 May 26, 2004

Photo 26: Water leakage from an apparent longitudinal construction joint in the deck slab beneath the concrete median barrier has resulted in moderate corrosion of the top flanges of Stringer S5 and the adjacent floorbeam between Piers 2W and 3W in the New Jersey approach spans, looking south. This defect is noticed in numerous spans throughout the recently repainted superstructure.

2895 May 26, 2004

Photo 27: A large spall with exposed rebar and unsound concrete extends 12 feet along the east side of the base of Pier 29W beneath the New Jersey approach spans, looking northwest.

2905 May 26, 2004

Photo 28: A large spall with exposed rebar is found at the northeast corner of the bearing pedestal at the support for the south through girder at Pier 28W beneath the westbound roadway of the New Jersey approach span over Conrail, looking southwest.

2808 May 19, 2004

Photo 29: Water leakage with moderate to heavy efflorescence is noted along the longitudinal joint in the roof slab of the New Jersey hollow abutment between Piers 45W and 46W, looking southwest.

2898 May 26, 2004

Photo 30: Rust stains and active water leakage extend down the north face of a concrete beam inside the New York hollow abutment near the north side wall on the west side of Pier 41E, looking up and south.

Appendix A

Daily Inspection Logs

GOETHALS BRIDGE MODERNIZATION PROJECT
ENVIRONMENTAL IMPACT STATEMENT (GBMP EIS)

GOETHALS BRIDGE DAILY LOG

DATE	HOURS OF WORK	ITEMS INSPECTED
5/17	7:30 AM TO 12:00 NOON	THE TOP OF DECK WAS INSPECTED FOR THE NEW YORK APPROACH SPANS FROM PIER D TO PIER 37E. R. SZATKOWSKI INSPECTED THE WESTBOUND ROADWAY FROM THE NORTH SAFETYWALK, AND A. FODEN INSPECTED THE EASTBOUND ROADWAY FROM THE SOUTH SAFETYWALK.
5/17	12:30 PM TO 3:30 PM	THE UNDERSIDE OF DECK AND SUPERSTRUCTURE WAS INSPECTED BENEATH THE NORTH & SOUTH SAFETYWALKS IN THE NEW YORK APPROACH SPANS. R. SZATKOWSKI INSPECTED THE CANTILEVERED AREA BENEATH THE NORTH SAFETYWALK FROM PIER D TO PIER 14E, AND A. FODEN INSPECTED THE CANTILEVERED AREA BENEATH THE SOUTH SAFETYWALK FROM PIER D TO PIER 20E. THE UNDERDECK AREAS WERE INSPECTED FROM THE EXTENSIVE TIMBER WORK PLATFORM THAT HAD BEEN INSTALLED BY THE KISKA CONTRACTOR, WHO WAS REHABILITATING THE NEW YORK APPROACH SPANS AT THE TIME OF THE INSPECTION.

GOETHALS BRIDGE MODERNIZATION PROJECT
ENVIRONMENTAL IMPACT STATEMENT (GBMP EIS)

GOETHALS BRIDGE DAILY LOG

DATE	HOURS OF WORK	ITEMS INSPECTED
5/18	7:15 AM	R. SZATKOWSKI & A. FODEN MEET RICH KERNEY OF THE PORT AUTHORITY AT HIS OFFICE TO TELL HIM THAT A LEAKING WATER MAIN / STAND PIPE WAS OBSERVED AT PIER 4E ALONG THE SOUTH SAFETYWALK DURING YESTERDAY'S INSPECTION (RICH WAS ON VACATION YESTERDAY). R. KERNEY IS ALSO TOLD THAT A LOOSE PIECE OF DECK JOINT ARMOR WAS NOTED NEAR THE SOUTH CURB IN THE EB ROADWAY AT PIER 8E, AND THE JOINT ARMOR MADE A VERY LOUD NOISE EACH TIME A VEHICLE DROVE OVER IT.
5/18	7:30 AM TO 11:00 AM	R. SZATKOWSKI INSPECTS THE UNDERSIDE OF DECK AND SUPERSTRUCTURE ALONG THE CANTILEVERED AREA BENEATH THE NORTH SAFETYWALK FROM PIER 14E TO PIER 35E. A. FODEN INSPECTS THE UNDERSIDE OF DECK AND SUPERSTRUCTURE BENEATH THE SOUTH SAFETYWALK FROM PIER 20E TO PIER 35E. SPANS 36E & 37E HAVE TIMBER SHIELDING INSTALLED BY THE CONTRACTOR THROUGHOUT THE UNDERSIDE WHICH MAKES INSPECTION OF THESE AREAS IMPOSSIBLE.
5/18	11:30 AM TO 3:15 PM	R. SZATKOWSKI INSPECTS THE UNDERSIDE OF DECK SLAB BETWEEN GIRDERS G1 AND G2 FROM PIER D TO PIER 17E BENEATH THE NEW YORK APPROACH SPANS, WHILE A. FODEN INSPECTS THE SUPERSTRUCTURE IN THE SAME SPANS.

GOETHALS BRIDGE MODERNIZATION PROJECT
ENVIRONMENTAL IMPACT STATEMENT (GBMP EIS)

GOETHALS BRIDGE DAILY LOG

DATE	HOURS OF WORK	ITEMS INSPECTED
5/19	7:15 AM	VISIT R. KERNEY TO TELL HIM OUR INSPECTION PLANS FOR THE DAY AND HE TELLS US THAT WE CAN JUST CALL HIM ON THE CELL PHONE EACH MORNING INSTEAD OF STOPPING BY HIS OFFICE IF IT'S EASIER.
5/19	7:30 AM TO 9:00 AM	A. FODEN INSPECTS THE SUPERSTRUCTURE AREA BETWEEN GIRDERS G1 AND G2 FROM PIER 17E TO PIER 35E TO FINISH THE NY APPROACH SPANS.
5/19	7:30 AM TO 10:30 AM	R. SZATKOWSKI INSPECTS THE UNDERSIDE OF DECK SLAB BETWEEN GIRDERS G1 AND G2 FROM PIER 17E TO PIER 35E TO FINISH THE NY APPROACH SPANS.
5/19	9:00 AM TO 10:30 AM	A. FODEN INSPECTS THE TOP OF DECK AREA ACROSS THE EAST HALF OF THE MAIN TRUSS SPANS IN THE EB ROADWAY AND IT STARTS TO RAIN AT 10:00.
5/19	11:00 AM TO 12:00 NOON	RAIN IS STEADY AFTER EATING AN EARLY LUNCH SO WE VISIT R. KERNEY TO OBTAIN KEYS TO INSPECT THE NJ HOLLOW ABUTMENT, BUT HE TELLS US THAT THE AREA IS OPEN, SECURITY WILL NOT ALLOW US TO ENTER THE ABUTMENT IN NJ, SO WE DRIVE BACK TO THE GOETHALS BRIDGE OFFICE IN NY AND THE SECURITY PERSON THERE CALLS THE SECURITY PERSON IN NJ TO CONFIRM THAT OUR WEEKLY PASSES ARE VALID AND WE SHOULD NOT HAVE BEEN TURNED AWAY.
5/19	12:00 PM TO 1:00 PM	R. SZATKOWSKI AND A. FODEN INSPECT THE NJ HOLLOW ABUTMENT.

GOETHALS BRIDGE MODERNIZATION PROJECT
ENVIRONMENTAL IMPACT STATEMENT (GBMP EIS)

GOETHALS BRIDGE DAILY LOG

DATE	HOURS OF WORK	ITEMS INSPECTED
5/19	1:00 PM TO 2:00 PM	R. SZATKOWSKI INSPECTS THE RAMP & STRUCTURE BEHIND THE NJ HOLLOW ABUTMENT WHILE A. FODEN INSPECTS THE RAMP & STRUCTURE.
5/19	2:30 PM	LEAVE FOR THE DAY DUE TO CONTINUED RAIN AFTER CALLING R. KERNEY TO FIND OUT THAT THE NY HOLLOW ABUTMENT IS LOCKED UP BY THE POINTING CONTRACTOR AT 1:30 PM AND MUST BE INSPECTED BEFORE THEN ON ANOTHER DAY.

GOETHALS BRIDGE MODERNIZATION PROJECT
ENVIRONMENTAL IMPACT STATEMENT (GBMP EIS)

GOETHALS BRIDGE DAILY LOG

DATE	HOURS OF WORK	ITEMS INSPECTED
5/20	7:30 AM TO 12:30 PM	R. SZATKOWSKI INSPECTS THE UNDERSIDE OF DECK AND SUPERSTRUCTURE ALONG THE CANTILEVERED AREA BENEATH THE NORTH SAFETYWALK IN THE MAIN TRUSS SPANS FROM PIER D TO PIER A. THE INSPECTION WAS PERFORMED FROM THE WIRE FENCE PLATFORM THAT HAD BEEN INSTALLED BY THE PAINTING CONTRACTOR A FEW YEARS AGO.
5/20	7:30 AM TO 12:30 PM	A. FODEN INSPECTS THE TOP OF DECK AREA ACROSS THE WEST HALF OF THE MAIN TRUSS SPANS IN THE EB ROADWAY. A. FODEN THEN INSPECTS THE TOP OF DECK AREA IN THE EB ROADWAY OF THE NJ APPROACH SPANS FROM THE SOUTH SAFETYWALK. THIS INSPECTION OF THE EB ROADWAY EXTENDS THE FULL LENGTH OF THE NJ APPROACH SPANS FROM PIER A TO PIER 135W.
5/20	1:00 PM TO 3:00 PM	R. SZATKOWSKI INSPECTS THE UNDERSIDE OF DECK AND SUPERSTRUCTURE ALONG THE CANTILEVERED AREA BENEATH THE SOUTH SAFETYWALK IN THE MAIN TRUSS SPANS FROM PIER A TO PANEL POINT L13.
5/20	1:00 PM TO 3:00 PM	A. FODEN INSPECTS THE TOP OF DECK AREA IN THE WB ROADWAY ACROSS THE FULL LENGTH OF THE MAIN TRUSS SPANS FROM PIER A TO PIER D. A. FODEN THEN INSPECTS THE TOP OF DECK AREA IN THE WB ROADWAY OF THE NJ APPROACH SPANS FROM PIER A TO PIER 8, FROM THE NORTH SAFETYWALK.

GOETHALS BRIDGE MODERNIZATION PROJECT
ENVIRONMENTAL IMPACT STATEMENT (GBMP EIS)

GOETHALS BRIDGE DAILY LOG

DATE	HOURS OF WORK	ITEMS INSPECTED
5/21	7:15 AM TO 9:30 AM	R. SZATKOWSKI INSPECTS THE UNDERSIDE OF DECK AND SUPERSTRUCTURE ALONG THE CANTILEVERED AREA BENEATH THE SOUTH SAFETY WALK IN THE MAIN TRUSS SPANS FROM PANEL POINT L13 TO PIER D USING THE WIRE FENCE PLATFORM TO WORK FROM.
5/21	7:15 AM TO 8:30 AM	A. FODEN INSPECTS THE TRUSS ELEMENTS OF THE ABOVE DECK SUPERSTRUCTURE IN THE MAIN SPANS FROM PIER D TO PIER A USING BINOCULARS FROM THE NORTH AND SOUTH SAFETY WALKS.
5/21	8:30 AM TO 11:30 AM	A. FODEN INSPECTS THE TOP OF DECK AREA IN THE WB ROADWAY OF THE NJ APPROACH SPANS FROM PIER 8W TO PIER 35W USING THE NORTH SAFETY WALK.
5/21	10:00 AM TO 3:15 PM	R. SZATKOWSKI INSPECTS THE BELOW DECK SUPERSTRUCTURE ELEMENTS IN THE MAIN TRUSS SPANS BETWEEN GIRDERS G1 AND G2 FROM PIER A TO PIER D.
5/21	12:00 NOON TO 3:15 PM	A. FODEN INSPECTS THE BELOW DECK SUPERSTRUCTURE ELEMENTS IN THE NJ APPROACH SPANS FROM PIER A TO PIER 28W USING THE CATWALK BENEATH THE WB ROADWAY.

GOETHALS BRIDGE MODERNIZATION PROJECT
ENVIRONMENTAL IMPACT STATEMENT (GBMP EIS)

GOETHALS BRIDGE DAILY LOG

DATE	HOURS OF WORK	ITEMS INSPECTED
5/24	7:00 PM TO 9:30 PM	R. SZATKOWSKI AND N. CHAO LEAVE THE PRINCETON OFFICE IN HEAVY RAIN AND MEET THE UB-60 OPERATOR AT THE GOETHALS BRIDGE AT 8:15 PM. A SECURITY PASS HAD NOT BEEN PREPARED FOR R. SZATKOWSKI SO A PORT AUTHORITY EMPLOYEE COMES FROM HOME TO PROCESS ONE IN THE ADMINISTRATION BUILDING. THE CONTRACTOR WAS NOT MADE AWARE THAT WE WOULD BE WORKING IN HIS LANE CLOSURES AND FURTHER DELAYS OUR START OF WORK UNTIL R. KERNEY TALKS TO HIM FROM HOME TO STRAIGHTEN THINGS OUT, AND THE SECURITY PERSON ON DUTY REQUIRES THAT A PORT AUTHORITY EMPLOYEE ESCORT US ONTO THE BRIDGE AND SIGN HIS PAPERWORK DUE TO OUR TEMPORARY PASSES.
5/24 5/25	9:30 PM TO 3:45 AM	R. SZATKOWSKI INSPECTS THE SUPERSTRUCTURE FROM THE UB-60 BENEATH THE NORTH AND SOUTH CANTILEVERED SAFETYWALKS IN THE NJ APPROACH SPANS FROM PIER A TO PIER 27W. N. CHAO INSPECTS THE UNDERSIDE OF DECK SLAB IN THE SAME AREAS FROM THE UB-60 ALSO.

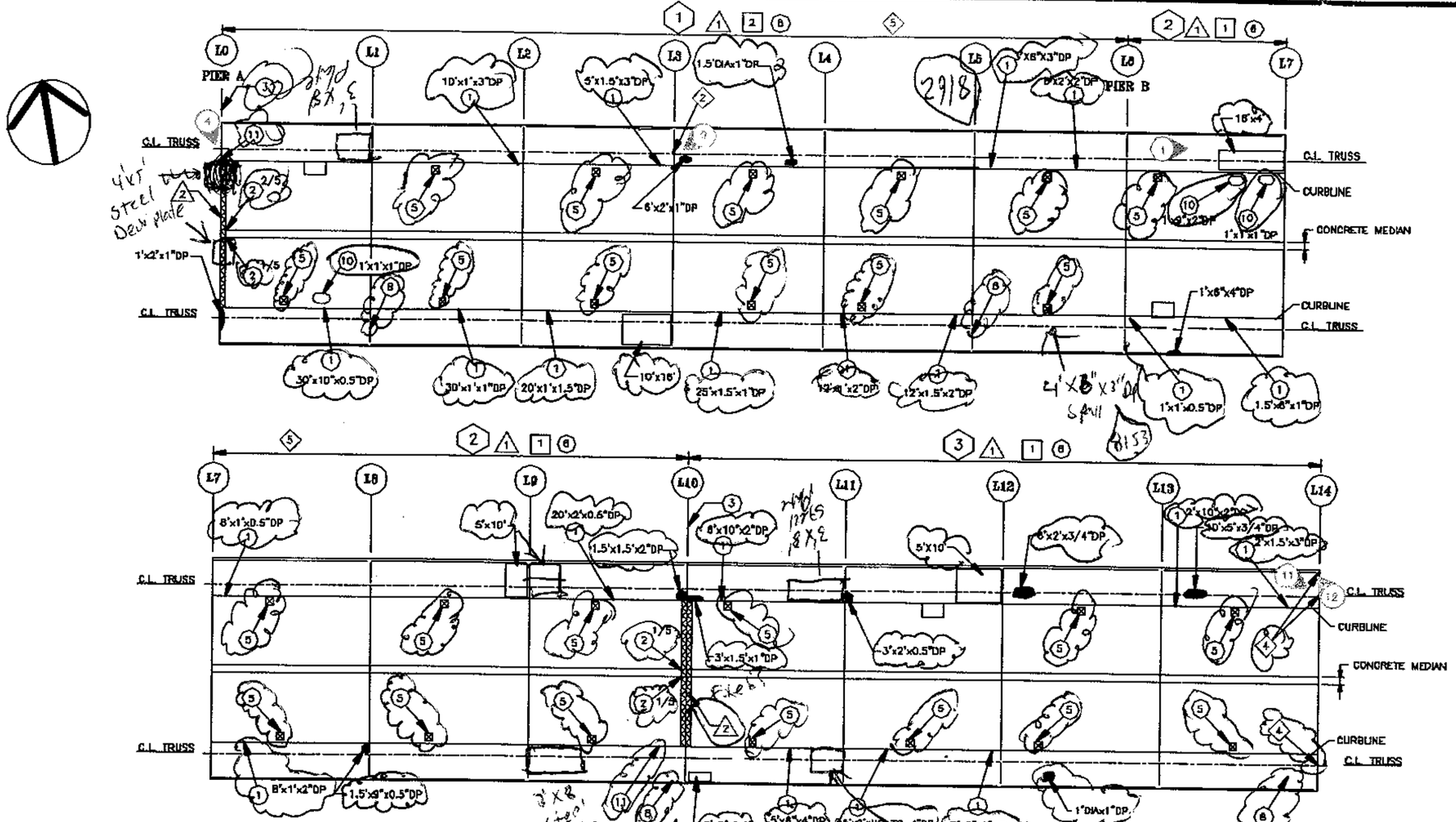
GOETHALS BRIDGE MODERNIZATION PROJECT
ENVIRONMENTAL IMPACT STATEMENT (GBMP EIS)

GOETHALS BRIDGE DAILY LOG

DATE	HOURS OF WORK	ITEMS INSPECTED
5/26	7:00 AM TO 10:30 AM	R. SZOTKOWSKI AND N. CHAO INSPECT THE UNDERSIDE OF DECK AND SUPERSTRUCTURE AREAS OF THE NJ APPROACH SPANS OVER THE NJ TURNPIKE, WHICH COULD NOT BE ACCESSED PREVIOUSLY DUE TO INSUFFICIENT VERTICAL CLEARANCE TO USE THE UB-60 AND RECOVER THE COTWALK ENDS AT PIER 28W.
5/26	11:00 AM TO 12:00 NOON	THE TMA IS RETURNED TO THE TURNPIKE MAINTENANCE YARD AFTER SHOULDER CLOSURES ARE COMPLETED ON THE TURNPIKE, AND R. SZOTKOWSKI VISITS THE OFFICE OF R. KERNEY AT THE GOETHALS BRIDGE ADMINISTRATION BUILDING TO FIND THAT HE IS ON VACATION AGAIN TODAY. IAN OBTAINS PERMISSION FOR R. SZOTKOWSKI AND N. CHAO TO INSPECT THE NY HOLLOW ABUTMENT, AND THE INSPECTION IS COMPLETED BEFORE LUNCH.
5/26	12:30 PM TO 2:30 PM	R. SZOTKOWSKI AND N. CHAO INSPECT THE UNDERSIDE OF DECK SLAB BENEATH THE NJ APPROACH SPANS FROM PIER A TO PIER 28W USING THE COTWALK UNDER THE WB ROADWAY.
5/26	2:30 PM TO 3:30 PM	R. SZOTKOWSKI AND N. CHAO INSPECT THE WEST-MOST SPANS OF THE NJ APPROACH ADJACENT TO THE NJ HOLLOW ABUTMENT.

Appendix B

Updated Deficiency and Photo Location Plans



KEY CONDITION NOTES – TOP OF DECK

PRIORITY REPAIRS

1. THE NORTH AND SOUTH SIDEWALKS EXHIBITS DELAMINATED AND SPALLED CONCRETE AT TOP SURFACE , SEE LEGEND BELOW. (PRIORITY REPAIR)

   DELAMINATED/SPALLED CONCRETE AT TOP SURFACE OF SIDEWALKS WITHOUT EXPOSED REBARS. SIZE AS SHOWN. (PRIORITY REPAIR)

2. UP TO 1" OF VERTICAL MISALIGNMENT AT THE FINGER JOINTS AT PANEL POINTS L0 (PIER A), L10, L10' AND L0' (PIER D). (PRIORITY REPAIR)

SAFETY REPAIRS

2. DISCONNECTED ELECTRICAL CONDUIT WITH EXPOSED WIRES AT THE NORTH TRUSS VERTICAL MEMBER AT PANEL POINT L3. (SAFETY REPAIR)

4. MISSING COVER OF ELECTRICAL JUNCTION BOX WITH EXPOSED ELECTRICAL WIRES ALONG THE NORTH AND SOUTH SIDEWALKS [illegible] NGS AND/OR AT THE TRUSS MEMBERS NEAR PANEL POINTS L14, L7' AND L0'. (SAFETY REPAIR)

5. MISSING 5' LONG SECTION OF THE BOTTOM RAIL OF THE SAFETY RAILING AT THE TOP CHORD OF THE NORTH AND SOUTH TRUSSES BETWEEN U4'–U5'(N&S), U7'–U8'(N&S), U12'–U13'(N), U13'–U14(S), U8–U7(N&S) AND U4–U5(N&S). (SAFETY REPAIR)

ROUTINE REPAIRS

1. THE NORTH AND SOUTH CONCRETE PARAPETS EXIBIT SPALLED OR DELAMINATED CONCRETE WITH OR WITHOUT EXPOSED REBARS. SIZE AS SHOWN. (ROUTINE REPAIR)

2. A/B THE STEEL EXPANSION PLATE CONNECTION TO THE CONCRETE MEDIAN OVER THE FINGER JOINTS HAS MISSING BOLTS. "A" INDICATES NUMBER OF MISSING BOLTS, "B" INDICATES TOTAL NUMBER OF BOLTS. (ROUTINE REPAIR)

3. HEAVLY DETERIORATED JOINT SEALER AT THE NORTH AND SOUTH SIDEWALKS AT PANEL POINTS L0, L10, L10' AND L0'. (ROUTINE REPAIR)

5. CLOGGED ROADWAY SCUPPER AND DOWNSPOUT. (ROUTINE REPAIR)

6. THE STEEL FACING OF THE PARAPET AT THE NORTH AND SOUTH CURBLINES EXHIBITS MODERATE RUST. (ROUTINE REPAIR)

8. SEVERELY RUSTED BRIDGE LIGHTING CONDUIT WHICH IS EMBEDDED TRANSVERSELY IN THE SIDEWALK SLAB AT THE NORTH AND SOUTH SIDEWALKS. (ROUTINE REPAIR)

10. POTHOLE IN ASPHALT WEARING SURFACE NEAR CURBLINE IN SPANS 1, 2 AND 5. (ROUTINE REPAIR)

11. THE CONNECTION BETWEEN THE STEEL SAFETY SHAPE PARAPET AND THE SUPPORT [illegible] HAS A LOOSE BOLT AT L0 AND A MISSING BOLT AT L10. (ROUTINE REPAIR)

NO REPAIR RECOMMENDED

1. THE BACK FACE OF ROADWAY BARRIER EXHIBIT MAPCRACKING THROUGHOUT THE BRIDGE. (NO REPAIR RECOMMENDED)

2. ALL STEEL MEMBERS EXHIBIT MINOR SECTION LOSS (< 1/8").

LEGEND

- (LZ) PIER NUMBER (AS PER PANY&NJ SYSTEM)
- (Z) SPAN NUMBER (AS PER NYSDOT SYSTEM)
- PHOTO TAKEN ABOVE DECK
- CLEAR SCUPPER
- CLOGGED SCUPPER (ROUTINE REPAIR)
- LARGE SCUPPER
- ASPHALT POTHOLE (ROUTINE REPAIR)
- EXPANSION FINGER JOINT
- STEEL PLATE

Could not see any missing rail

Severe deterioration of parapet

Sheet 2 Of 7

THE PORT AUTHORITY OF NY & NJ

2002 BIENNIAL INSPECTION

OF THE GOETHALS BRIDGE

Title

BIN 5523059

MAIN SPAN

DEFICIENCY AND PHOTO LOCATION PLAN
TOP OF DECK – 1
PANEL POINTS L0 TO L14

No	Date	Revision	Approved

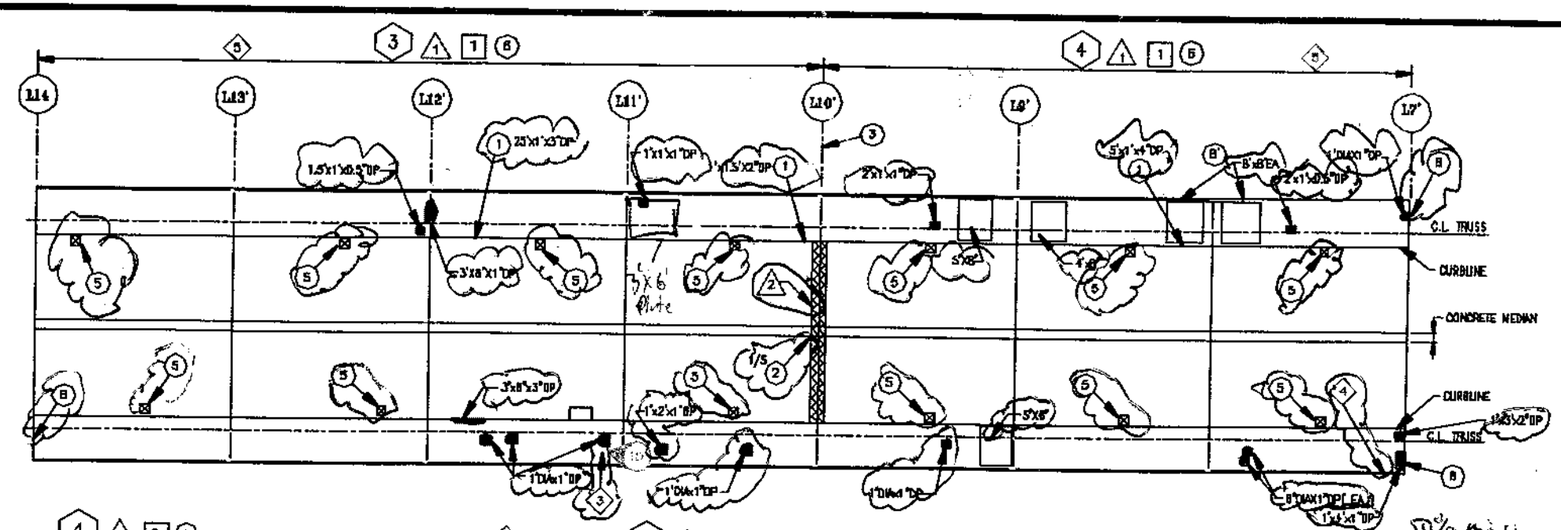
This drawing subject to conditions in contract. All inventions, ideas, designs and methods herein are reserved to Port Authority and may not be used without its written consent.

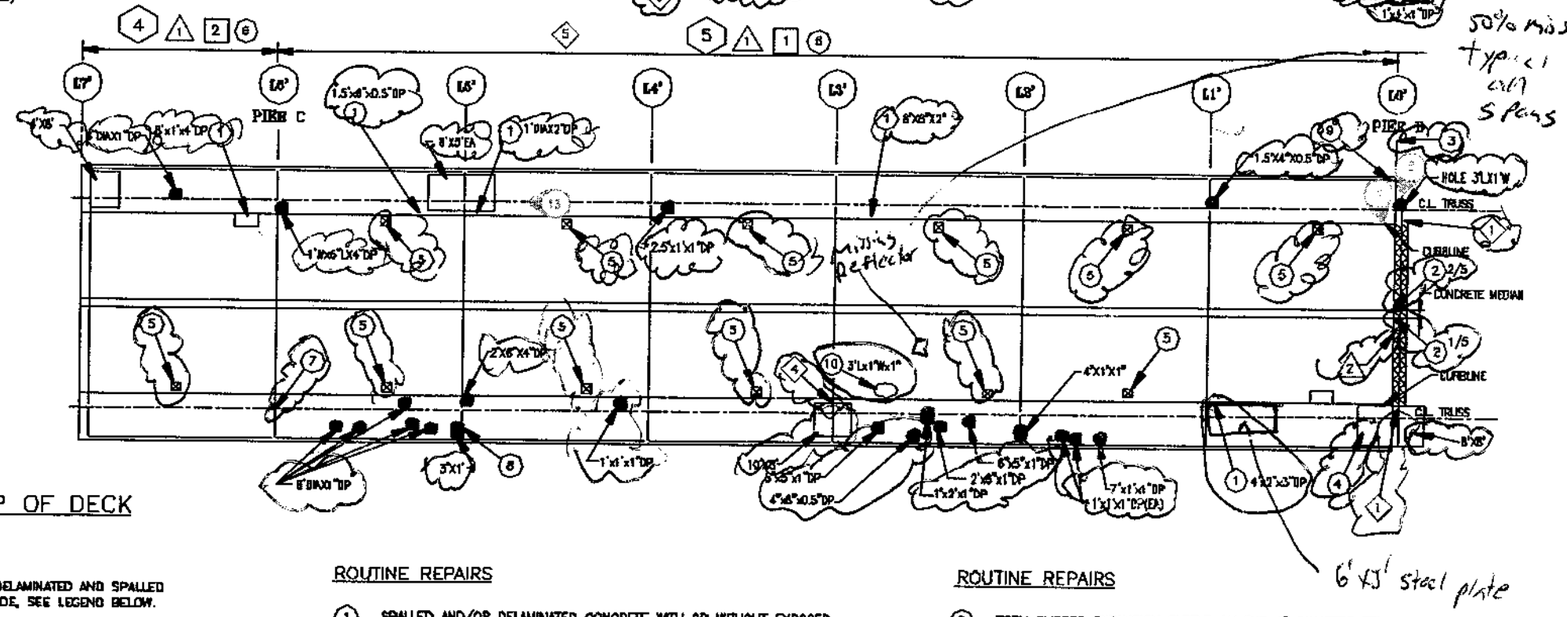
Designed by	Drawn by	Task Leader
	VD	CD

Date 11/01/02 Scale N.T.S.

Contract Number 405-99-01 Drawing Number 5523059-2

A. FODEN 5-20-04





LEGEND

- (LZ) PIER NUMBER (AS PER PANY&NJ SYSTEM)
- (Z) SPAN NUMBER (AS PER NYSDOT SYSTEM)
- PHOTO TAKEN ABOVE DECK
- CLEAR SCUPPER
- CLOGGED SCUPPER (ROUTINE REPAIR)
- LARGE SCUPPER
- ASPHALT POTHOLE (ROUTINE REPAIR)
- EXPANSION FINGER JOINT
- STEEL PLATE

KEY CONDITION NOTES – TOP OF DECK

PRIORITY REPAIRS

1. THE NORTH AND SOUTH SIDEWALKS EXHIBIT DELAMINATED AND SPALLED CONCRETE AT TOP SURFACE AND AT UNDERSIDE, SEE LEGEND BELOW. (PRIORITY REPAIR)
   - DELAMINATED/SPALLED CONCRETE AT TOP SURFACE OF SIDEWALKS WITHOUT EXPOSED REBARS. SIZE AS SHOWN. (PRIORITY REPAIR)
2. UP TO 1" OF VERTICAL MISALIGNMENT AT THE FINGER JOINTS AT PANEL POINTS L0 (PIER A), L10, L10' AND L0' (PIER D). (PRIORITY REPAIR)

SAFETY REPAIRS

1. THE NORTH AND SOUTH END SUPPORT POSTS FOR THE STEEL SAFETY SHAPE PARAPET ARE SLIGHTLY LOOSE AT PANEL POINT L0'. (SAFETY REPAIR)
3. HOLED THRU COVER OF THE OLD ABANDONED JUNCTION BOX EMBEDDED IN THE SOUTH SIDEWALK AT PANEL POINT L11'. (SAFETY REPAIR)
4. MISSING COVER OF ELECTRICAL JUNCTION BOX WITH EXPOSED ELECTRICAL WIRES ALONG THE NORTH AND SOUTH SIDEWALKS RAILINGS AND/OR AT THE TRUSS MEMBERS NEAR PANEL POINTS L14, L7' AND L3'. (SAFETY REPAIR)
6. MISSING 6' LONG SECTION OF THE BOTTOM RAIL OF THE SAFETY RAILING AT THE TOP CHORD OF THE NORTH AND SOUTH TRUSSES BETWEEN U4'–U5'(N&S), U7'–U8'(N&S), U12'–U13'(N), U13'–U14(S), U8–U7(N&S) AND U4–U5(N&S). (SAFETY REPAIR)

ROUTINE REPAIRS

1. SPALLED AND/OR DELAMINATED CONCRETE WITH OR WITHOUT EXPOSED REBARS AT THE NORTH AND SOUTH CONCRETE PARAPETS. SIZE AS SHOWN. (ROUTINE REPAIR)
2. A/B MISSING BOLTS AT THE STEEL EXPANSION PLATE CONNECTION TO THE CONCRETE MEDIAN OVER THE FINGER JOINTS. "A" INDICATES NUMBER OF MISSING BOLTS, "B" INDICATES TOTAL NUMBER OF BOLTS. (ROUTINE REPAIR)
3. HEAVILY DETERIORATED JOINT SEALER AT THE NORTH AND SOUTH SIDEWALKS AT PANEL POINTS L0, L10, L10' AND L0'. (ROUTINE REPAIR)
4. MISSING AND LOOSE ANCHOR BOLTS AT FIRE STANDPIPE SUPPORT AT THE SOUTH SIDEWALK AT PANEL POINT L0'. (ROUTINE REPAIR)
5. CLOGGED ROADWAY SCUPPER AND DOWNSPOUT. (ROUTINE REPAIR)
6. MODERATE RUST AT THE STEEL FACING OF THE PARAPET AT THE NORTH AND SOUTH CURBLINES. (ROUTINE REPAIR)
7. CRACKED BLUE LIGHT FOR THE EMERGENCY TELEPHONE AT PANEL POINT L8' OF THE SOUTH TRUSS. (ROUTINE REPAIR)
8. SEVERELY RUSTED BRIDGE LIGHTING CONDUIT WHICH IS EMBEDDED TRANSVERSELY IN THE SIDEWALK SLAB AT THE NORTH AND SOUTH SIDEWALKS. (ROUTINE REPAIR)

Did not see any missing rail

ROUTINE REPAIRS

9. TORN RUBBER EXPANSION SLEEVE ON THE 4" DIAMETER STEEL CONDUIT AT THE NORTH SIDEWALK RAILING AT PANEL POINT L0'. (ROUTINE REPAIR)
10. POTHOLE IN ASPHALT WEARING SURFACE NEAR CURBLINE IN SPANS 1, 2 AND 5. (ROUTINE REPAIR)

NO REPAIRS RECOMMENDED

1. THE BACK FACE OF ROADWAY BARRIER EXHIBIT MAPCRACKING THROUGHOUT THE BRIDGE. (NO REPAIR RECOMMENDED)
2. ALL STEEL MEMBERS EXHIBIT MINOR SECTION LOSS (< 1/8").

THE PORT AUTHORITY OF NY & NJ

2002 BIENNIAL INSPECTION

OF THE GOETHALS BRIDGE

Title

BIN 5523059

MAIN SPAN

DEFICIENCY AND PHOTO LOCATION PLAN
TOP OF DECK – 2
PANEL POINTS L14 TO L0'

No	Date	Revision	Approved

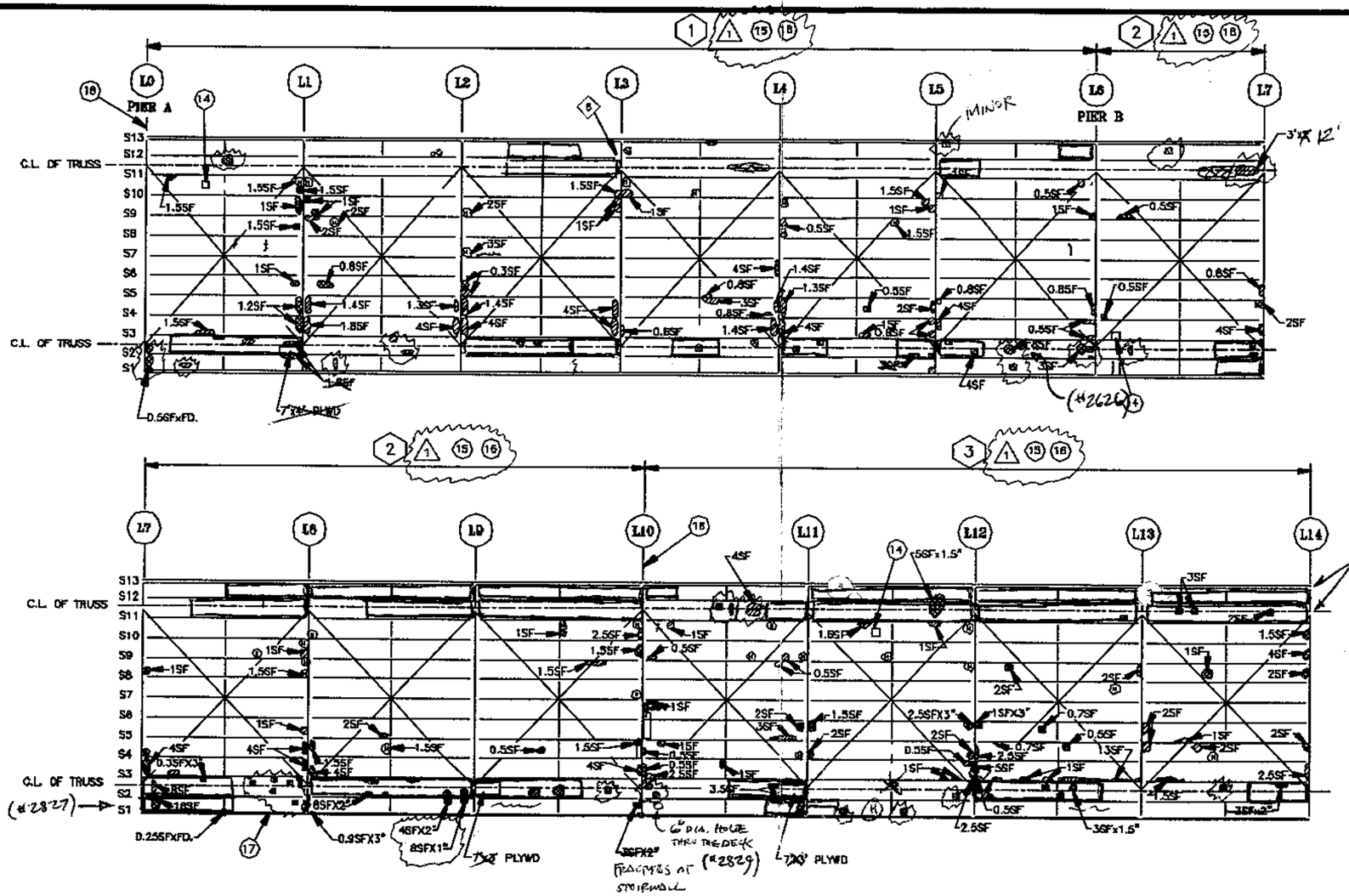
This drawing subject to conditions in contract. All inventions, ideas, designs and methods herein are reserved to Port Authority and may not be used without its written consent.

Designed by	Drawn by	Team Leader
	VD	DD

Date 11/01/02 Scale N.T.S.

Contract Number 403-99-01 Drawing Number 5523059-3

A. FODEN 5-19-04 & 5-20-04 A-10



KEY CONDITION NOTES – UNDERSIDE OF DECK

PRIORITY REPAIRS

1. THE NORTH AND SOUTH SIDEWALKS EXHIBIT DELAMINATED AND SPALLED CONCRETE AT TOP SURFACE AND AT UNDERSIDE, SEE LEGEND BELOW. (PRIORITY REPAIR)
   - SPALLED CONCRETE WITHOUT EXPOSED REBARS AT THE UNDERSIDE OF NORTH AND SOUTH SIDEWALKS UP TO 3SF AND UP TO 1"DP. UNLESS OTHERWISE NOTED. (PRIORITY REPAIR)
   - SPALLED CONCRETE WITH EXPOSED REBARS AT THE UNDERSIDE OF NORTH AND SOUTH SIDEWALKS UP TO 3SF AND UP TO 2"DP. UNLESS OTHERWISE NOTED. (PRIORITY REPAIR)
   - HL HOLLOW CONCRETE AT UNDERSIDE OF SIDEWALK UP TO 1SF. UNLESS OTHERWISE NOTED. (PRIORITY REPAIR)

SAFETY REPAIRS

CATWALK ON U3 60

5. DISCONNECTED AND HANGING ELECTRICAL CONDUIT WITH EXPOSED WIRES AT THE UNDERSIDE OF DECK NEAR PANEL POINTS L3, L10" AND L7". (SAFETY REPAIR)

ROUTINE REPAIR

14. MISSING DOWNSPOUT AT LARGE SCUPPER IN ALL SPANS. (ROUTINE REPAIR)
15. SPALLED, DELAMINATED AND HOLLOW CONCRETE AT THE UNDERSIDE OF DECK. SEE LEGEND BELOW. (ROUTINE REPAIR)
    - SPALLED CONCRETE WITHOUT EXPOSED REBARS UP TO 1" DEEP UNLESS OTHERWISE NOTED. (ROUTINE REPAIR)
    - SPALLED CONCRETE WITH EXPOSED REBARS UP TO 2" DEEP UNLESS OTHERWISE NOTED. (ROUTINE REPAIR)
    - HL HOLLOW CONCRETE UP TO 1SF UNLESS OTHERWISE NOTED. (ROUTINE REPAIR)
16. HEAVILY SPALLED VERTICAL FACE OF THE CONCRETE HAUNCH OVER STRINGERS S2, S3, S11 AND S12. (ROUTINE REPAIR)
17. DISCONNECTED ELECTRICAL CONDUIT SUPPORT AT THE UNDERSIDE OF BRIDGE NEAR L8. (ROUTINE REPAIR)
18. MISSING DRAINAGE TROUGH BELOW FINGER JOINTS AT PANEL POINTS L0, L10, L10" AND L0". (ROUTINE REPAIR)

LEGEND

- LZ PIER NUMBER (AS PER PANY&NJ SYSTEM)
- Z SPAN NUMBER (AS PER NYSDOT SYSTEM)
- PHOTO TAKEN BELOW DECK
- LARGE SCUPPER
- FINE CRACK WITH EFFLORESCENCE. (NO REPAIR RECOMMENDED)

THE PORT AUTHORITY OF NY & NJ

2002 BIENNIAL INSPECTION

OF THE GOETHALS BRIDGE

Title

BIN 5523059

MAIN SPAN

DEFICIENCY AND PHOTO LOCATION PLAN
UNDERSIDE OF DECK–1
PANEL POINTS L0 TO L14

No	Date	Revision	Approved

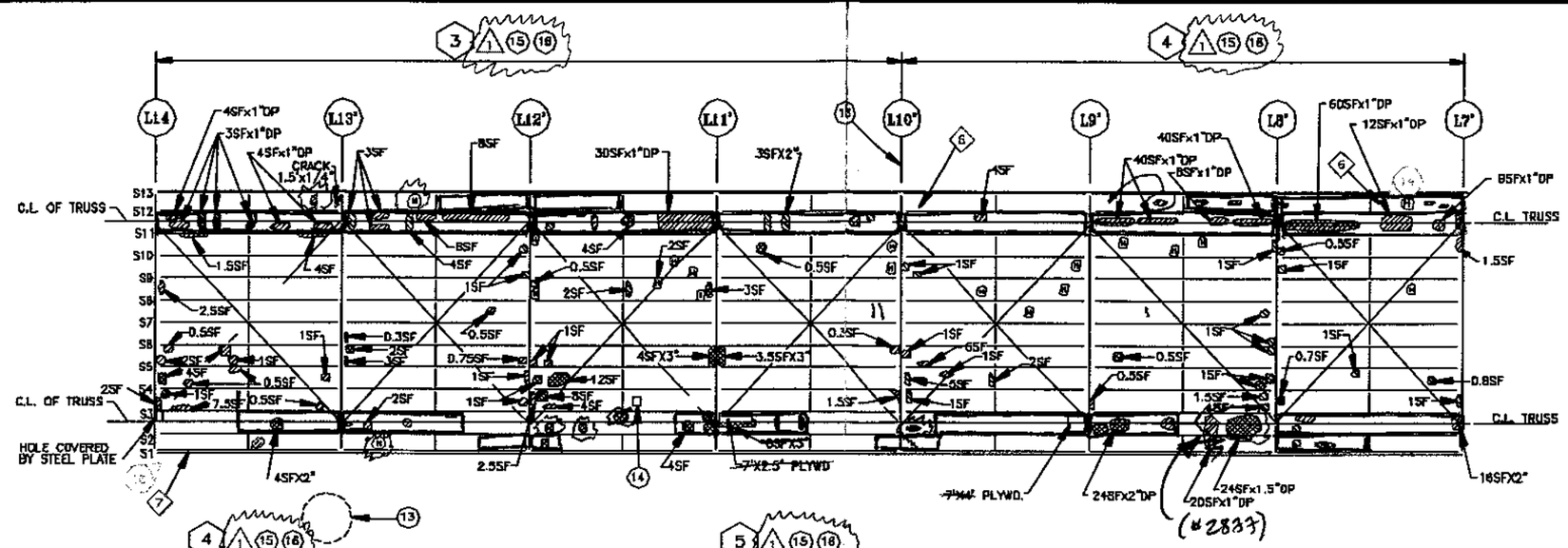
This drawing subject to conditions in contract. All inventions, ideas, designs and methods herein are reserved to Port Authority and may not be used without its written consent.

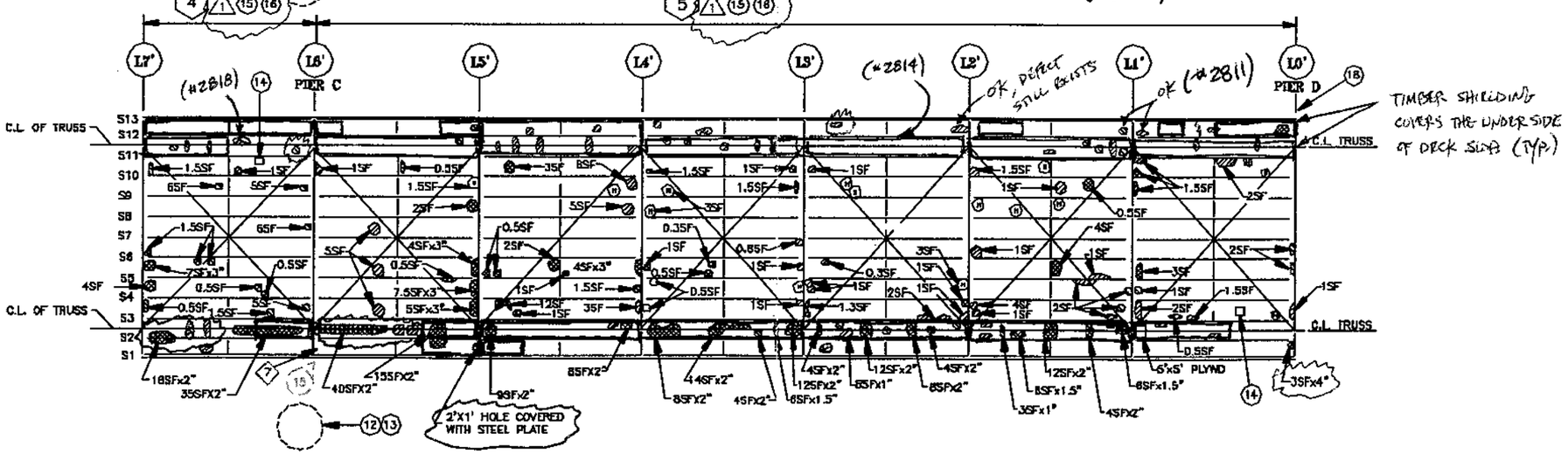
Designed by	Drawn by	Task Leader
	VD	CD

Date 11/01/02 Scale N.T.S.

Contract Number 405–98–01 Drawing Number 5523059–4

R. SLATKOWSKI 5-20-04 & 5-21-04





KEY CONDITION NOTES – UNDERSIDE OF DECK

PRIORITY REPAIRS

(1) THE NORTH AND SOUTH SIDEWALKS EXHIBIT DELAMINATED AND SPALLED CONCRETE AT TOP SURFACE AND AT UNDERSIDE, SEE LEGEND BELOW. (PRIORITY REPAIR)

- SPALLED CONCRETE WITHOUT EXPOSED REBARS AT THE UNDERSIDE OF NORTH AND SOUTH SIDEWALKS UP TO 3SF AND UP TO 1"DP. UNLESS OTHERWISE NOTED. (PRIORITY REPAIR)
- SPALLED CONCRETE WITH EXPOSED REBARS AT THE UNDERSIDE OF NORTH AND SOUTH SIDEWALKS UP TO 3SF AND UP TO 2"DP. UNLESS OTHERWISE NOTED. (PRIORITY REPAIR)
- (H) HOLLOW CONCRETE AT UNDERSIDE OF SIDEWALK UP TO 1SF. UNLESS OTHERWISE NOTED. (PRIORITY REPAIR)

SAFETY REPAIRS

1860

(6) DISCONNECTED AND HANGING ELECTRICAL CONDUIT WITH EXPOSED WIRES AT THE UNDERSIDE OF DECK NEAR PANEL POINTS L3, L10' AND L7'. (SAFETY REPAIR)

(7) MISSING COVER OF ELECTRICAL JUNCTION BOXES WITH EXPOSED WIRES AT UNDERSIDE OF DECK NEAR L14 AND L6'. (SAFETY REPAIR)

ROUTINE REPAIR

(12) MISSING "NO TRESPASSING" AND "NO MOORING" SIGNS AT THE ACCESS LADDER ON THE SOUTH DOLPHIN AT PIER C. (ROUTINE REPAIR)

(13) HEAVILY DETERIORATED WATERPROOF COATING ON TOP OF NORTH AND SOUTH DOLPHINS AT PIER C. (ROUTINE REPAIR)

(14) MISSING DOWNSPOUT AT LARGE SCUPPER IN ALL SPANS. (ROUTINE REPAIR)

(15) SPALLED, DELAMINATED AND HOLLOW CONCRETE AT THE UNDERSIDE OF DECK. SEE LEGEND BELOW. (ROUTINE REPAIR)

- SPALLED CONCRETE WITHOUT EXPOSED REBARS UP TO 1" DEEP UNLESS OTHERWISE NOTED. (ROUTINE REPAIR)
- SPALLED CONCRETE WITH EXPOSED REBARS UP TO 2" DEEP UNLESS OTHERWISE NOTED. (ROUTINE REPAIR)
- (H) HOLLOW CONCRETE UP TO 1SF UNLESS OTHERWISE NOTED. (ROUTINE REPAIR)

(16) HEAVILY SPALLED VERTICAL FACE OF THE CONCRETE HAUNCH OVER STRINGERS S2, S3, S11 AND S12. (ROUTINE REPAIR)

(18) MISSING DRAINAGE TROUGH BELOW FINGER JOINTS AT PANEL POINTS L0, L10, L10' AND L0'. (ROUTINE REPAIR)

LEGEND

- (LZ) PIER NUMBER (AS PER PANY&NJ SYSTEM)
- (Z) SPAN NUMBER (AS PER NYSDOT SYSTEM)
- PHOTO TAKEN BELOW DECK
- LARGE SCUPPER
- FINE CRACK WITH EFFLORESCENCE.

Sheet 5 Of 7

THE PORT AUTHORITY OF NY & NJ

2002 BIENNIAL INSPECTION

OF THE GOETHALS BRIDGE

Title

BIN 5523059

MAIN SPAN

DEFICIENCY AND PHOTO LOCATION PLAN
UNDERSIDE OF DECK–2
PANEL POINTS L14 TO L0'

No	Date	Revision	Approved

This drawing subject to conditions in contract. All inventions, ideas, designs and methods herein are reserved to Port Authority and may not be used without its written consent.

Designed by	Drawn by	Task Leader
	VD	CD

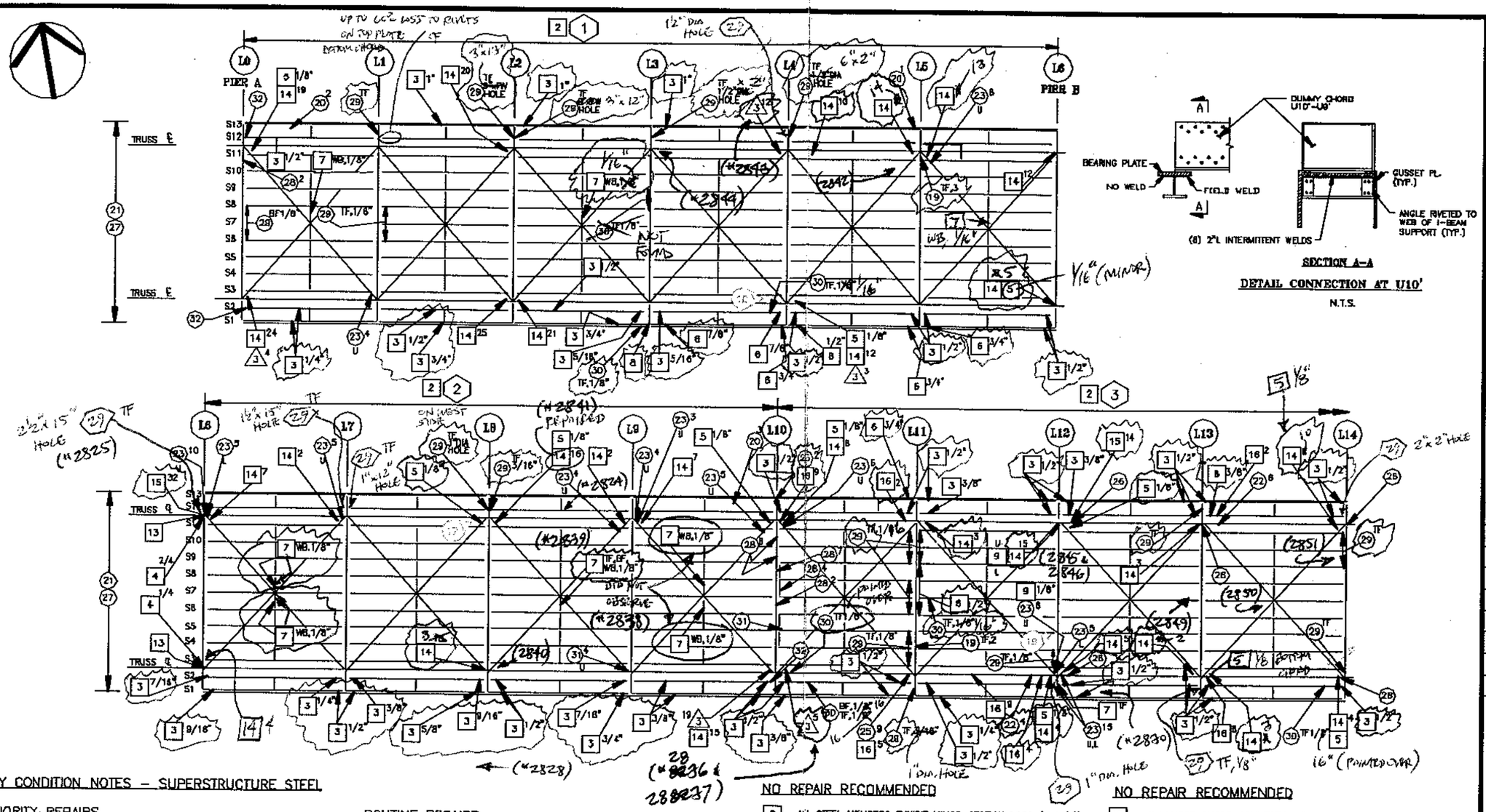
Date 11/01/02 Scale N.T.S.

Contract Number 405-99-01 Drawing Number 5523059-5

PANY&NJ – QAD – 2002

A-12

R. SZATKOWSKI 5-20-04 & 5-21-04



KEY CONDITION NOTES – SUPERSTRUCTURE STEEL

PRIORITY REPAIRS

△3 DETERIORATED RIVETS WITH 50% OR MORE HEAD LOSS AT THE GUSSET PLATE CONNECTIONS TO THE TRUSS LOWER CHORDS. NUMBER OF AFFECTED RIVETS AS SHOWN. (PRIORITY REPAIR)

ROUTINE REPAIRS

(19) RUSTED RIVETS WITH SECTION LOSSES ON FLOORBEAMS OUTSIDE THE PREVIOUSLY REPAIRED AREAS. NUMBER AND LOCATION AS SHOWN. (ROUTINE REPAIR)

(20) MISSING SIDEWALK BRACING ANGLE IN SPANS 1 AND 2. "A" INDICATES NUMBER OF MISSING ANGLES. (ROUTINE REPAIR)

(21) MODERATE RUST AT ALL STEEL MEMBERS INCLUDING THE UNDERSIDE OF JOINT AND BRACING MEMBERS. (ROUTINE REPAIR)

(22) MISSING AND/OR SEVERELY RUSTED LACING BARS WITH SIGNIFICANT SECTION LOSS (1/8") ON THE LOWER CHORD OF THE NORTH AND SOUTH TRUSSES IN SPAN 3. NUMBER OF AFFECTED LACING BARS AS SHOWN.(ROUTINE REPAIR)

(23) SEVERE RUST WITH SECTION LOSS MORE THEN 50% AT RIVETS ON THE UPPER AND LOWER GUSSET PLATES CONNECTING THE WIND BRACING TO THE LOWER TRUSS PANEL POINTS IN SPANS 1 THROUGH 4. NUMBER AND LOCATION SHOWN. (ROUTINE REPAIR)

ROUTINE REPAIRS

(25) MORE THAN 50% SECTION LOSS AT THE BATTEN PLATE RIVETS ON THE BOTTOM OF THE LOWER CHORD IN SPANS 3 AND 4. NUMBER OF AFFECTED RIVETS AS SHOWN. (ROUTINE REPAIR)

(26) HEAVY ACCUMULATION OF DEBRIS AT THE INSIDE OF THE BOTTOM CHORD AT L12, L14 AND L12'. (ROUTINE REPAIR)

(27) IMPACTED RUST ON THE VERTICAL AND DIAGONAL TRUSS MEMBERS ABOVE, AT AND BELOW SIDEWALK LEVEL. REFER TO APPENDIX A FOR LOCATION AND AMOUNT. (ROUTINE REPAIR)

(28) MISSING RIVETS AND/OR LOOSE BOLTS CONNECTING THE FINGER JOINTS TO THE FLOORBEAMS AT L0, L10, AND L10'. NUMBER AS SHOWN. (ROUTINE REPAIR)

(29) SEVERELY RUSTED FLOORBEAM FLANGES WITH SIGNIFICANT SECTION LOSS (1/8" OR AS SHOWN). (ROUTINE REPAIR)

(30) SEVERELY RUSTED STRINGER FLANGES WITH SIGNIFICANT SECTION LOSS (1/8" OR AS SHOWN). (ROUTINE REPAIR)

(31) MODERATE RUST AND DEBRIS ACCUMULATION AT THE STRINGER BEARINGS AT L10 AND L10'. (ROUTINE REPAIR)

(32) IMPACTED RUST AT THE STRINGER SEAT ANGLES AT L0, L10, AND L0'. (ROUTINE REPAIR)

NO REPAIR RECOMMENDED

[2] ALL STEEL MEMBERS EXHIBIT MINOR SECTION LOSS (< 1/8").

[3] A GAP EXISTS BETWEEN THE STRINGER TOP FLANGE AND THE CONCRETE DECK. SIZE AS SHOWN.

[4] THE NUTS ON THE ANCHOR BOLTS FOR THE BEARINGS ON THE NORTH AND SOUTH TRUSSES EXHIBIT UP TO 60% SECTION LOSS.

[5] THE INNER GUSSET PLATE OF THE TRUSS LOWER CHORD IS RUSTED WITH SIGNIFICANT SECTION LOSS (1/8" OR AS SHOWN).

[6] THERE IS IMPACT RUST BETWEEN THE TOP FLANGE OF THE STRINGERS AND/OR FLOORBEAMS AND THE CONCRETE DECK. ALSO BETWEEN THE BOTTOM FLANGE ANGLES AND THE COVER PLATES. SIZE AS SHOWN.

[7] THE TOP AND BOTTOM FLANGES AND/OR WEB OF THE DIAPHRAGMS EXHIBIT SIGNIFICANT SECTION LOSS (1/8" OR AS SHOWN) FOR FULL WIDTH OF FLANGES OR FULL DEPTH OF WEB.

[8] THE CROSS BRACING TOP GUSSET PLATE BETWEEN STRINGERS S1 AND S2 AT PANEL POINT L3 OF THE SOUTH TRUSS EXHIBIT SIGNIFICANT SECTION LOSS (1/8") WITH EIGHT RIVETS EXHIBITING 1/8" HEAD LOSS.

[9] THE UPPER OR LOWER CROSS BRACING GUSSET PLATE CONNECTED TO THE TRUSS LOWER CHORD EXHIBITS SIGNIFICANT SECTION LOSS (1/8" OR AS SHOWN).

NO REPAIR RECOMMENDED

[13] THE UPPER CHORD CONNECTION PLATES ARE MISSING TWO RIVETS ON THE NORTH AND SOUTH TRUSSES.

[14] THE RIVET HEADS ON THE INNER GUSSET PLATE OF THE FLOORBEAM TO TRUSS LOWER CHORD CONNECTION ARE SEVERELY RUSTED WITH 20-40% SECTION LOSS. THE NUMBER OF AFFECTED RIVETS IS SHOWN.

[15] THE RIVET HEADS ON THE TOP PLATE OF THE TRUSS LOWER CHORD ARE SEVERELY RUSTED WITH 20-40% SECTION LOSS. THE NUMBER OF AFFECTED RIVETS IS SHOWN.

[16] THE RIVET HEADS ON THE BOTTOM PLATE OF THE TRUSS LOWER CHORD ARE SEVERELY RUSTED WITH 20-40% SECTION LOSS. THE NUMBER OF AFFECTED RIVETS IS SHOWN.

LEGEND

(LZ) PANEL POINT NUMBER (AS PER PANY&NJ SYSTEM)

(Z) SPAN NUMBER (AS PER NYSDOT SYSTEM)

PHOTO TAKEN BELOW DECK

THE PORT AUTHORITY OF NY & NJ

2002 BIENNIAL INSPECTION

OF THE GOETHALS BRIDGE

Title

BIN 5523059

MAIN SPAN

DEFICIENCY AND PHOTO LOCATION PLAN
SUPERSTRUCTURE STEEL – 1
PANEL POINTS L0 TO L14

No	Date	Revision	Approved

This drawing subject to conditions in contract. All inventions, ideas, designs and methods herein are reserved to Port Authority and may not be used without its written consent.

Designed by	Drawn by	Task Leader
	VD	CD

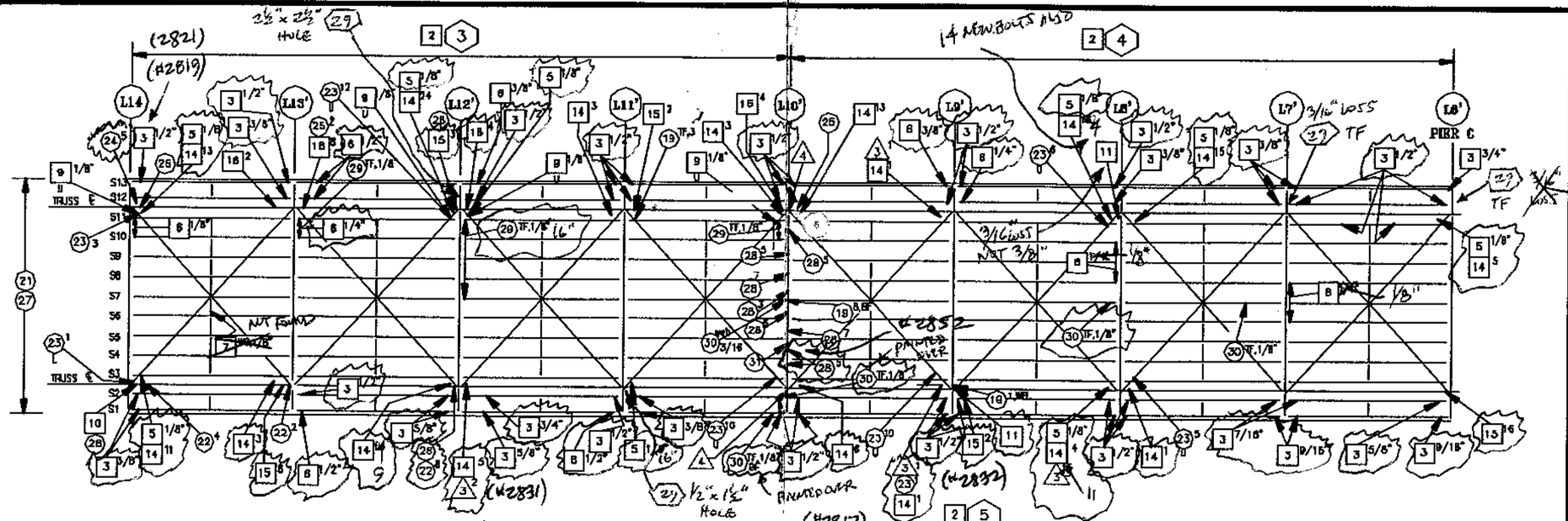
Date 11/01/02 Scale N.T.S.

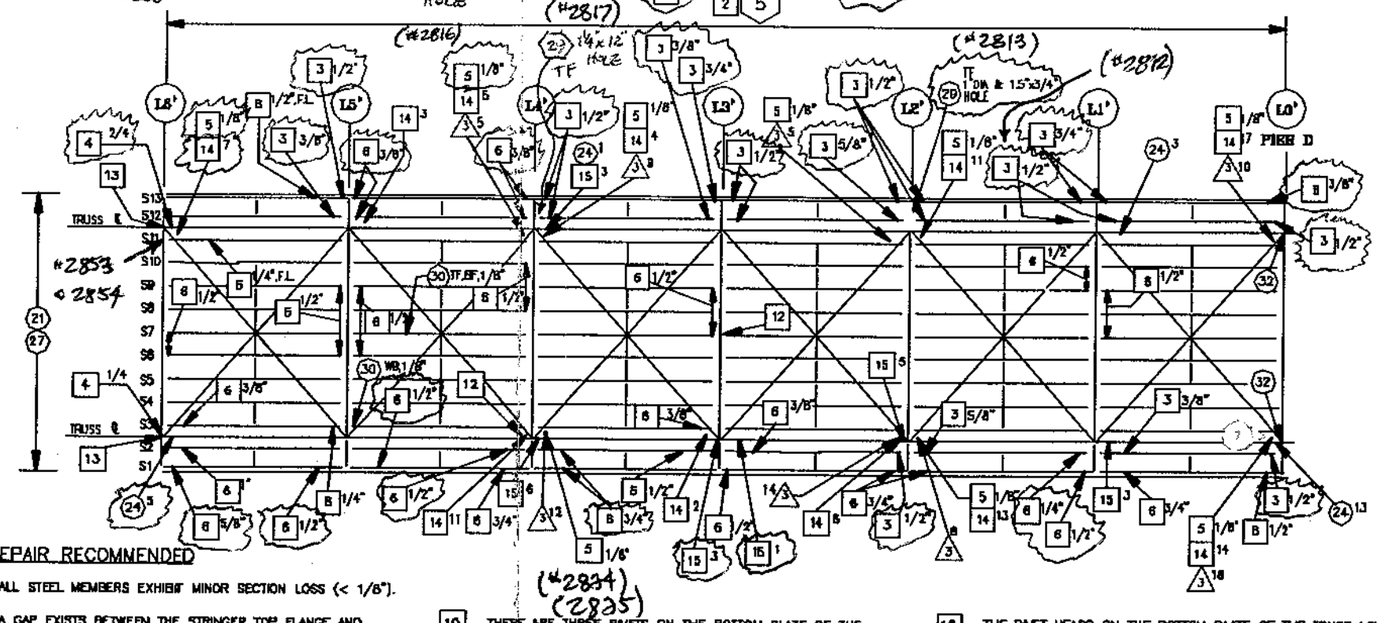
Contract Number 405-99-01 Drawing Number 5523059-6

PANY&NJ – QAD – 2002

A-13

R. SZATKOWSKI 5-20-04 & 5-21-04





KEY CONDITION NOTES – SUPERSTRUCTURE STEEL

PRIORITY REPAIRS

△3 DETERIORATED RIVETS WITH 50% OR MORE HEAD LOSS AT THE GUSSET PLATE CONNECTIONS TO THE TRUSS LOWER CHORDS. NUMBER OF AFFECTED RIVETS AS SHOWN. (PRIORITY REPAIR)

△4 CRACKED INTERMITTENT FILLET WELD AND IMPACTED RUST BETWEEN BEARING PLATE AND THE I-BEAM OF THE DUMMY CHORD AT PANEL POINT L10' OF THE NORTH AND SOUTH TRUSSES. (PRIORITY REPAIR)

ROUTINE REPAIRS

(19) RUSTED RIVETS WITH SECTION LOSSES ON FLOORBEAMS OUTSIDE THE PREVIOUSLY REPAIRED AREAS. NUMBER AND LOCATION AS SHOWN. (ROUTINE REPAIR)

(21) MODERATE RUST AT ALL STEEL MEMBERS INCLUDING THE UNDERSIDE OF JOINT AND BRACING MEMBERS. (ROUTINE REPAIR)

(22) MISSING AND/OR SEVERELY RUSTED LACING BARS WITH SIGNIFICANT SECTION LOSS (1/8") ON THE LOWER CHORD OF THE NORTH AND SOUTH TRUSSES IN SPAN 3. NUMBER OF AFFECTED LACING BARS AS SHOWN (ROUTINE REPAIR)

(23) SEVERE RUST WITH SECTION LOSS MORE THEN 50% AT RIVETS ON THE UPPER AND LOWER GUSSET PLATES CONNECTING THE WIND BRACING TO THE LOWER TRUSS PANEL POINTS IN SPANS 1 THROUGH 4. NUMBER AND LOCATION SHOWN. (ROUTINE REPAIR)

(24) MORE THAN 50% SECTION LOSS AT THE BATTEN PLATE RIVETS ON THE TOP OF THE LOWER CHORD IN SPANS 3 AND 5. (ROUTINE REPAIR)

(25) MORE THAN 50% SECTION LOSS AT THE BATTEN PLATE RIVETS ON THE BOTTOM OF THE LOWER CHORD IN SPANS 3 AND 4. NUMBER OF AFFECTED LACING BARS AS SHOWN. (ROUTINE REPAIR)

(26) HEAVY ACCUMULATION OF DEBRIS AT THE INSIDE OF THE BOTTOM CHORD AT L12, L14 AND L12'. (ROUTINE REPAIR)

(27) IMPACTED RUST ON THE VERTICAL AND DIAGONAL TRUSS MEMBERS ABOVE, AT AND BELOW SIDEWALK LEVEL. REFER TO APPENDIX A FOR LOCATION AND AMOUNT. (ROUTINE REPAIR)

(28) MISSING RIVETS AND/OR LOOSE BOLTS CONNECTING THE FINGER JOINTS TO THE FLOORBEAMS AT L0, L10, AND L10'. NUMBER AS SHOWN. (ROUTINE REPAIR)

(29) SEVERELY RUSTED FLOORBEAM FLANGES WITH SIGNIFICANT SECTION LOSS (1/8" OR AS SHOWN). (ROUTINE REPAIR)

(30) SEVERELY RUSTED STRINGER FLANGES WITH SIGNIFICANT SECTION LOSS (1/8" OR AS SHOWN). (ROUTINE REPAIR)

(31) MODERATE RUST AND DEBRIS ACCUMULATION AT THE STRINGER BEARINGS AT L1D AND L10'. (ROUTINE REPAIR)

(32) IMPACTED RUST AT THE STRINGER SEAT ANGLES AT L0, L10, AND L0'. (ROUTINE REPAIR)

NO REPAIR RECOMMENDED

[2] ALL STEEL MEMBERS EXHIBIT MINOR SECTION LOSS (< 1/8").

[3] A GAP EXISTS BETWEEN THE STRINGER TOP FLANGE AND THE CONCRETE DECK. SIZE AS SHOWN.

[4] THE NUTS ON THE ANCHOR BOLTS FOR THE BEARINGS ON THE NORTH AND SOUTH TRUSSES EXHIBIT UP TO 80% SECTION LOSS.

[5] THE INNER GUSSET PLATE OF THE TRUSS LOWER CHORD IS RUSTED WITH SIGNIFICANT SECTION LOSS (1/8" OR AS SHOWN).

[6] THERE IS IMPACT RUST BETWEEN THE TOP FLANGE OF THE STRINGERS AND/OR FLOORBEAMS AND THE CONCRETE DECK. ALSO BETWEEN THE BOTTOM FLANGE ANGLES AND THE COVER PLATES. SIZE AS SHOWN.

[7] THE TOP AND BOTTOM FLANGES AND/OR WEB OF THE DIAPHRAGMS EXHIBIT SIGNIFICANT SECTION LOSS (1/8" OR AS SHOWN) FOR FULL WIDTH OF FLANGES OR FULL DEPTH OF WEB.

[8] THE UPPER OR LOWER CROSS BRACING GUSSET PLATE CONNECTED TO THE TRUSS LOWER CHORD EXHIBITS SIGNIFICANT SECTION LOSS (1/8" OR AS SHOWN).

[10] THERE ARE THREE RIVETS ON THE BOTTOM PLATE OF THE DIAGONAL MEMBER OF THE SOUTH TRUSS AT PANEL POINT 14 WITH 30% HEAD LOSS.

[11] THE INNER GUSSET PLATE AT THE UNDERSIDE OF THE DECK ON THE NORTH AND SOUTH TRUSSES EXHIBITS 3/8" SECTION LOSS IN SPAN 4.

[12] THE LATERAL CROSS BRACINGS OF THE UPPER CHORD IS MISSING ONE RIVET IN SPAN 5.

[13] THE UPPER CHORD CONNECTION PLATES ARE MISSING TWO RIVETS ON THE NORTH AND SOUTH TRUSSES.

[14] THE RIVET HEADS ON THE INNER GUSSET PLATE OF THE FLOORBEAM TO TRUSS LOWER CHORD CONNECTION ARE SEVERELY RUSTED WITH 20–40% SECTION LOSS. THE NUMBER OF AFFECTED RIVETS IS SHOWN.

[15] THE RIVET HEADS ON THE TOP PLATE OF THE TRUSS LOWER CHORD ARE SEVERELY RUSTED WITH 20–40% SECTION LOSS. THE NUMBER OF AFFECTED RIVETS IS SHOWN.

[16] THE RIVET HEADS ON THE BOTTOM PLATE OF THE TRUSS LOWER CHORD ARE SEVERELY RUSTED WITH 20–40% SECTION LOSS. THE NUMBER OF AFFECTED RIVETS IS SHOWN.

LEGEND

(LZ) PANEL POINT NUMBER (AS PER PANY&NJ SYSTEM)

(Z) SPAN NUMBER (AS PER NYSDOT SYSTEM)

PHOTO TAKEN BELOW DECK

Sheet 7 Of 7

THE PORT AUTHORITY OF NY & NJ

2002 BIENNIAL INSPECTION OF THE GOETHALS BRIDGE

Title

BIN 5523059

MAIN SPAN

DEFICIENCY AND PHOTO LOCATION PLAN SUPERSTRUCTURE STEEL – 2 PANEL POINTS L14 TO L0'

No	Date	Revision	Approved

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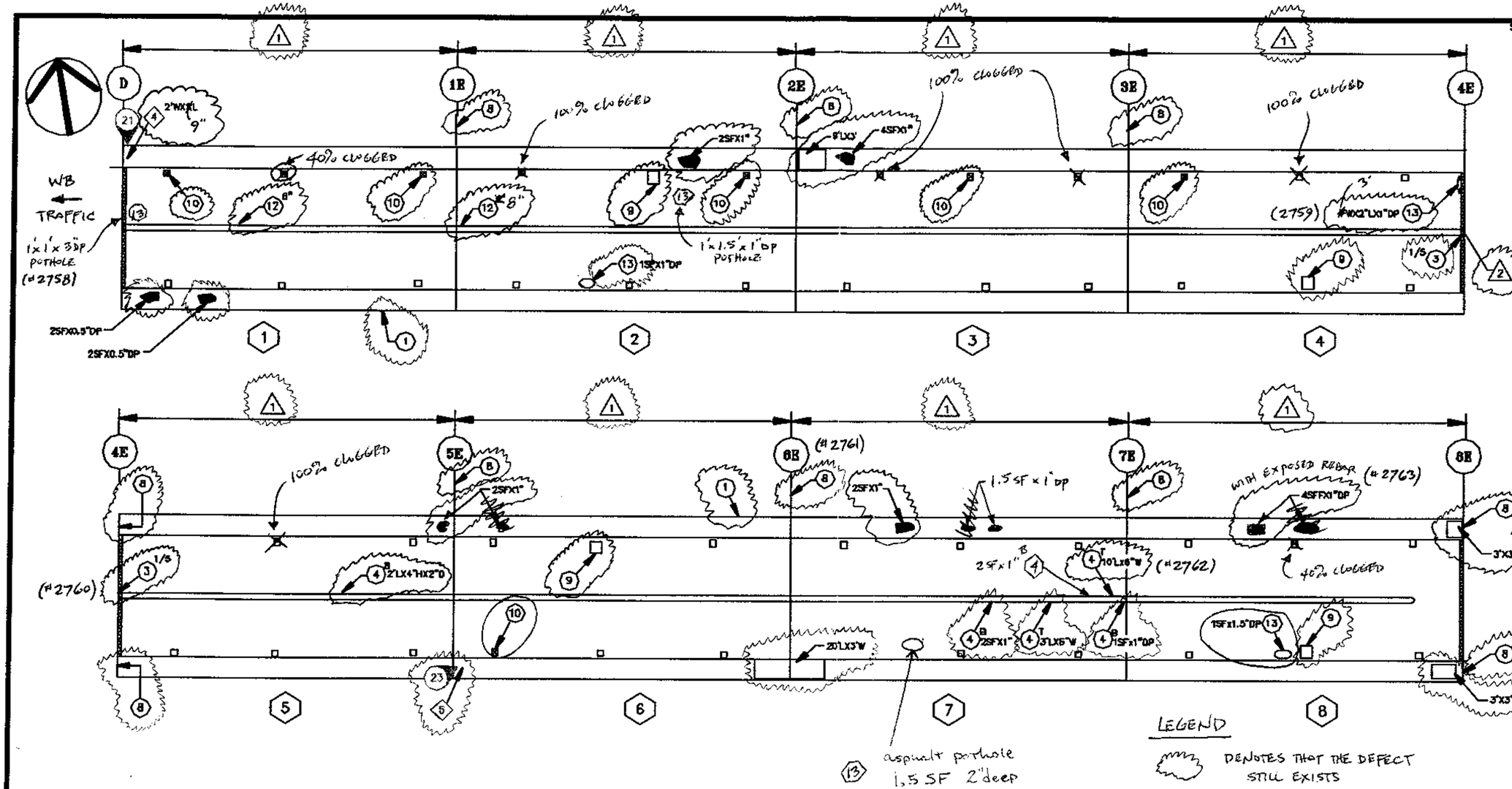
Designed by	Drawn by	Task Leader
	VO	CD

Date 11/01/02 Scale N.T.S.

Contract Number 405-99-01 Drawing Number 5523059-7

R. SZATKOWSKI 5-20-04 & 5-21-04 A-14



KEY CONDITION NOTES – TOP OF DECK

PRIORITY REPAIRS

△1 THE NORTH AND SOUTH SIDEWALKS EXHIBIT DELAMINATED AND SPALLED CONCRETE AT TOP SURFACE AND AT UNDERSIDE, SEE LEGEND BELOW. (PRIORITY REPAIR)

DELAMINATED/SPALLED CONCRETE AT TOP SURFACE OF SIDEWALKS WITHOUT EXPOSED REBARS. SIZE AS SHOWN. (PRIORITY REPAIR)

△2 UP TO 1" OF VERTICAL MISALIGNMENT AT THE FINGER JOINTS OVER PIERS 4E, 8E, 12E, 16E, 20E, 24E, 30E AND 35E. (PRIORITY REPAIR)

SAFETY REPAIRS

◇4 HOLES THROUGH SIDEWALK AND/OR CURB AT PIERS D, 15E AND 33E. SIZE AS SHOWN. (SAFETY REPAIR)

◇5 MISSING COVER OF SMALL JUNCTION BOX WITH EXPOSED WIRES AT BASE OF THE SIGN STRUCTURE POST AT SOUTH SIDEWALK NEAR PIER 5E. (SAFETY REPAIR)

ROUTINE REPAIRS

(1) MISSING LIGHT STANDARD AT SOUTH FASCIA OF SPAN 1 AND AT NORTH FASCIA OF SPAN 6. (ROUTINE REPAIR)

(3)A/B MISSING BOLTS AT THE STEEL PLATE CONNECTION TO THE CONCRETE MEDIAN OVER THE FINGER EXPANSION JOINTS. "A" INDICATES THE NUMBER OF MISSING BOLTS. "B" INDICATES TOTAL NUMBER OF BOLTS. (ROUTINE REPAIR)

(4)x SPALLED, CRACKED AND/OR DELAMINATED CONCRETE AT THE TOP AND BASE OF THE MEDIAN BARRIER. SIZE AS SHOWN. "x" INDICATES LOCATION ON BARRIER (T=TOP, B=BOTTOM). (ROUTINE REPAIR)

(8) DETERIORATED AND WORN OUT COMPRESSION JOINT MATERIAL AT THE PIERS AND/OR SIDEWALKS. (ROUTINE REPAIR)

(9) UP TO 1" OF VERTICAL DIFFERENTIAL BETWEEN THE LARGE SCUPPER GRATING AND GRATE FRAMING. (ROUTINE REPAIR)

(10) 100% OR PARTIALLY CLOGGED SMALL ROADWAY SCUPPERS. (ROUTINE REPAIR)

(12)X MISALIGNED MEDIAN PARAPET DUE TO VEHICULAR IMPACT IN SPANS 1, 2 AND 13. "X" INDICATES VALUE OF MISALIGNMENT. (ROUTINE REPAIR)

(13) POTHOLE IN ASPHALT WEARING SURFACE. SIZE AS SHOWN. (ROUTINE REPAIR)

LEGEND

DENOTES THAT THE DEFECT STILL EXISTS

DENOTES THAT THE DEFECT HAS BEEN REPAIRED

LEGEND

(13) PIER NUMBER (AS PER PANY&NJ SYSTEM)

(2) SPAN NUMBER (AS PER NYSDOT SYSTEM)

PHOTO TAKEN ABOVE DECK

CLEAR SCUPPER

CLOGGED SCUPPER (ROUTINE REPAIR)

LARGE SCUPPER

ASPHALT POTHOLE (ROUTINE REPAIR)

EXPANSION FINGER JOINT

STEEL PLATE

THE PORT AUTHORITY OF NY & NJ

2002 BIENNIAL INSPECTION OF THE GOETHALS BRIDGE

Title

BIN 552305A

NEW YORK APPROACH

DEFICIENCY & PHOTO LOCATION PLAN
TOP OF DECK – 1
PIERS 'D' TO 8E

No	Date	Revision	Approved

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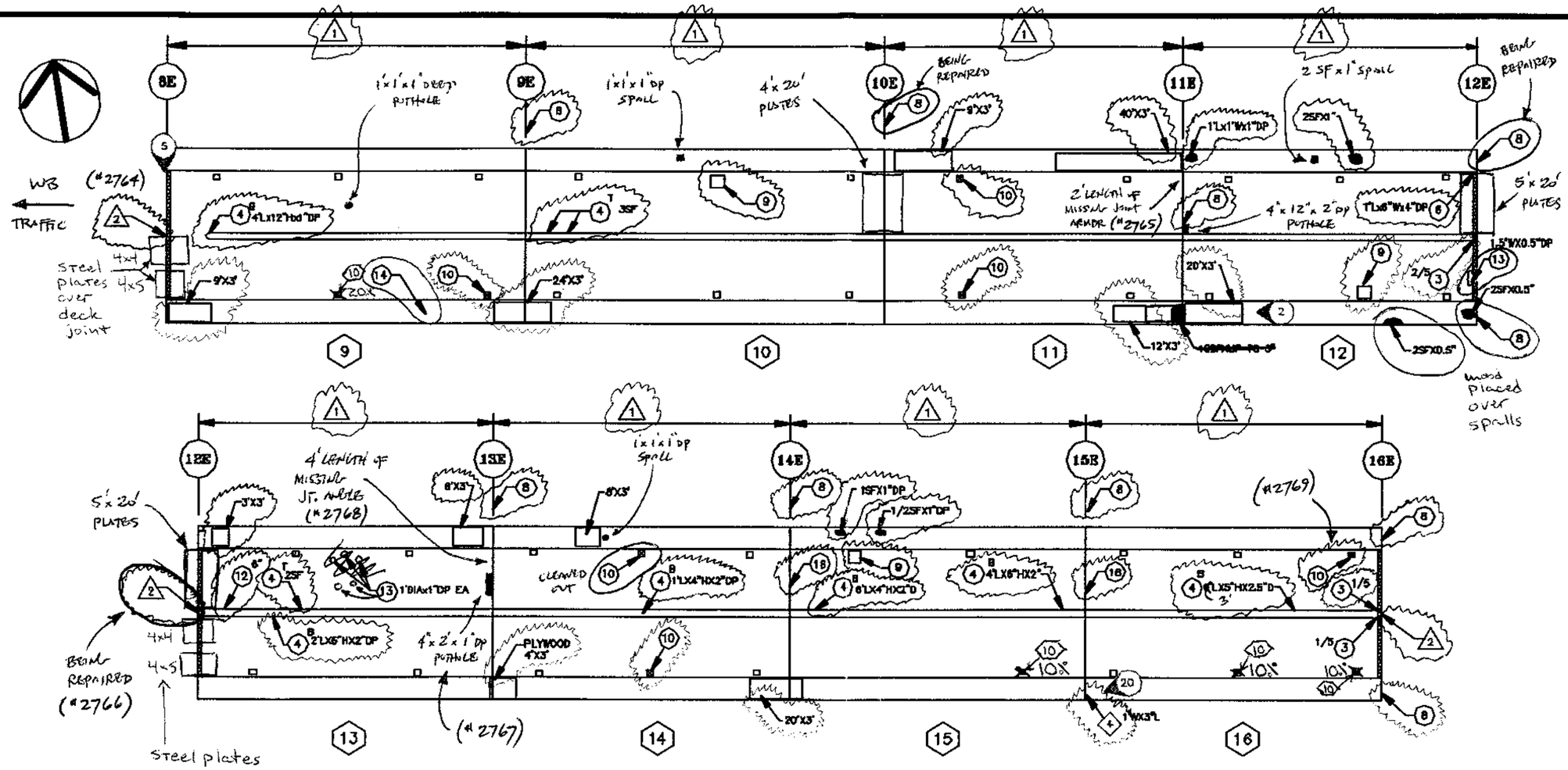
Designed by	Drawn by	Task Leader
	VD	CD

Date 11/01/02 Scale N.T.S.

Contract Number 403-09-01 Drawing Number 552305A-2

R. SZATKOWSKI 5-17-04



KEY CONDITION NOTES – TOP OF DECK

PRIORITY REPAIRS

1. THE NORTH AND SOUTH SIDEWALKS EXHIBIT DELAMINATED AND SPALLED CONCRETE AT TOP SURFACE AND AT UNDERSIDE. SEE LEGEND BELOW. (PRIORITY REPAIR)

   DELAMINATED/SPALLED CONCRETE AT TOP SURFACE OF SIDEWALKS WITHOUT EXPOSED REBARS. SIZE AS SHOWN. (PRIORITY REPAIR)

2. UP TO 1" OF VERTICAL MISALIGNMENT AT THE FINGER JOINTS OVER PIERS 4E, 8E, 12E, 16E, 20E, 24E, 30E AND 35E. (PRIORITY REPAIR)

SAFETY REPAIRS

4. HOLES THROUGH SIDEWALK AND/OR CURB AT PIERS D, 15E AND 33E. SIZE AS SHOWN. (SAFETY REPAIR)

ROUTINE REPAIRS

3 A/B MISSING BOLTS AT THE STEEL PLATE CONNECTION TO THE CONCRETE MEDIAN OVER THE FINGER EXPANSION JOINTS. "A" INDICATES THE NUMBER OF MISSING BOLT. "B" INDICATES TOTAL NUMBER OF BOLTS. (ROUTINE REPAIR)

4 X SPALLED, CRACKED AND/OR DELAMINATED CONCRETE AT THE TOP AND BASE OF THE MEDIAN BARRIER. SIZE AS SHOWN. "X" INDICATES LOCATION ON BARRIER (T=TOP, B=BOTTOM). (ROUTINE REPAIR)

6 SPALLED GRANITE CURBS ALONG THE NORTH SIDEWALK NEAR PIER 12E AND BETWEEN 18E–19E. SIZE AS SHOWN. (ROUTINE REPAIR)

8 DETERIORATED AND WORN OUT COMPRESSION JOINT MATERIAL AT THE PIERS AND/OR SIDEWALKS. (ROUTINE REPAIR)

9 UP TO 1" OF VERTICAL DIFFERENTIAL BETWEEN THE LARGE SCUPPER GRATING AND GRATE FRAMING. (ROUTINE REPAIR)

10 100% OR PARTIALLY CLOGGED SMALL ROADWAY SCUPPERS. (ROUTINE REPAIR)

12 X MISALIGNED MEDIAN PARAPET DUE TO VEHICULAR IMPACT IN SPANS 1, 2 AND 13. "X" INDICATES VALUE OF MISALIGNMENT. (ROUTINE REPAIR)

13 POTHOLE IN ASPHALT WEARING SURFACE. SIZE AS SHOWN. (ROUTINE REPAIR)

14 MISSING LIGHT FIXTURE AT TOP OF THE SOUTH LIGHT STANDARD BETWEEN PIERS 8E AND 9E. (ROUTINE REPAIR)

16 FULLY OR PARTIALLY PAVED OVER ROADWAY JOINT AT PIERS 14E, 15E, 18E, 27E, 33E, 34E, 36E, 37E AND 40E. (ROUTINE REPAIR)

LEGEND

- PIER NUMBER (AS PER PANY&NJ SYSTEM)
- SPAN NUMBER (AS PER NYSDOT SYSTEM)
- PHOTO TAKEN ABOVE DECK
- CLEAR SCUPPER
- CLOGGED SCUPPER (ROUTINE REPAIR)
- LARGE SCUPPER (ROUTINE REPAIR)
- ASPHALT POTHOLE
- EXPANSION FINGER JOINT
- STEEL PLATE

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2002 BIENNIAL INSPECTION

OF THE GOETHALS BRIDGE

Title

BIN 552305A

NEW YORK APPROACH

DEFICIENCY & PHOTO LOCATION PLAN
TOP OF DECK – 2
PIERS 8E TO 16E

No	Date	Revision	Approved

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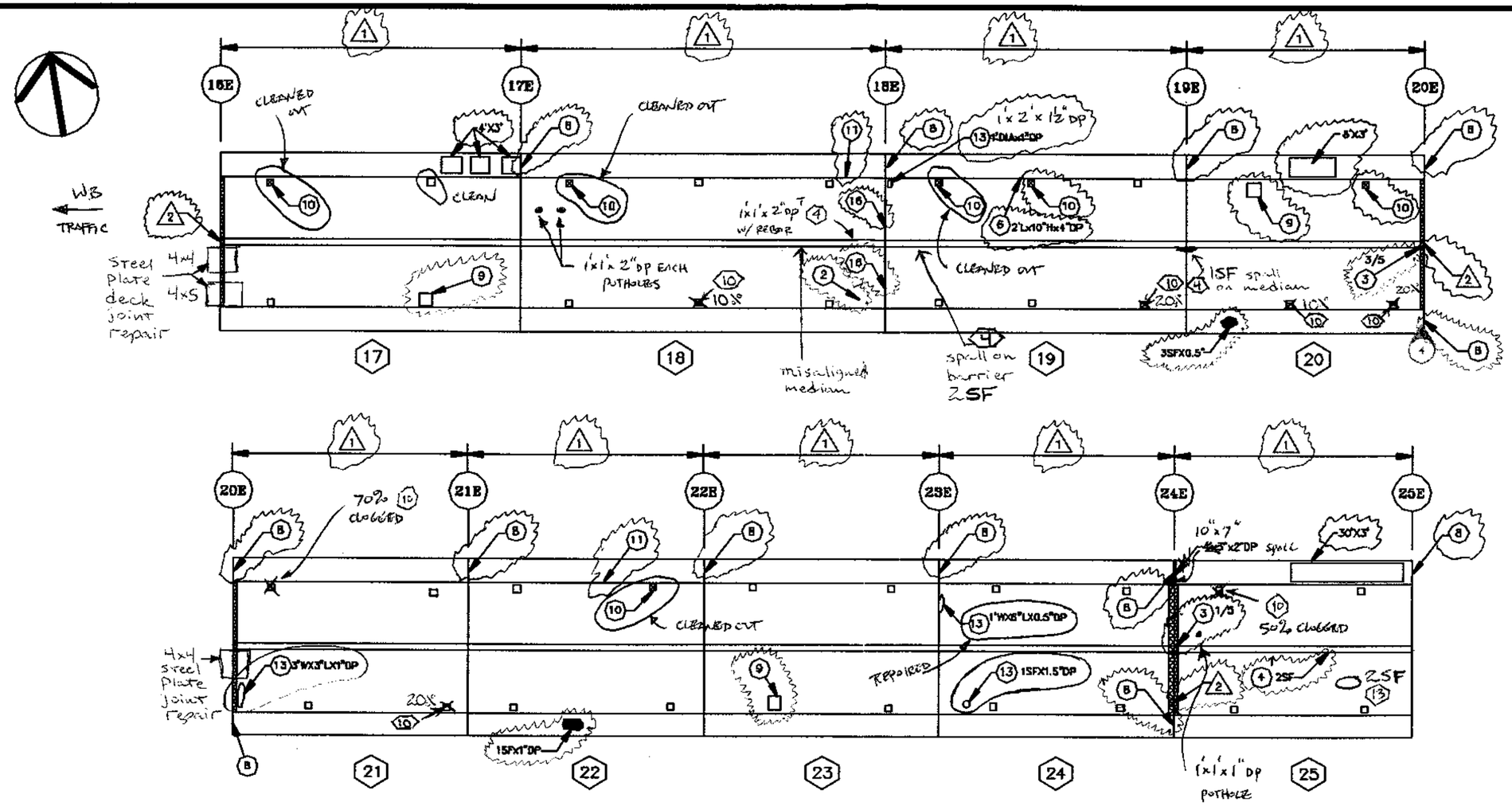
Date 11/01/02 | Scale N.T.S.

Contract Number 405-99-D1 | Drawing Number 552305A-3

PANY&NJ – QAD – 2002

R. SZATKOWSKI 5/17/04



KEY CONDITION NOTES – TOP OF DECK

PRIORITY REPAIRS

1. THE NORTH AND SOUTH SIDEWALKS EXHIBIT DELAMINATED AND SPALLED CONCRETE AT TOP SURFACE AND AT UNDERSIDE, SEE LEGEND BELOW. (PRIORITY REPAIR)

   DELAMINATED/SPALLED CONCRETE AT TOP SURFACE OF SIDEWALKS WITHOUT EXPOSED REBARS. SIZE AS SHOWN. (PRIORITY REPAIR)

2. UP TO 1" OF VERTICAL MISALIGNMENT AT THE FINGER JOINTS OVER PIERS 4E, 8E, 12E, 16E, 20E, 24E, 30E AND 35E. (PRIORITY REPAIR)

ROUTINE REPAIRS

(2) DAMAGED OVERHEAD CONTROL SIGNAL OVER THE RIGHT LANE OF THE EASTBOUND ROADWAY BETWEEN PIERS 17E AND 18E. (ROUTINE REPAIR)

(3)A/B MISSING BOLTS AT THE STEEL PLATE CONNECTION TO THE CONCRETE MEDIAN OVER THE FINGER EXPANSION JOINTS. "A" INDICATES THE NUMBER OF MISSING BOLTS. "B" INDICATES TOTAL NUMBER OF BOLTS. (ROUTINE REPAIR)

(4)X SPALLED, CRACKED AND/OR DELAMINATED CONCRETE AT THE TOP AND BASE OF THE MEDIAN BARRIER. SIZE AS SHOWN. "X" INDICATES LOCATION ON BARRIER (T=TOP, B=BOTTOM). (ROUTINE REPAIR)

(6) SPALLED GRANITE CURBS ALONG THE NORTH SIDEWALK NEAR PIER 12E AND BETWEEN 18E–19E. SIZE AS SHOWN. (ROUTINE REPAIR)

(8) DETERIORATED AND WORN OUT COMPRESSION JOINT MATERIAL AT THE PIERS AND/OR SIDEWALKS. (ROUTINE REPAIR)

(9) UP TO 1" OF VERTICAL DIFFERENTIAL BETWEEN THE LARGE SCUPPER GRATING AND GRATE FRAMING. (ROUTINE REPAIR)

(10) 100% OR PARTIALLY CLOGGED SMALL ROADWAY SCUPPERS. (ROUTINE REPAIR)

(11) HOLES THROUGH THE STEEL SECTION OF THE PARAPET AT THE NORTH SIDEWALK BETWEEN PIERS 17E–18E, 21E–22E AND 26E–27E. (ROUTINE REPAIR)

(13) POTHOLE IN ASPHALT WEARING SURFACE. SIZE AS SHOWN. (ROUTINE REPAIR)

(16) FULLY OR PARTIALLY PAVED OVER ROADWAY JOINT AT PIERS 14E, 15E, 18E, 27E, 33E, 34E, 36E, 37E AND 40E. (ROUTINE REPAIR)

LEGEND

- PIER NUMBER (AS PER PANY&NJ SYSTEM)
- SPAN NUMBER (AS PER NYSDOT SYSTEM)
- PHOTO TAKEN ABOVE DECK
- CLEAR SCUPPER
- CLOGGED SCUPPER (ROUTINE REPAIR)
- LARGE SCUPPER
- ASPHALT POTHOLE (ROUTINE REPAIR)
- EXPANSION FINGER JOINT
- STEEL PLATE

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THE PORT AUTHORITY OF NY & NJ

2002 BIENNIAL INSPECTION

OF THE GOETHALS BRIDGE

Title

BIN 552305A

NEW YORK APPROACH

DEFICIENCY & PHOTO LOCATION PLAN
TOP OF DECK – 3
PIERS 16E TO 25E

No	Date	Revision	Approved

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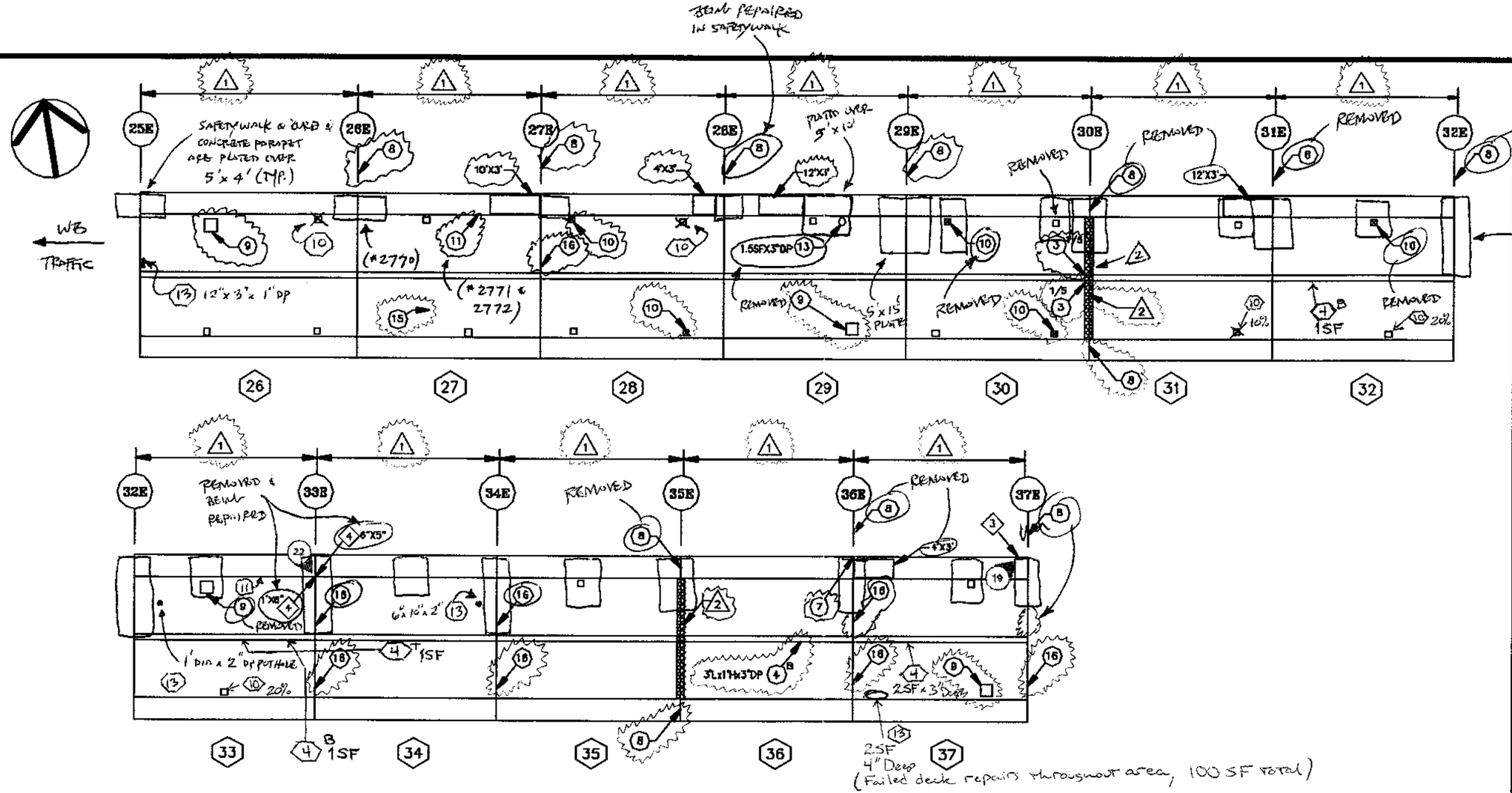
	VD	CB

Date 11/01/02 Scale N.T.S.

Contract Number 405-99-01 Drawing Number 552305A-4

R. STATKUNSKI 5/17/04



KEY CONDITION NOTES – TOP OF DECK

PRIORITY REPAIRS

1. THE NORTH AND SOUTH SIDEWALKS EXHIBIT DELAMINATED AND SPALLED CONCRETE AT TOP SURFACE AND AT UNDERSIDE, SEE LEGEND BELOW. (PRIORITY REPAIR)

   DELAMINATED/SPALLED CONCRETE AT TOP SURFACE OF SIDEWALKS WITHOUT EXPOSED REBARS. SIZE AS SHOWN. (PRIORITY REPAIR)

2. UP TO 1" OF VERTICAL MISALIGNMENT AT THE FINGER JOINTS OVER PIERS 4E, 8E, 12E, 16E, 20E, 24E, 30E AND 35E. (PRIORITY REPAIR)

SAFETY REPAIRS

3. MISSING 2 FOOT LONG SECTION OF THE VERTICAL BARS AT THE NORTH SIDEWALK RAILING AT PIER 37E. (SAFETY REPAIR)
4. HOLES THROUGH SIDEWALK AND/OR CURB AT PIERS D, 15E AND 33E. SIZE AS SHOWN. (SAFETY REPAIR)

ROUTINE REPAIRS

3 A/B MISSING BOLTS AT THE STEEL PLATE CONNECTION TO THE CONCRETE MEDIAN OVER THE FINGER EXPANSION JOINTS. "A" INDICATES THE NUMBER OF MISSING BOLTS. "B" INDICATES TOTAL NUMBER OF BOLTS. (ROUTINE REPAIR)

4 x SPALLED, CRACKED AND/OR DELAMINATED CONCRETE AT THE TOP AND BASE OF THE MEDIAN BARRIER. SIZE AS SHOWN. "x" INDICATES LOCATION ON BARRIER (T=TOP, B=BOTTOM). (ROUTINE REPAIR)

7 UP TO 2" OFFSET AT RAILING OF THE NORTH SIDEWALK AT PIER 36E DUE TO IMPACT DAMAGE. (ROUTINE REPAIR)

8 DETERIORATED AND WORN OUT COMPRESSION JOINT MATERIAL AT THE PIERS AND/OR SIDEWALKS. (ROUTINE REPAIR)

9 UP TO 1" OF VERTICAL DIFFERENTIAL BETWEEN THE LARGE SCUPPER GRATING AND GRATE FRAMING. (ROUTINE REPAIR)

10 100% OR PARTIALLY CLOGGED SMALL ROADWAY SCUPPERS. (ROUTINE REPAIR)

11 HOLES THROUGH THE STEEL SECTION OF THE PARAPET AT THE NORTH SIDEWALK BETWEEN PIERS 17E–19E, 21E–22E AND 26E–27E. (ROUTINE REPAIR)

13 POTHOLE IN ASPHALT WEARING SURFACE. SIZE AS SHOWN. (ROUTINE REPAIR)

15 MISSING LIGHT FIXTURE AT THE CANTILEVERED SIGN OVER THE EAST BOUND ROADWAY IN SPAN 27E. (ROUTINE REPAIR)

18 FULLY OR PARTIALLY PAVED OVER ROADWAY JOINT AT PIERS 14E, 15E, 18E, 27E, 33E, 34E, 36E, 37E AND 40E. (ROUTINE REPAIR)

LEGEND

- PIER NUMBER (AS PER PANY&NJ SYSTEM)
- SPAN NUMBER (AS PER NYSDOT SYSTEM)
- PHOTO TAKEN ABOVE DECK
- CLEAR SCUPPER
- CLOGGED SCUPPER (ROUTINE REPAIR)
- LARGE SCUPPER
- ASPHALT POTHOLE (ROUTINE REPAIR)
- EXPANSION FINGER JOINT
- STEEL PLATE

Sheet 5 Of 18

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2002 BIENNIAL INSPECTION OF THE GOETHALS BRIDGE

Title

BIN 552305A

NEW YORK APPROACH

DEFICIENCY & PHOTO LOCATION PLAN
TOP OF DECK – 4
PIERS 25E TO 37E

No	Date	Revision	Approved

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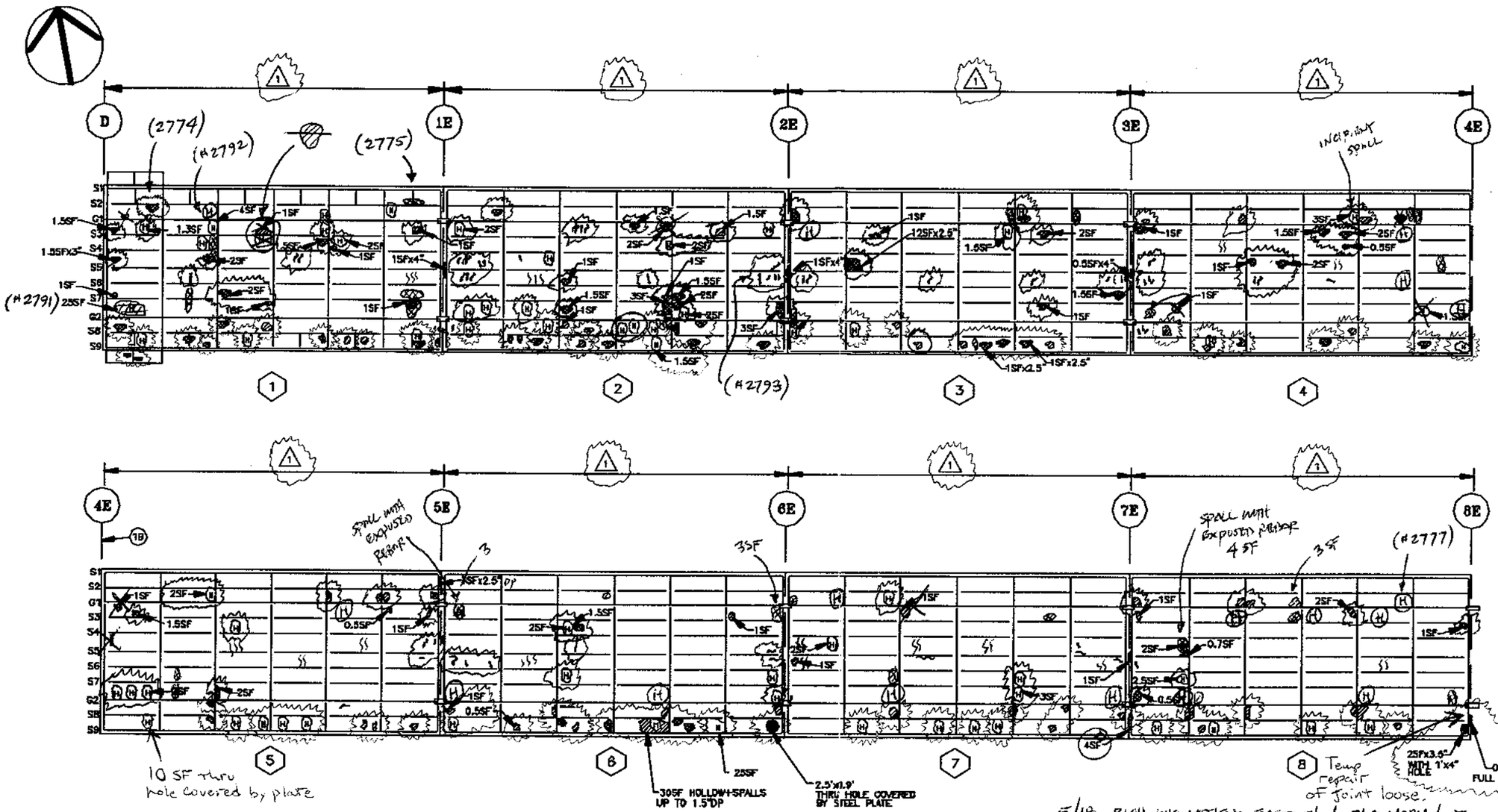
	VD	CB

Date 11/01/02 Scale N.T.S.

Contract Number 406-99-D1 Drawing Number 552305A-5

R. SZATKOWSKI 5-17-04



5/18 RICH WAS NOTIFIED FIRST THING THIS MORNING OF LOOSE DECK JOINT ARMOR AT PIER 8E IN THE EB ROADWAY & A LEAKING WATER MAIN AT PIER 4E ALONG THE SOUTH SAFETYWALK.

KEY CONDITION NOTES – UNDERSIDE OF DECK

PRIORITY REPAIRS

△1 THE NORTH AND SOUTH SIDEWALKS EXHIBIT DELAMINATED AND SPALLED CONCRETE AT TOP SURFACE AND AT UNDERSIDE, SEE LEGEND BELOW. (PRIORITY REPAIR)

- SPALLED CONCRETE WITHOUT EXPOSED REBARS AT THE UNDERSIDE OF NORTH AND SOUTH SIDEWALKS UP TO 3SF AND UP TO 1"DP. UNLESS OTHERWISE NOTED. (PRIORITY REPAIR)
- SPALLED CONCRETE WITH EXPOSED REBARS AT THE UNDERSIDE OF NORTH AND SOUTH SIDEWALKS UP TO 3SF AND UP TO 2"DP. UNLESS OTHERWISE NOTED. (PRIORITY REPAIR)
- (H) HOLLOW CONCRETE AT UNDERSIDE OF SIDEWALK UP TO 1SF. (PRIORITY REPAIR)

ROUTINE REPAIRS

(18) SPALLED, DELAMINATED OR HOLLOW CONCRETE AT THE UNDERSIDE OF DECK. SEE LEGEND BELOW. (ROUTINE REPAIR)

- SPALLED CONCRETE WITHOUT EXPOSED REBARS UP TO 1" DEEP UNLESS OTHERWISE NOTED. (ROUTINE REPAIR)
- SPALLED CONCRETE WITH EXPOSED REBARS UP TO 2" DEEP UNLESS OTHERWISE NOTED. (ROUTINE REPAIR)
- (H) HOLLOW CONCRETE UP TO 1SF UNLESS OTHERWISE NOTED. (ROUTINE REPAIR)

(19) MISSING DRAINAGE TROUGH UNDER THE EXPANSION FINGER JOINT AT PIERS 4E, 8E, 12E, 18E, 20E, 24E, 30E AND 35E. (ROUTINE REPAIR)

LEGEND

- (1E) PIER NUMBER (AS PER PANY&NJ SYSTEM)
- (2) SPAN NUMBER (AS PER NYSDOT SYSTEM)
- FINE CRACK WITH EFFLORESCENCE.

LIGHT TO MODERATE RUST IS TYPICAL ALONG THE TOP FLANGES OF SS BENEATH THE MEDIAN BARRIER DUE TO AN APPARENT E CONSTRUCTION JOINT IN THE DECK SLAB.

THE PORT AUTHORITY OF NY & NJ

2002 BIENNIAL INSPECTION

OF THE GOETHALS BRIDGE

Title

BIN 552305A

NEW YORK APPROACH

DEFICIENCY & PHOTO LOCATION PLAN UNDERSIDE OF DECK – 1 PIERS 'D' TO 8E

No	Date	Revision	Approved

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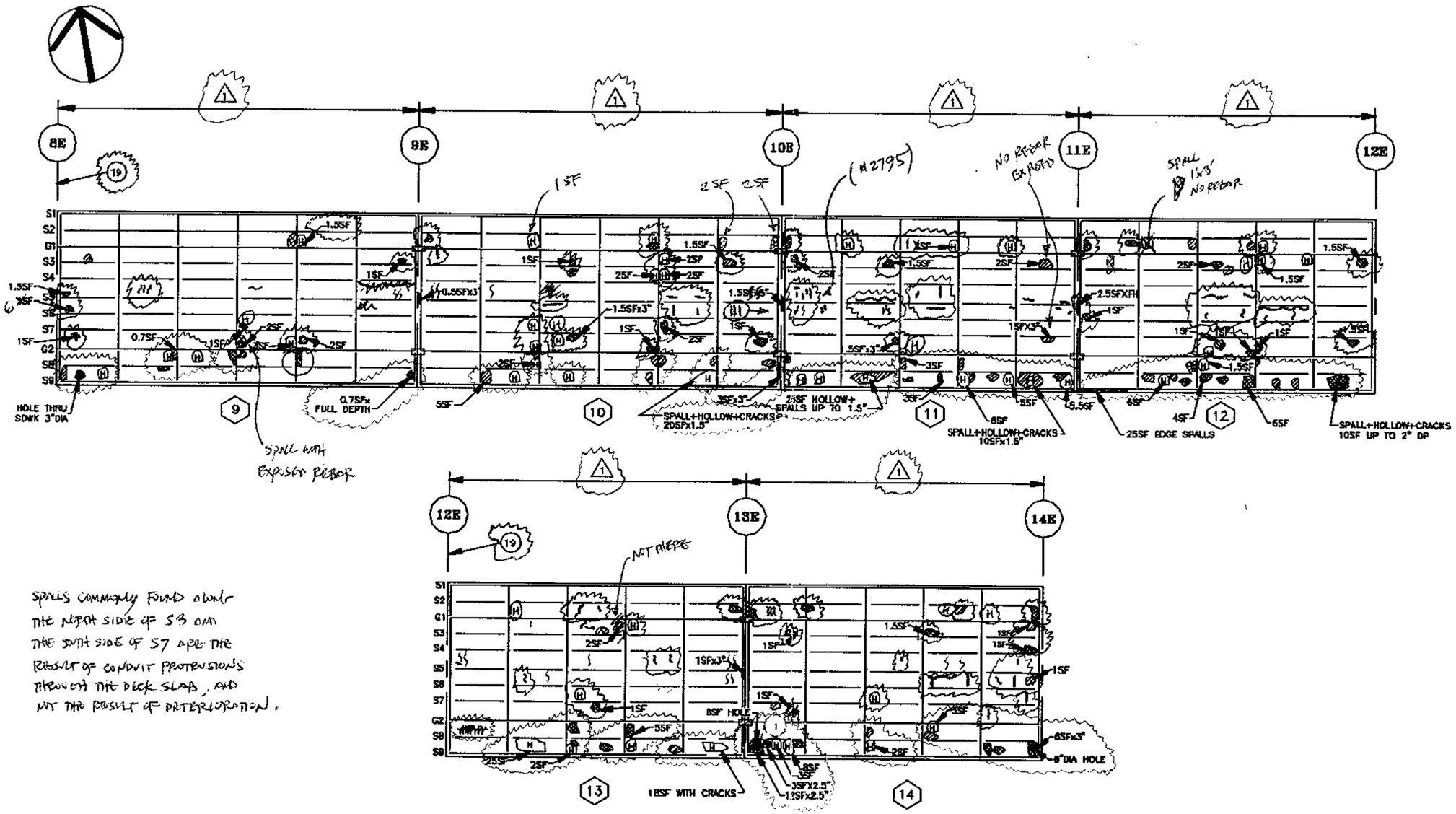
Designed by	Drawn by	Task Leader
	VD	CD

Date 11/01/02 Scale N.T.S.

Contract Number 405-99-01 Drawing Number 552305A-7

R. SZATKUWSKI 5-17-04 & 5-18-04



SPALLS COMMONLY FOUND ALONG THE NORTH SIDE OF S3 AND THE SOUTH SIDE OF S7 ARE THE RESULT OF CONDUIT PROTRUSIONS THROUGH THE DECK SLAB, AND NOT THE RESULT OF DETERIORATION.

KEY CONDITION NOTES – UNDERSIDE OF DECK

PRIORITY REPAIRS

(1) THE NORTH AND SOUTH SIDEWALKS EXHIBIT DELAMINATED AND SPALLED CONCRETE AT TOP SURFACE AND AT UNDERSIDE. SEE LEGEND BELOW. (PRIORITY REPAIR)

- SPALLED CONCRETE WITHOUT EXPOSED REBARS AT THE UNDERSIDE OF NORTH AND SOUTH SIDEWALKS UP TO 3SF AND UP TO 1"DP. UNLESS OTHERWISE NOTED. (PRIORITY REPAIR)
- SPALLED CONCRETE WITH EXPOSED REBARS AT THE UNDERSIDE OF NORTH AND SOUTH SIDEWALKS UP TO 3SF AND UP TO 2"DP. UNLESS OTHERWISE NOTED. (PRIORITY REPAIR)
- HOLLOW CONCRETE AT UNDERSIDE OF SIDEWALK UP TO 1SF. (PRIORITY REPAIR)

ROUTINE REPAIRS

(18) SPALLED, DELAMINATED OR HOLLOW CONCRETE AT THE UNDERSIDE OF DECK. SEE LEGEND BELOW. (ROUTINE REPAIR)

- SPALLED CONCRETE WITHOUT EXPOSED REBARS UP TO 1" DEEP UNLESS OTHERWISE NOTED. (ROUTINE REPAIR)
- SPALLED CONCRETE WITH EXPOSED REBARS UP TO 2" DEEP UNLESS OTHERWISE NOTED. (ROUTINE REPAIR)
- HOLLOW CONCRETE UP TO 1SF UNLESS OTHERWISE NOTED. (ROUTINE REPAIR)

(19) MISSING DRAINAGE TROUGH UNDER THE EXPANSION FINGER JOINT AT PIERS 4E, 8E, 12E, 16E, 20E, 24E, 30E AND 35E. (ROUTINE REPAIR)

LEGEND

- (12) PIER NUMBER (AS PER PANY&NJ SYSTEM)
- (2) SPAN NUMBER (AS PER NYSDOT SYSTEM)
- PHOTO TAKEN BELOW DECK
- FINE CRACK WITH EFFLORESCENCE.

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THE PORT AUTHORITY OF NY & NJ

2002 BIENNIAL INSPECTION OF THE GOETHALS BRIDGE

Title

BIN 552305A
NEW YORK APPROACH

DEFICIENCY & PHOTO LOCATION PLAN
UNDERSIDE OF DECK – 2
PIERS BE TO 14E

No	Date	Revision	Approved

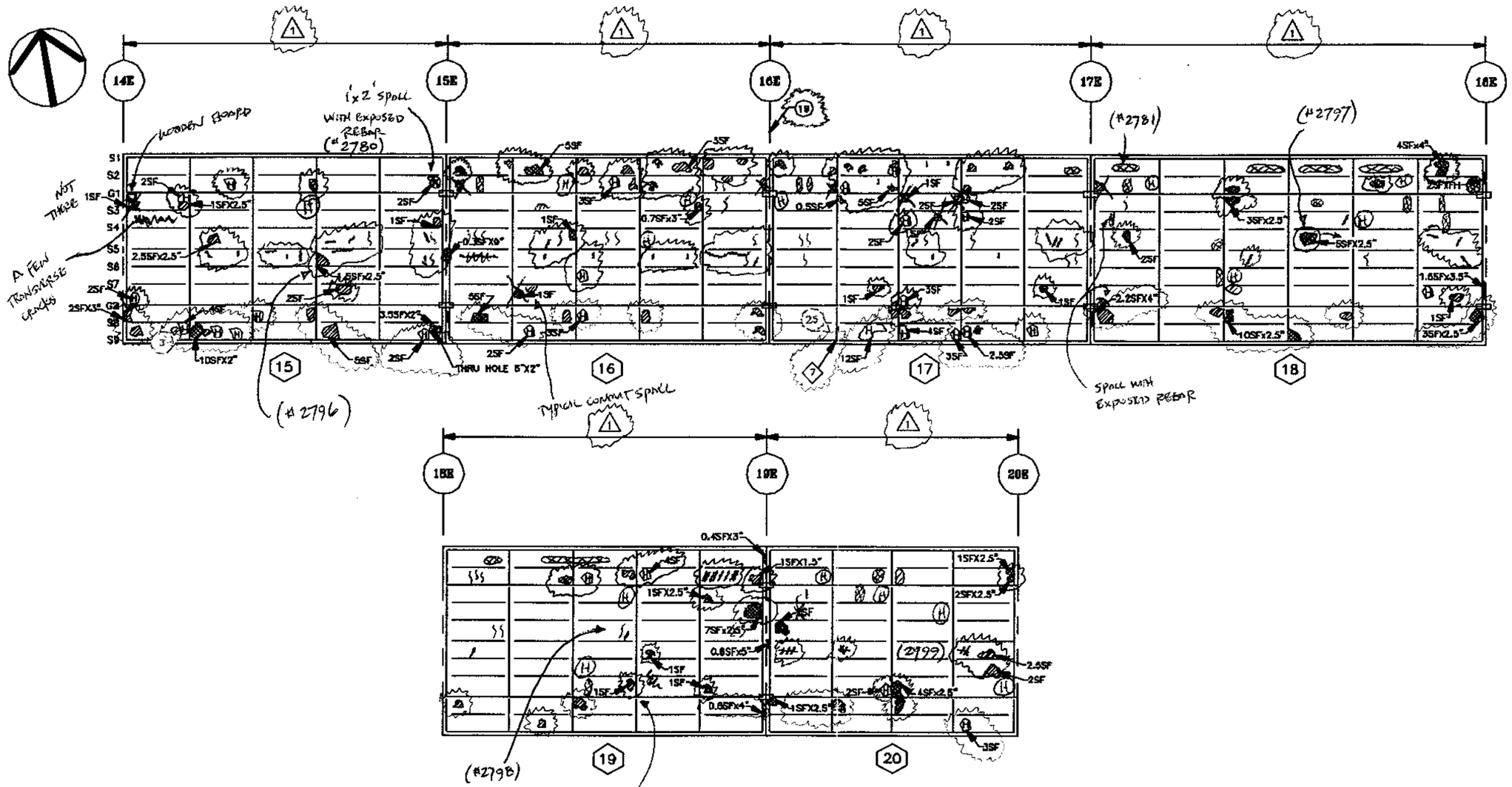
This drawing subject to conditions in contract. All inventions, ideas, designs and methods herein are reserved to Port Authority and may not be used without its written consent.

Designed by	Drawn by	Task Leader
	VD	CD

Date 11/01/02 Scale N.T.S.

Contract Number 405-99-01 Drawing Number 552305A-8

R. Starkweather 5-17-04 & 5-18-04



KEY CONDITION NOTES – UNDERSIDE OF DECK

PRIORITY REPAIRS

(1) THE NORTH AND SOUTH SIDEWALKS EXHIBIT DELAMINATED AND SPALLED CONCRETE AT TOP SURFACE AND AT UNDERSIDE. SEE LEGEND BELOW. (PRIORITY REPAIR)

- SPALLED CONCRETE WITHOUT EXPOSED REBARS AT THE UNDERSIDE OF NORTH AND SOUTH SIDEWALKS UP TO 3SF AND UP TO 1"DP. UNLESS OTHERWISE NOTED. (PRIORITY REPAIR)
- SPALLED CONCRETE WITH EXPOSED REBARS AT THE UNDERSIDE OF NORTH AND SOUTH SIDEWALKS UP TO 3SF AND UP TO 2"DP. UNLESS OTHERWISE NOTED. (PRIORITY REPAIR)
- (H) HOLLOW CONCRETE AT UNDERSIDE OF SIDEWALK UP TO 1SF. (PRIORITY REPAIR)

SAFETY REPAIRS

(7) SHEARED OFF ONE END OF THE U-BOLT CONNECTING THE SOUTH LIGHT STANDARD TO THE SOUTH FASCIA BETWEEN PIERS 18E AND 17E. (SAFETY REPAIR)

ROUTINE REPAIRS

(18) SPALLED, DELAMINATED OR HOLLOW CONCRETE AT THE UNDERSIDE OF DECK. SEE LEGEND BELOW. (ROUTINE REPAIR)

- SPALLED CONCRETE WITHOUT EXPOSED REBARS UP TO 1" DEEP UNLESS OTHERWISE NOTED. (ROUTINE REPAIR)
- SPALLED CONCRETE WITH EXPOSED REBARS UP TO 2" DEEP UNLESS OTHERWISE NOTED. (ROUTINE REPAIR)
- (H) HOLLOW CONCRETE UP TO 1SF UNLESS OTHERWISE NOTED. (ROUTINE REPAIR)

(19) MISSING DRAINAGE TROUGH UNDER THE EXPANSION FINGER JOINT AT PIERS 4E, 8E, 12E, 16E, 20E, 24E, 30E AND 35E. (ROUTINE REPAIR)

LEGEND

- (IZ) PIER NUMBER (AS PER PANY&NJ SYSTEM)
- (Z) SPAN NUMBER (AS PER NYSDOT SYSTEM)
- PHOTO TAKEN BELOW DECK
- FINE CRACK WITH EFFLORESCENCE.

Sheet 9 Of 18

THE PORT AUTHORITY OF NY & NJ

2002 BIENNIAL INSPECTION OF THE GOETHALS BRIDGE

Title

BIN 552305A

NEW YORK APPROACH

DEFICIENCY & PHOTO LOCATION PLAN
UNDERSIDE OF DECK – 3
PIERS 14E TO 20E

No	Date	Revision	Approved

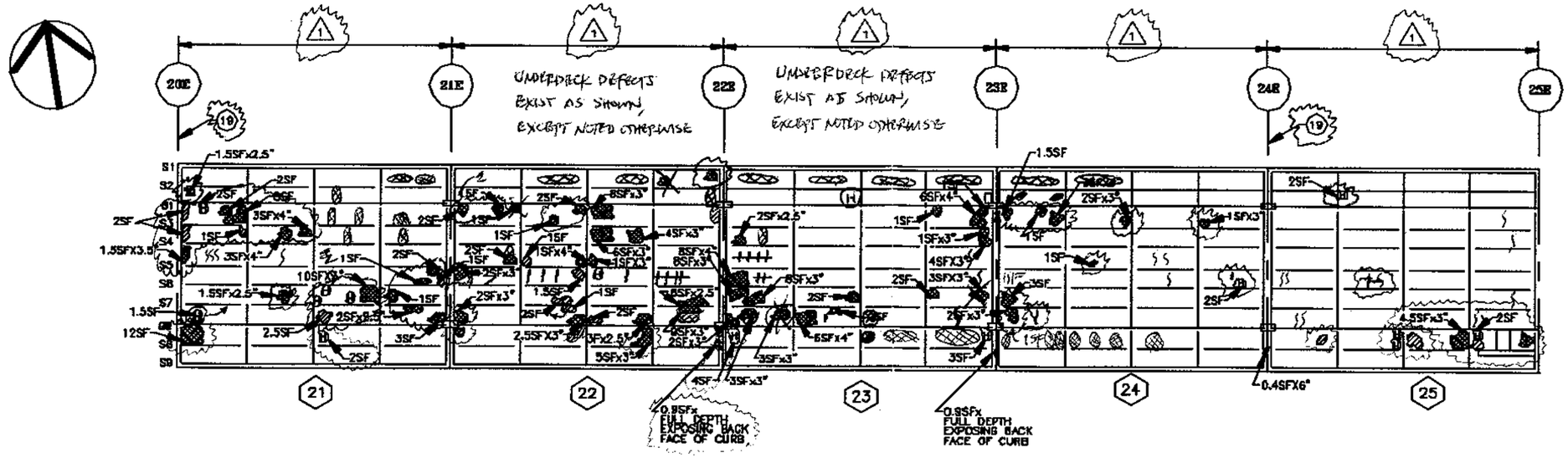
This drawing subject to conditions in contract. All inventions, ideas, designs and methods herein are reserved to Port Authority and may not be used without its written consent.

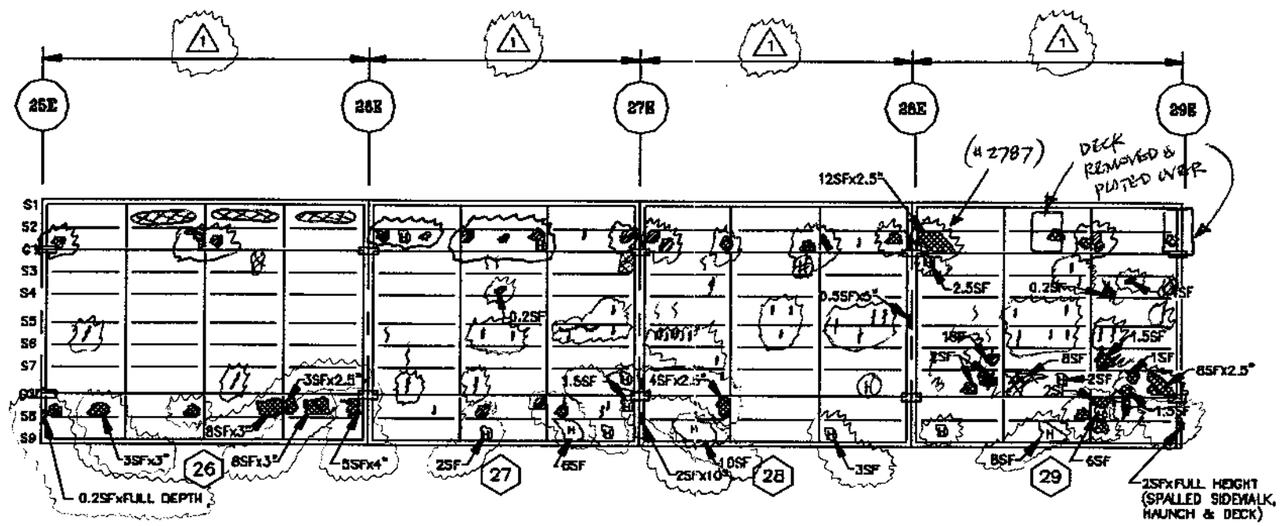
Designed by	Drawn by	Task Leader
	VD	CD

Date 11/01/02 Scale N.T.S.

Contract Number 405-99-01 Drawing Number 552305A-9

R. SZATKOWSKI 5-18-04 & 5-19-04





KEY CONDITION NOTES – UNDERSIDE OF DECK

PRIORITY REPAIRS

1. THE NORTH AND SOUTH SIDEWALKS EXHIBIT DELAMINATED AND SPALLED CONCRETE AT TOP SURFACE AND AT UNDERSIDE, SEE LEGEND BELOW. (PRIORITY REPAIR)
   - SPALLED CONCRETE WITHOUT EXPOSED REBARS AT THE UNDERSIDE OF NORTH AND SOUTH SIDEWALKS UP TO 3SF AND UP TO 1"DP. UNLESS OTHERWISE NOTED. (PRIORITY REPAIR)
   - SPALLED CONCRETE WITH EXPOSED REBARS AT THE UNDERSIDE OF NORTH AND SOUTH SIDEWALKS UP TO 3SF AND UP TO 2"DP. UNLESS OTHERWISE NOTED. (PRIORITY REPAIR)
   - HOLLOW CONCRETE AT UNDERSIDE OF SIDEWALK UP TO 1SF. (PRIORITY REPAIR)

ROUTINE REPAIRS

18. SPALLED, DELAMINATED OR HOLLOW CONCRETE AT THE UNDERSIDE OF DECK. SEE LEGEND BELOW. (ROUTINE REPAIR)
    - SPALLED CONCRETE WITHOUT EXPOSED REBARS UP TO 1" DEEP UNLESS OTHERWISE NOTED. (ROUTINE REPAIR)
    - SPALLED CONCRETE WITH EXPOSED REBARS UP TO 2" DEEP UNLESS OTHERWISE NOTED. (ROUTINE REPAIR)
    - HOLLOW CONCRETE UP TO 1SF UNLESS OTHERWISE NOTED. (ROUTINE REPAIR)
19. MISSING DRAINAGE TROUGH UNDER THE EXPANSION FINGER JOINT AT PIERS 4E, 6E, 12E, 16E, 20E, 24E, 30E AND 33E. (ROUTINE REPAIR)

LEGEND

- (LE) PIER NUMBER (AS PER PANY&NJ SYSTEM)
- (Z) SPAN NUMBER (AS PER NYSDOT SYSTEM)
- FINE CRACK WITH EFFLORESCENCE.

THE PORT AUTHORITY OF NY & NJ

2002 BIENNIAL INSPECTION OF THE GOETHALS BRIDGE

Title

BIN 552305A

NEW YORK APPROACH

DEFICIENCY & PHOTO LOCATION PLAN
UNDERSIDE OF DECK – 4
PIERS 20E TO 29E

No	Date	Revision	Approved

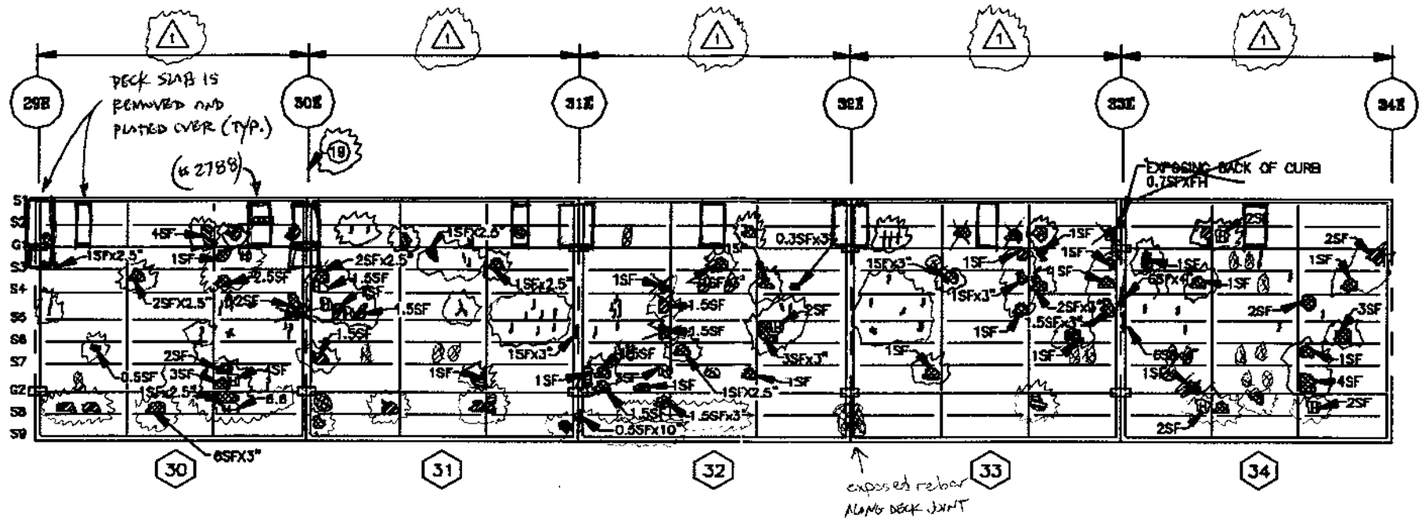
This drawing subject to conditions in contract. All inventions, ideas, designs and methods herein are reserved to Port Authority and may not be used without its written consent.

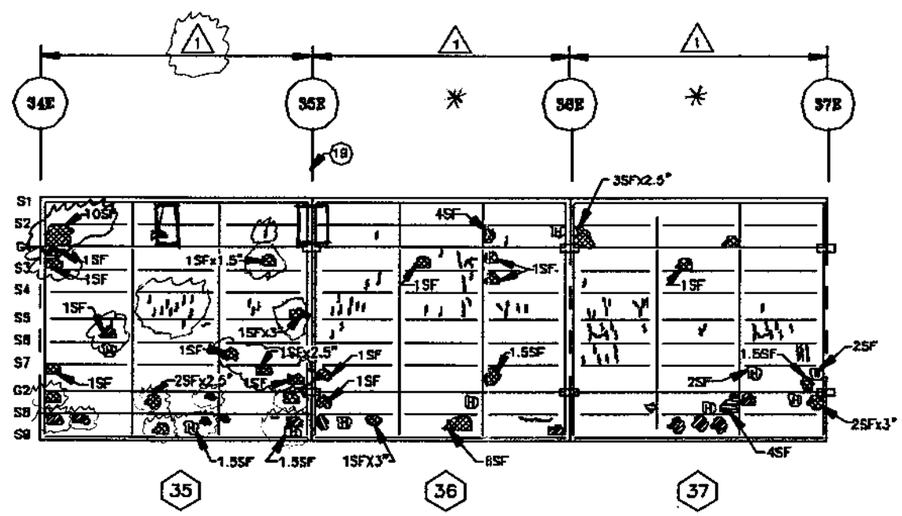
Designed by	Drawn by	Task Leader
	VD	CD

Date 11/01/02 Scale N.T.S.

Contract Number 405-99-01 Drawing Number 552305A-10

R. SZATKOWSKI 5-18-04 & 5-19-04





* NORTH CANTILEVERED PORTION OF DECK IS COVERED BY TIMBER SHIELDING & CAN NOT BE INSPECTED. THE SOUTH CANTILEVERED PORTION AND UNDER DECK AREA BETWEEN THE GIRDERS IS SIMILAR.

KEY CONDITION NOTES – UNDERSIDE OF DECK

PRIORITY REPAIRS

1. THE NORTH AND SOUTH SIDEWALKS EXHIBITS DELAMINATED AND SPALLED CONCRETE AT UNDERSIDE, SEE LEGEND BELOW. (PRIORITY REPAIR)
   - SPALLED CONCRETE WITHOUT EXPOSED REBARS AT THE UNDERSIDE OF NORTH AND SOUTH SIDEWALK UP TO 3SF AND UP TO 1"DP. UNLESS OTHERWISE NOTED. (PRIORITY REPAIR)
   - SPALLED CONCRETE WITH EXPOSED REBARS AT THE UNDERSIDE OF NORTH AND SOUTH SIDEWALK'S UP TO 3SF AND UP TO 2"DP. UNLESS OTHERWISE NOTED. (PRIORITY REPAIR)
   - HOLLOW CONCRETE AT UNDERSIDE OF SIDEWALK UP TO 1SF. (PRIORITY REPAIR)

ROUTINE REPAIRS

18. SPALLED, DELAMINATED OR HOLLOW CONCRETE AT THE UNDERSIDE OF DECK. SEE LEGEND BELOW. (ROUTINE REPAIR)
    - SPALLED CONCRETE WITHOUT EXPOSED REBARS UP TO 1" DEEP UNLESS OTHERWISE NOTED. (ROUTINE REPAIR)
    - SPALL CONCRETE WIT EXPOSED REBARS UP TO 2" DEEP UNLESS OTHERWISE NOTED. (ROUTINE REPAIR)
    - HOLLOW CONCRETE UP TO 1SF UNLESS OTHERWISE NOTED. (ROUTINE REPAIR)
19. MISSING DRAINAGE TROUGH UNDER THE EXPANSION FINGER JOINT AT PIERS "D", 4E, 8E, 12E, 16E, 20E, 24E, 30E AND 35E. (ROUTINE REPAIR)

LEGEND

- (1Z) PIER NUMBER (AS PER PANY&NJ SYSTEM)
- (Z) SPAN NUMBER (AS PER NYSDOT SYSTEM)
- FINE CRACK WITH EFFLORESCENCE.

THE PORT AUTHORITY OF NY & NJ

2002 BIENNIAL INSPECTION

OF THE GOETHALS BRIDGE

Title

BIN 552305A

NEW YORK APPROACH

DEFICIENCY & PHOTO LOCATION PLAN
UNDERSIDE OF DECK – 5
PIERS 29E TO 37E

No	Date	Revision	Approved

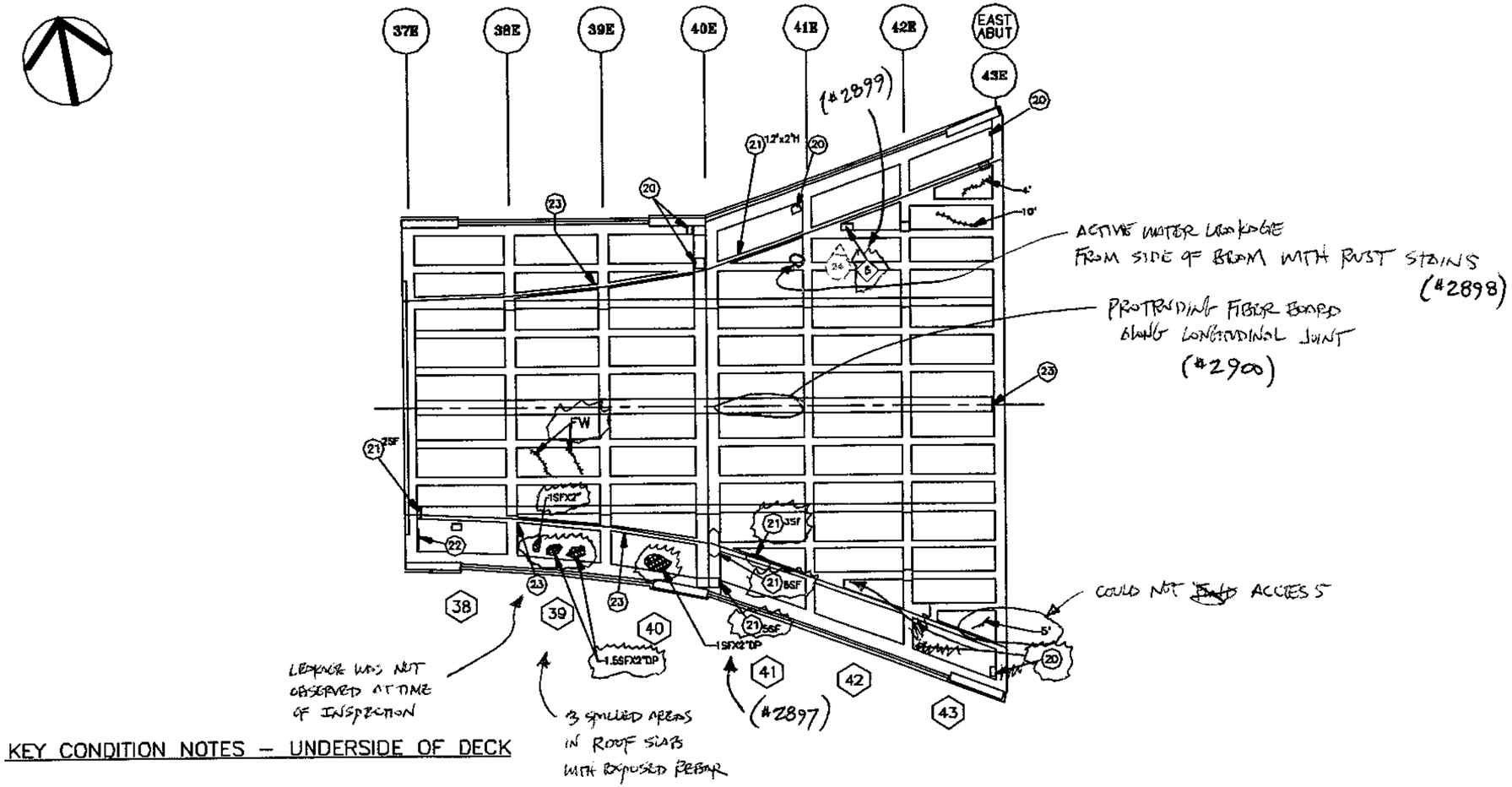
This drawing subject to conditions in contract. All inventions, ideas, designs and methods herein are reserved to Port Authority and may not be used without its written consent.

Designed by	Drawn by	Task Leader
	VO	CD

Date 11/01/02 Scale N.T.S.

Contract Number 405-99-01 Drawing Number 552305A-11

R. SZATKOWSKI 5-18-04 & 5-19-04



KEY CONDITION NOTES – UNDERSIDE OF DECK

SAFETY REPAIRS

(6) LOOSE AND OPEN COVER OF ELECTRICAL JUNCTION BOX WITH EXPOSED WIRES NEAR GROUND INSIDE THE NEW YORK HOLLOW ABUTMENT BETWEEN BENTS 41E AND 42E. (SAFETY REPAIR)

ROUTINE REPAIRS

(18) SPALLED, DELAMINATED OR HOLLOW CONCRETE AT THE UNDERSIDE OF DECK. SEE LEGEND BELOW. (ROUTINE REPAIR)

- SPALLED CONCRETE WITHOUT EXPOSED REBARS UP TO 1" DEEP UNLESS OTHERWISE NOTED. (ROUTINE REPAIR)
- SPALLED CONCRETE WITH EXPOSED REBARS UP TO 2" DEEP UNLESS OTHERWISE NOTED. (ROUTINE REPAIR)
- HOLLOW CONCRETE UP TO 1SF UNLESS OTHERWISE NOTED. (ROUTINE REPAIR)

(20) MISSING COVER OF ELECTRICAL JUNCTION BOX AT UNDERSIDE OF DECK INSIDE THE NEW YORK HOLLOW ABUTMENT. (ROUTINE REPAIR)

(21) DELAMINATED CONCRETE AT THE UNDERSIDE AND/OR VERTICAL FACE OF CONCRETE BEAM AND/OR CAP BEAM INSIDE THE NEW YORK HOLLOW ABUTMENT. SIZE AS SHOWN. (ROUTINE REPAIR)

(22) LARGE SPALL WITH EXPOSED REBARS (1.5SFx2.5"DP) AT TOP OF WALL INSIDE THE NEW YORK HOLLOW ABUTMENT AT EAST SIDE OF PIER 37E. (ROUTINE REPAIR)

(23) WATER LEAKAGE THROUGH THE LONGITUDINAL JOINTS AT CENTER LINE OF BRIDGE AND EAST AND WEST BOUND ROADWAYS OVER THE NEW YORK HOLLOW ABUTMENT. (ROUTINE REPAIR)

LEGEND

- (LZ) PIER NUMBER (AS PER PANY&NJ SYSTEM)
- (Z) SPAN NUMBER (AS PER NYSDOT SYSTEM)
- PHOTO TAKEN BELOW DECK
- FINE CRACK WITH EFFLORESCENCE.

THE PORT AUTHORITY OF NY & NJ

2002 BIENNIAL INSPECTION

OF THE GOETHALS BRIDGE

Title

BIN 552305A

NEW YORK APPROACH

DEFICIENCY & PHOTO LOCATION PLAN
UNDERSIDE OF DECK – 6
PIERS 37E TO 43E

No	Date	Revision	Approved

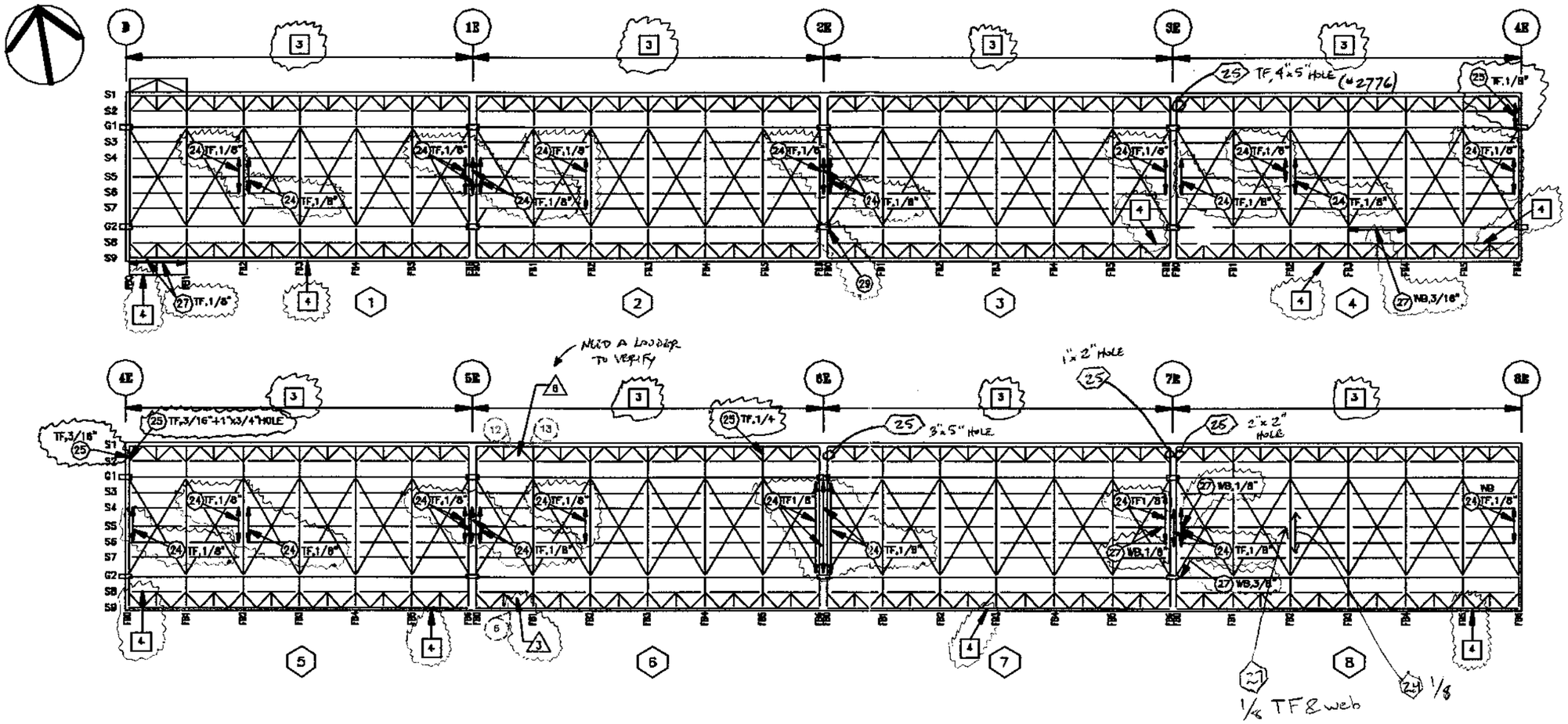
This drawing subject to conditions in contract. All inventions, ideas, designs and methods herein are reserved to Port Authority and may not be used without its written consent.

Designed by	Drawn by	Task Leader
	VD	CB

Date 11/01/02 Scale N.T.S.

Contract Number 405-99-01 Drawing Number 552305A-12

R. SZATKOWSKI 5/26/04



moderate rust along top flange of stringer S5 typ.

KEY CONDITION NOTES – SUPERSTRUCTURE STEEL

PRIORITY REPAIRS

(3) THE SIGNAL GANTRY SOUTH POST BASE NEAR PIERS 5E AND 18E EXHIBITS DIAGONAL CRACKS. (3 OUT OF 4 CORNERS ARE CRACKED AT 5E AND 2 OUT OF 4 CORNERS ARE CRACKED AT 18E. TEMPORARY REPAIRS EXIST AT BASE NEAR PIER 5E ONLY). (PRIORITY REPAIR)

(8) THE SIGNAL GANTRY NORTH POST BASE NEAR PIER 5E EXHIBITS DIAGONAL CRACKS AT 3 OUT OF 4 CORNERS AND THE FOURTH CORNER IS COMPLETELY BROKEN OFF EXPOSING THE THREADS OF THE ANCHOR BOLT. TEMPORARY REPAIRS EXIST AT THIS TIME. THE SOUTH CHANNEL SUPPORTING THE BASE EXHIBITS SEVERE SECTION LOSSES TO BOTH FLANGES AND SMALL HOLES THRU THE WEB. (PRIORITY REPAIR)

ROUTINE REPAIRS

(24) THE FLANGE AND/OR WEB OF THE FLOORBEAM EXHIBITS SIGNIFICANT SECTION LOSS (1/8" OR MORE) LOCATION AND AMOUNT OF LOSS AS SHOWN. (ROUTINE REPAIR)

(25) THE OUTSTANDING LEG OF THE TOP FLANGE AT THE CANTILEVERED FLOORBEAM BRACKET EXHIBITS SIGNIFICANT SECTION LOSS (1/8" OR MORE) LOCATION AND AMOUNT OF LOSS AS SHOWN. (ROUTINE REPAIR)

(27) THE TOP FLANGE AND/OR WEB OF THE STRINGER EXHIBITS SIGNIFICANT SECTION LOSS (1/8" OR MORE) LOCATION AND AMOUNT OF LOSS AS SHOWN. (ROUTINE REPAIR)

REPAIRS NOT REQUIRED

[3] ALL STEEL MEMBERS EXHIBIT MINOR SECTION LOSS. (<1/8")

[4] IMPACT RUST BETWEEN THE TOP FLANGE OF THE STRINGERS, FLOORBEAMS OR GIRDERS AND THE CONCRETE DECK.

LEGEND

(12) PIER NUMBER (AS PER PANY&NJ SYSTEM)

(2) SPAN NUMBER (AS PER NYSDOT SYSTEM)

PHOTO TAKEN BELOW DECK

THE PORT AUTHORITY OF NY & NJ

2002 BIENNIAL INSPECTION OF THE GOETHALS BRIDGE

Title

BIN 552305A

NEW YORK APPROACH

DEFICIENCY & PHOTO LOCATION PLAN SUPERSTRUCTURE STEEL – 1 PIERS 'D' TO BE

No	Date	Revision	Approved

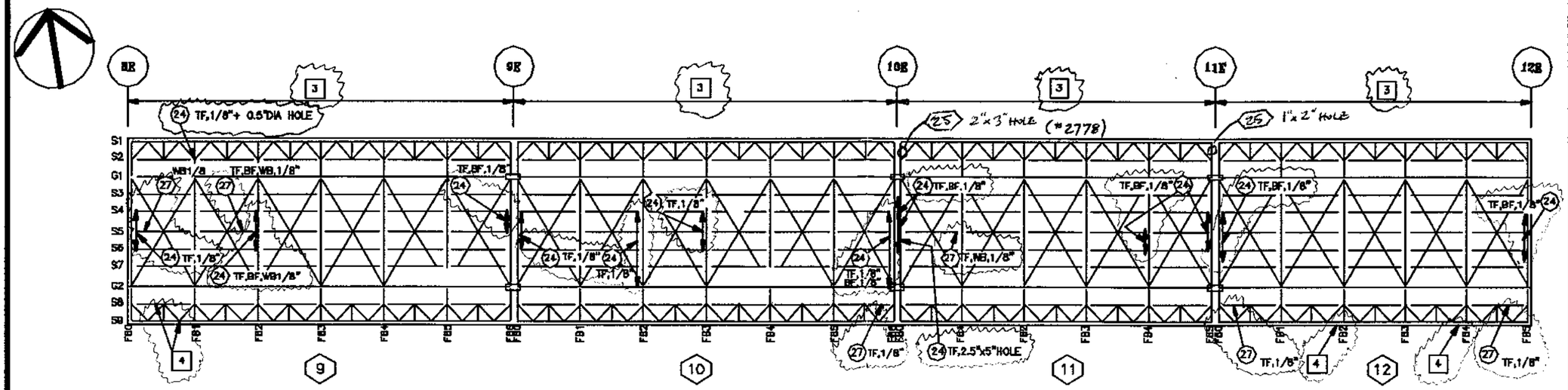
This drawing subject to conditions in contract. All inventions, ideas, designs and methods herein are reserved to Port Authority and may not be used without its written consent.

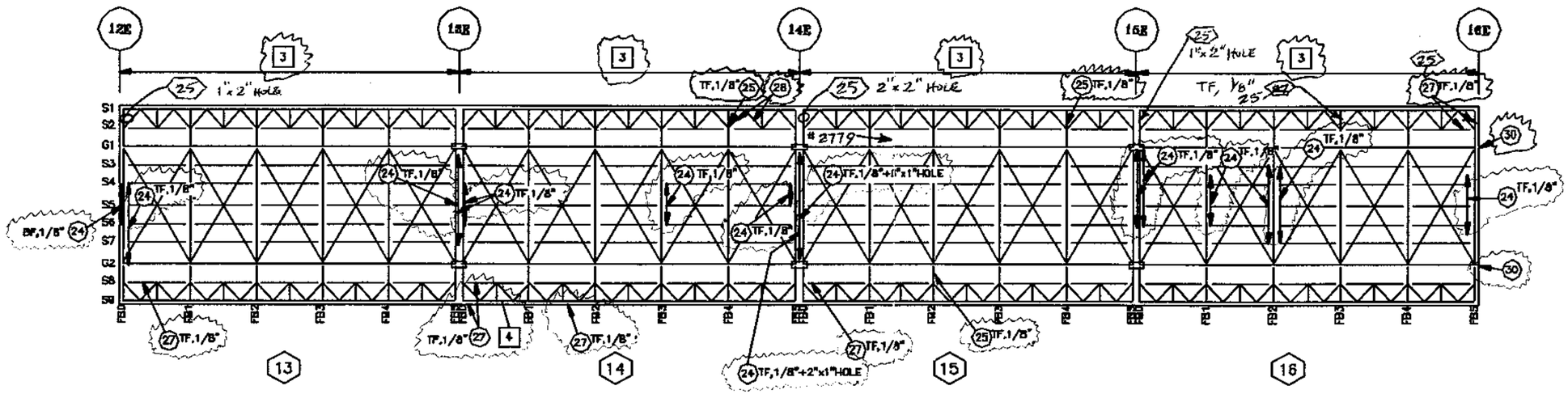
Designed by	Drawn by	Task Leader
	VD	CD

Date 11/01/02 Scale N.T.S.

Contract Number 405-99-01 Drawing Number 552305A-13

R. SZOTKOWSKI 5-17-04





KEY CONDITION NOTES – SUPERSTRUCTURE STEEL

ROUTINE REPAIRS

(24) THE FLANGE AND/OR WEB OF THE FLOORBEAM EXHIBITS SIGNIFICANT SECTION LOSS (1/8" OR MORE) LOCATION AND AMOUNT OF LOSS AS SHOWN. (ROUTINE REPAIR)

(25) THE OUTSTANDING LEG OF THE TOP FLANGE AT THE CANTILEVERED FLOORBEAM BRACKET EXHIBITS SIGNIFICANT SECTION LOSS (1/8" OR MORE) LOCATION AND AMOUNT OF LOSS AS SHOWN. (ROUTINE REPAIR)

(27) THE TOP FLANGE AND/OR WEB OF THE STRINGER EXHIBITS SIGNIFICANT SECTION LOSS (1/8" OR MORE) LOCATION AND AMOUNT OF LOSS AS SHOWN. (ROUTINE REPAIR)

(28) MISSING BRACING ANGLES UNDER NORTH SIDEWALK NEAR PIER 14E. (ROUTINE REPAIR)

(30) ROCKER BEARING SLIGHTLY EXTENDED OR CONTRACTED AT TOP OF NORTH AND SOUTH COLUMN AT PIER 15E AND 26E. (ROUTINE REPAIR)

REPAIRS NOT REQUIRED

[3] ALL STEEL MEMBERS EXHIBIT MINOR SECTION LOSS. (<1/8")

[4] IMPACT RUST BETWEEN THE TOP FLANGE OF THE STRINGERS, FLOORBEAMS OR GIRDERS AND THE CONCRETE DECK.

LEGEND

(LZ) PIER NUMBER (AS PER PANY&NJ SYSTEM)

(Z) SPAN NUMBER (AS PER NYSDOT SYSTEM)

THE PORT AUTHORITY OF NY & NJ

2002 BIENNIAL INSPECTION

OF THE GOETHALS BRIDGE

Title

BIN 552305A

NEW YORK APPROACH

DEFICIENCY & PHOTO LOCATION PLAN SUPERSTRUCTURE STEEL – 2

PIERS 8E TO 16E

No	Date	Revision	Approved

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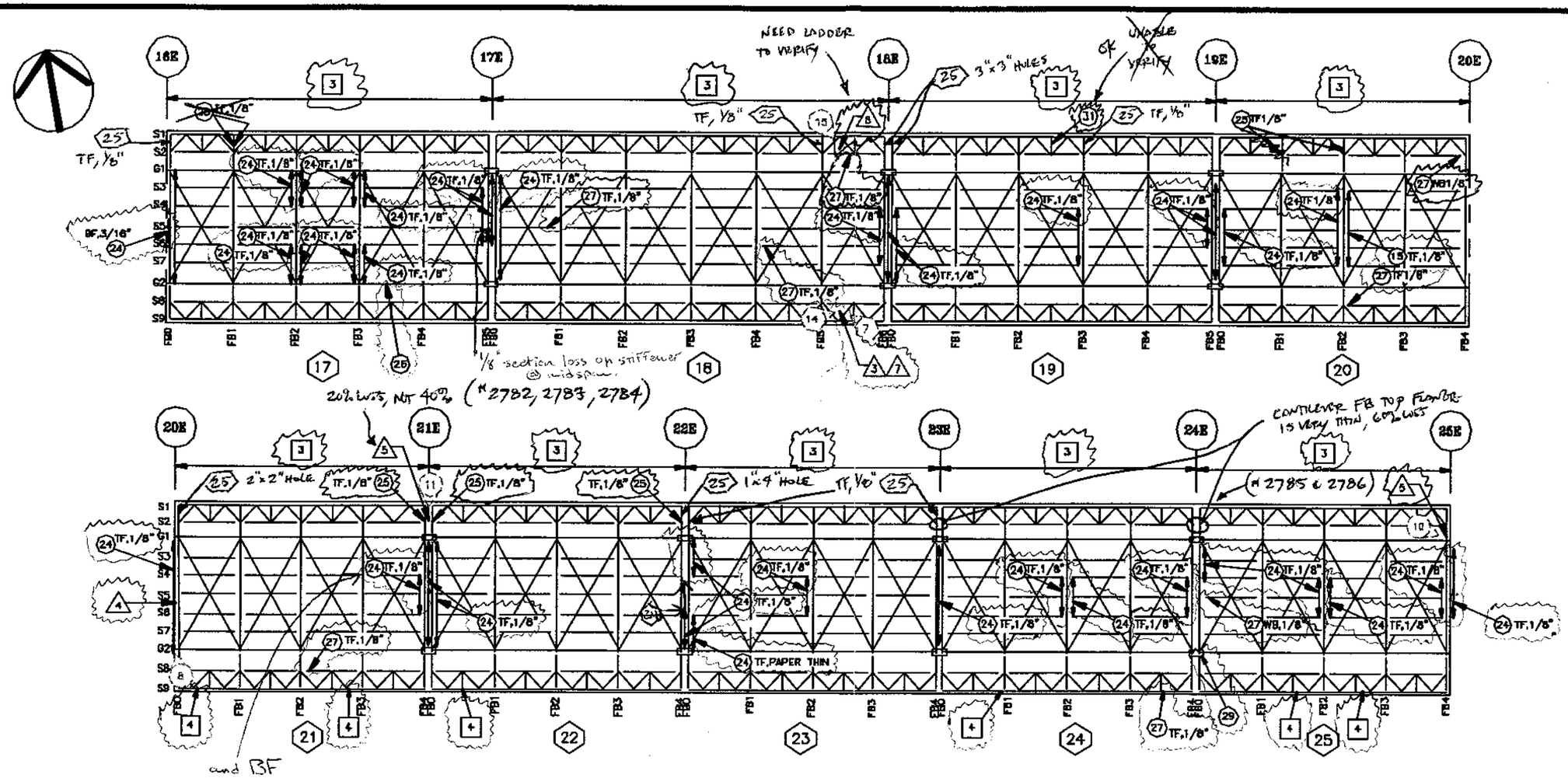
Designed by	Drawn by	Task Leader
	VD	CD

Date 11/01/02 Scale N.T.S.

Contract Number 405-99-01 Drawing Number 552305A-14

R. SZATKOWSKI 5-17-04 & 5-18-04



KEY CONDITION NOTES – SUPERSTRUCTURE STEEL

PRIORITY REPAIRS

3. THE SIGNAL GANTRY SOUTH POST BASE NEAR PIERS 5E AND 18E EXHIBITS DIAGONAL CRACKS. (3 OUT OF 4 CORNERS ARE CRACKED AT 5E AND 2 OUT OF 4 CORNERS ARE CRACKED AT 18E. TEMPORARY REPAIRS EXIST AT BASE NEAR PIER 5E ONLY). (PRIORITY REPAIR)

4. THE OUTSTANDING LEG OF THE TOP FLANGE OF THE FLOORBEAM EXHIBITS OVER 40% SECTION LOSS AT MIDSPAN AT PIERS 20E AND 37E. (PRIORITY REPAIR)

5. THE OUTSTANDING LEG OF THE TOP FLANGE OF THE FLOORBEAM CANTILEVER BRACKET EXHIBITS OVER 40% SECTION LOSS AT PIERS 21E AND 25E. (PRIORITY REPAIR)

7. SEVERE SECTION LOSSES AND HOLES THRU THE FLANGES AND WEB OF THE CHANNEL BEAMS SUPPORTING THE BASE OF THE SOUTH SIGNAL GANTRY POST NEAR PIER 18E. (PRIORITY REPAIR)

8. THE SIGNAL GANTRY NORTH POST BASE BETWEEN PIERS 17E AND 18E EXHIBITS DIAGONAL CRACKS AT 2 CORNERS AND THE 3rd CORNER IS COMPLETELY BROKEN OFF EXPOSING THE THREADS OF THE ANCHOR BOLT. TEMPORARY REPAIRS EXIST AT THIS TIME. (PRIORITY REPAIR)

ROUTINE REPAIRS

24. THE FLANGE AND/OR WEB OF THE FLOORBEAM EXHIBITS SIGNIFICANT SECTION LOSS (1/8" OR MORE) LOCATION AND AMOUNT OF LOSS AS SHOWN. (ROUTINE REPAIR)

25. THE OUTSTANDING LEG OF THE TOP FLANGE AT THE CANTILEVERED FLOORBEAM BRACKET EXHIBITS SIGNIFICANT SECTION LOSS (1/8" OR MORE) LOCATION AND AMOUNT OF LOSS AS SHOWN. (ROUTINE REPAIR)

26. SECTION LOSS UP TO 1/4" AT THE SOUTH ANGLE OF THE BOTTOM FLANGE AND WEB OF THE SOUTH GIRDER NEAR PIER 17E. (ROUTINE REPAIR)

27. THE TOP FLANGE AND/OR WEB OF THE STRINGER EXHIBITS SIGNIFICANT SECTION LOSS (1/8" OR MORE) LOCATION AND AMOUNT OF LOSS AS SHOWN. (ROUTINE REPAIR)

29. MISSING N.E. ANCHOR BOLT NUT OF EAST BEARING UNDER GIRDER G2 OF SPAN 23 AT PIER 24E. (ROUTINE REPAIR)

31. SECTION LOSS (GREATER THAN 1/8") AT WEB OF THE DIAPHRAGM UNDER THE NORTH SIDEWALK BETWEEN PIERS 18E AND 19E. (ROUTINE REPAIR)

REPAIRS NOT REQUIRED

3. ALL STEEL MEMBERS EXHIBIT MINOR SECTION LOSS. (<1/8")

4. IMPACT RUST BETWEEN THE TOP FLANGE OF THE STRINGERS, FLOORBEAMS OR GIRDERS AND THE CONCRETE DECK.

LEGEND

- 12 — PIER NUMBER (AS PER PANY&NJ SYSTEM)
- Z — SPAN NUMBER (AS PER NYSDOT SYSTEM)
- PHOTO TAKEN BELOW DECK

Sheet 15 Of 16

THE PORT AUTHORITY OF NY & NJ

2002 BIENNIAL INSPECTION OF THE GOETHALS BRIDGE

Title

BIN 552305A

NEW YORK APPROACH

DEFICIENCY & PHOTO LOCATION PLAN SUPERSTRUCTURE STEEL – 3 PIERS 16E TO 25E

No	Date	Revision	Approved

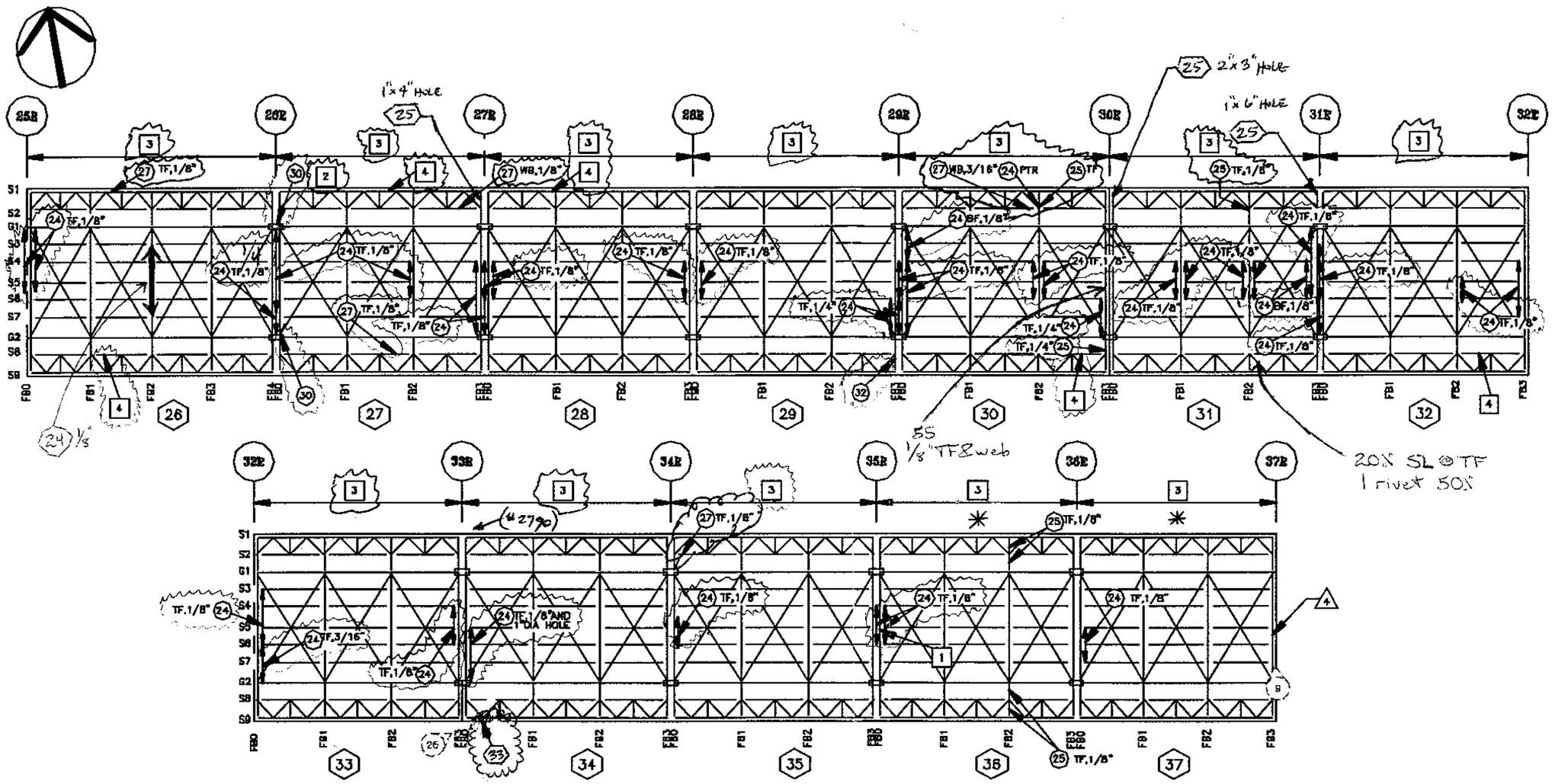
This drawing subject to conditions in contract. All inventions, ideas, designs and methods herein are reserved to Port Authority and may not be used without its written consent.

Designed by	Drawn by	Task Leader
	VD	CD

Date 11/01/02 Scale N.T.S.

Contract Number 405-99-01 Drawing Number 552305A-15

R. SZATKOWSKI 5-18-04



* Superstructure could not be inspected due to contractor's timber shielding.

KEY CONDITION NOTES–SUPERSTRUCTURE STEEL

PRIORITY REPAIRS

4 THE OUTSTANDING LEG OF THE TOP FLANGE OF THE FLOORBEAM EXHIBITS OVER 40% SECTION LOSS AT MIDSPAN AT PIERS 20E AND 37E. (PRIORITY REPAIR)

ROUTINE REPAIRS

24 THE FLANGE AND/OR WEB OF THE FLOORBEAM EXHIBITS SIGNIFICANT SECTION LOSS (1/8" OR MORE) LOCATION AND AMOUNT OF LOSS AS SHOWN. (ROUTINE REPAIR)

25 THE OUTSTANDING LEG OF THE TOP FLANGE AT THE CANTILEVERED FLOORBEAM BRACKET EXHIBITS SIGNIFICANT SECTION LOSS (1/8" OR MORE) LOCATION AND AMOUNT OF LOSS AS SHOWN. (ROUTINE REPAIR)

27 THE TOP FLANGE AND/OR WEB OF THE STRINGER EXHIBITS SIGNIFICANT SECTION LOSS (1/8" OR MORE) LOCATION AND AMOUNT OF LOSS AS SHOWN. (ROUTINE REPAIR)

30 ROCKER BEARING SLIGHTLY EXTENDED OR CONTRACTED AT TOP OF NORTH AND SOUTH COLUMN AT PIER 16E AND 28E. (ROUTINE REPAIR)

32 GAP BETWEEN THE CONCRETE DECK AND THE TOP FLANGE OF THE STRINGER AT PIER 29E. (ROUTINE REPAIR)

33 UP TO 20% SECTION LOSS WITH TWO SMALL PIN HOLES AT BASE OF THE LIGHT STANDARD AT SOUTH FASCIA OF SPAN 34E. (ROUTINE REPAIR)

REPAIRS NOT REQUIRED

1 THE EAST FLOORBEAM AT PIER 35E HAS A DRILLED HOLE IN THE BOTTOM FLANGE.

2 THE NORTH GIRDER BEARING STIFFENER AT PIER 25E IS HORIZONTALLY MISALIGNED 1" WITH THE CENTERLINE OF BEARING.

3 ALL STEEL MEMBERS EXHIBIT MINOR SECTION LOSS. (<1/8")

4 IMPACT RUST BETWEEN THE TOP FLANGE OF THE STRINGERS, FLOORBEAMS OR GIRDERS AND THE CONCRETE DECK.

LEGEND

12 PIER NUMBER (AS PER PANY&NJ SYSTEM)

Z SPAN NUMBER (AS PER NYSDOT SYSTEM)

PHOTO TAKEN BELOW DECK

Sheet 18 Of 18

THE PORT AUTHORITY OF NY & NJ

2002 BIENNIAL INSPECTION OF THE GOETHALS BRIDGE

Title

BIN 552305A

NEW YORK APPROACH

DEFICIENCY & PHOTO LOCATION PLAN SUPERSTRUCTURE STEEL – 4 PIERS 25E TO 37E

No	Date	Revision	Approved

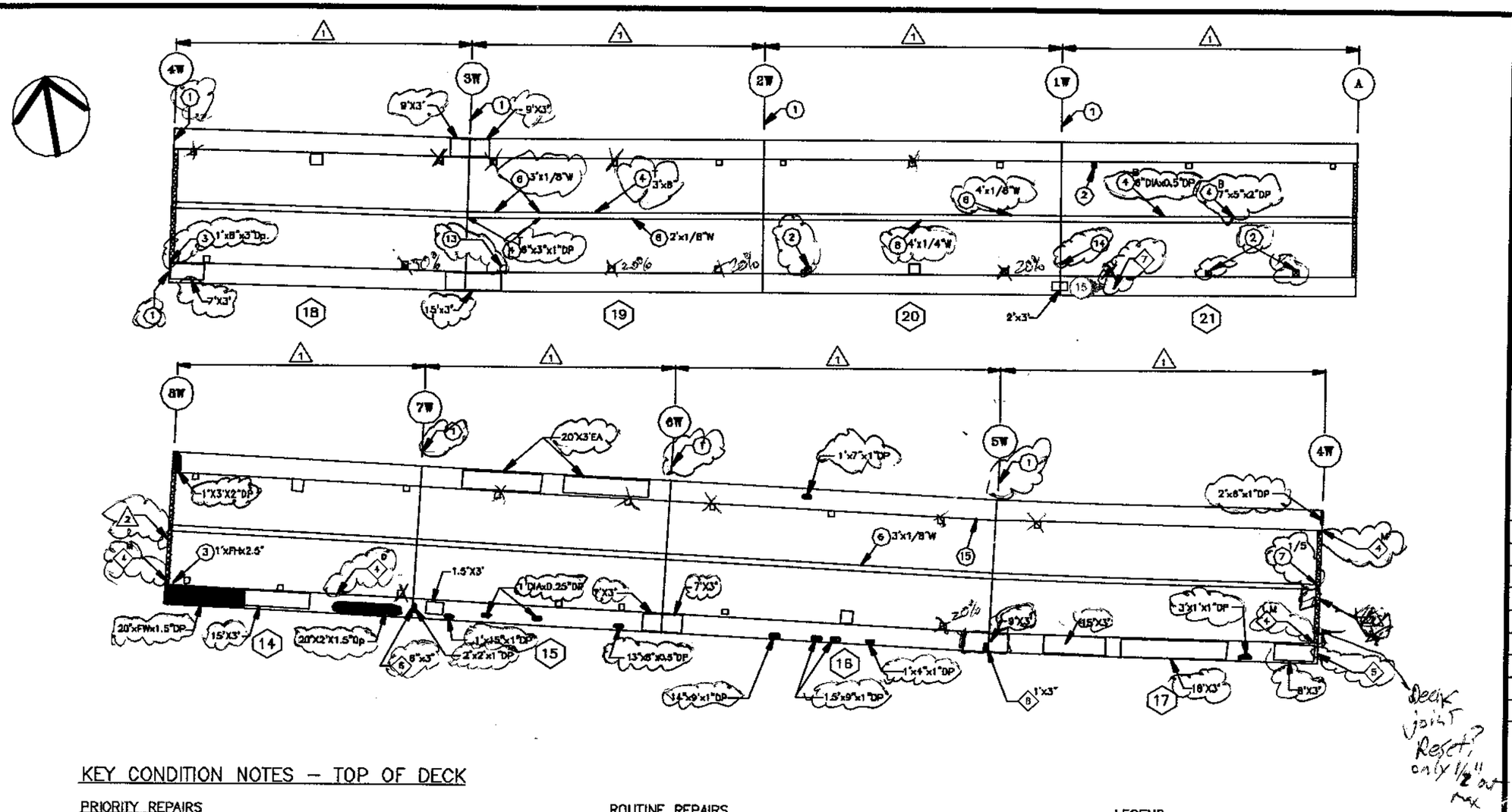
This drawing subject to conditions in contract. All inventions, ideas, designs and methods herein are reserved to Port Authority and may not be used without its written consent.

Designed by	Drawn by	Task Leader
	VD	CD

Date 11/01/02 Scale N.T.S.

Contract Number 405-99-01 Drawing Number 552305A-16

R. SZATKOWSKI 5-18-04



KEY CONDITION NOTES – TOP OF DECK

PRIORITY REPAIRS

△1 THE NORTH AND SOUTH SIDEWALKS EXHIBIT DELAMINATED AND SPALLED CONCRETE AT TOP SURFACE, SEE LEGEND BELOW. (PRIORITY REPAIR)

DELAMINATED/SPALLED CONCRETE AT TOP SURFACE OF SIDEWALK WITHOUT EXPOSED REBARS. SIZE AS SHOWN. (PRIORITY REPAIR)

△2 UP TO 1" OF VERTICAL MISALIGNMENT AT THE FINGER JOINT OVER PIERS 4W, 8W, 12W, 16W AND 21W. (PRIORITY REPAIR)

SAFETY REPAIRS

◇4x MISSING OR DISPLACED STEEL EXPANSION PLATES AT THE CONCRETE PARAPETS "x" INDICATES THE STATUS OF THE STEEL PARAPET SECTION (D=DISCONNECTED, M=MISSING). (SAFETY REPAIR)

◇5 SIDEWALK JOINT ANGLES ARE EXPOSED DUE TO SPALLED SIDEWALK AND ARE SLIGHTLY BENT POSING A TRIPPING HAZARD. (SAFETY REPAIR)

◇6 THROUGH HOLES IN THE SIDEWALK SLAB. SIZE AS SHOWN. (SAFETY REPAIR)

◇7 TWO 5" DIA HOLES THROUGH COVER OF THE ABANDONED ELECTRICAL JUNCTION BOX EMBEDDED IN SOUTH SIDEWALK NEAR PIER 1W. (SAFETY REPAIR)

ROUTINE REPAIRS

(1) DETERIORATED JOINT FILLER MATERIAL OVER THE PIER AND AT SIDEWALKS. (ROUTINE REPAIR)

(2) CLOGGED ROADWAY SCUPPER. (ROUTINE REPAIR)

(3) SPALLED CONCRETE CURB ALONG THE NORTH AND/OR SOUTH PARAPET. SIZE AS SHOWN. (ROUTINE REPAIR)

(4)x SPALLED AND DELAMINATED CONCRETE ALONG THE TOP AND BOTTOM OF THE MEDIAN BARRIER. SIZE AS SHOWN. "x" INDICATES LOCATION OF SPALL. (T=TOP, B=BOTTOM) (ROUTINE REPAIR)

(8) MEDIUM TO WIDE LONGITUDINAL CRACKS AT THE TOP OF THE CONCRETE MEDIAN BARRIER. SIZE AS SHOWN. (ROUTINE REPAIR)

(7)A/B MISSING ANCHOR BOLTS AT THE STEEL EXPANSION PLATE CONNECTION TO THE CONCRETE MEDIAN OVER THE FINGER JOINTS AT PIERS 4W AND 12W. "A" INDICATES NUMBER OF MISSING BOLTS. "B" INDICATES TOTAL NUMBER OF BOLTS. (ROUTINE REPAIR)

(13) PAVED OVER ROADWAY SCUPPER NEAR PIER 3W. (ROUTINE REPAIR)

(14) THE JOINT OVER PIER 1W IS PAVED OVER FOR FULL WIDTH OF THE RIGHT LANE OF THE EAST BOUND ROADWAY. (ROUTINE REPAIR)

(15) THE NORTH SIDEWALK PARAPET HAS A FULL DEPTH, 1" WIDE DIAGONAL CRACK NEAR PIER 5W. (ROUTINE REPAIR)

LEGEND

(12) PIER NUMBER (AS PER PANY&NJ SYSTEM)

(2) SPAN NUMBER (AS PER NYSDOT SYSTEM)

PHOTO TAKEN ABOVE DECK

CLEAR SCUPPER

CLOGGED SCUPPER (ROUTINE REPAIR)

LARGE SCUPPER

EXPANSION FINGER JOINT

STEEL PLATE

Sheet 2 Of 11

THE PORT AUTHORITY OF NY & NJ

2002 BIENNIAL INSPECTION

OF THE GOETHALS BRIDGE

Title

BIN 552305B

NEW JERSEY APPROACH

DEFICIENCY & PHOTO LOCATION PLAN
TOP OF DECK – 1
PIERS 'A' TO 8W

No	Date	Revision	Approved

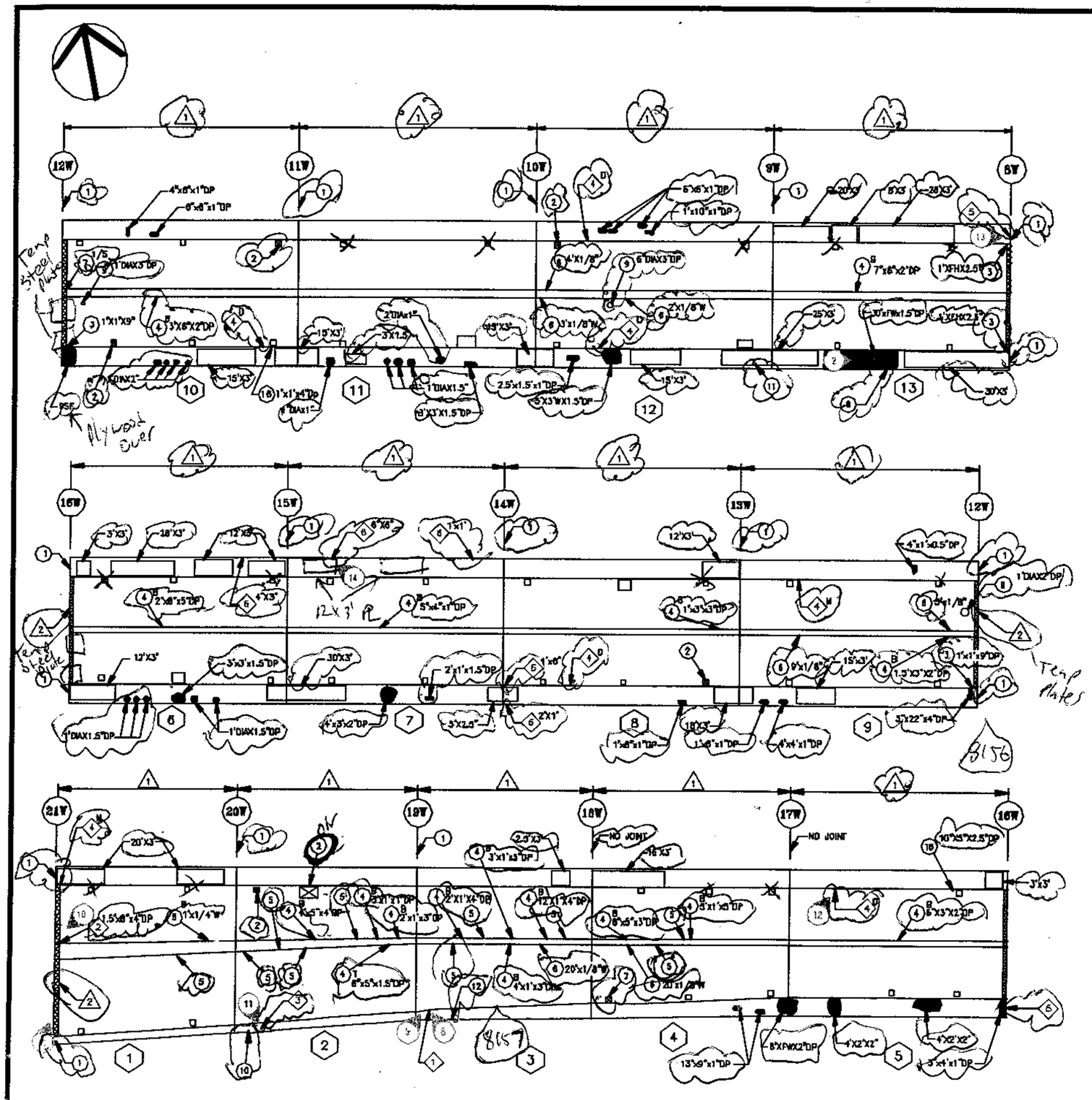
This drawing subject to conditions in contract. All inventions, ideas, designs and methods herein are reserved to Port Authority and may not be used without its written consent.

Designed by	Drawn by	Team Leader
	VO	CB

Date 11/01/02 Scale N.T.S.

Contract Number 403-99-01 Drawing Number 552305B-2

A. FODEN 5-20-04



KEY CONDITION NOTES – TOP OF DECK

PRIORITY REPAIRS

△1 THE NORTH AND SOUTH SIDEWALKS EXHIBIT DELAMINATED AND SPALLED CONCRETE AT TOP SURFACE. SEE LEGEND BELOW. (PRIORITY REPAIR)

DELAMINATED/SPALLED CONCRETE AT TOP SURFACE OF SIDEWALK WITHOUT EXPOSED REBARS. SIZE AS SHOWN. (PRIORITY REPAIR)

△2 UP TO 1" OF VERTICAL MISALIGNMENT AT THE FINGER JOINT OVER PIERS 4W, 8W, 12W, 16W AND 21W. (PRIORITY REPAIR)

SAFETY REPAIRS

◇1 THE W-SECTION GUIDERAIL AND ITS SUPPORTING POSTS ALONG THE SOUTH PARAPET BETWEEN PIERS 18W AND 19W ARE DAMAGED. (SAFETY REPAIR)

◇2 THE SOUTH CURB OF THE WESTBOUND ROADWAY AT THE FINGER JOINT OVER PIER 21W IS SPALLED. SIZE AS SHOWN. (SAFETY REPAIR)

◇3 MISSING HANDHOLE ACCESS COVER AT BASE OF THE LIGHT STANDARD WITH EXPOSED WIRES AT THE SOUTH PARAPET BETWEEN PIERS 19W AND 20W. (SAFETY REPAIR)

◇4 x MISSING OR DISPLACED STEEL EXPANSION PLATES AT THE CONCRETE PARAPETS "x" INDICATES THE STATUS OF THE STEEL PARAPET SECTION (D=DISCONNECTED, M=MISSING). (SAFETY REPAIR)

◇5 SIDEWALK JOINT ANGLES ARE EXPOSED DUE TO SPALLED SIDEWALK AND ARE SLIGHTLY BENT POSING A TRIPPING HAZARD. (SAFETY REPAIR)

◇8 THROUGH HOLES IN THE SIDEWALK SLAB. SIZE AS SHOWN. (SAFETY REPAIR)

ROUTINE REPAIRS

(1) DETERIORATED JOINT FILLER MATERIAL OVER THE PIER AND AT SIDEWALKS. (ROUTINE REPAIR)

(2) CLOGGED ROADWAY SCUPPER. (ROUTINE REPAIR)

(3) SPALLED CONCRETE CURB ALONG THE NORTH AND/OR SOUTH PARAPET. SIZE AS SHOWN. (ROUTINE REPAIR)

(4) x SPALLED AND DELAMINATED CONCRETE ALONG THE TOP AND BOTTOM OF THE MEDIAN BARRIER. SIZE AS SHOWN. "x" INDICATES LOCATION OF SPALL. (T=TOP, B=BOTTOM) (ROUTINE REPAIR)

(5) MISSING AND/OR LOOSE MEDIAN BARRIER ANCHOR BOLTS. (ROUTINE REPAIR)

(6) MEDIUM TO WIDE LONGITUDINAL CRACKS AT THE TOP OF THE CONCRETE MEDIAN BARRIER. SIZE AS SHOWN. (ROUTINE REPAIR)

(7) A/B MISSING ANCHOR BOLTS AT THE STEEL EXPANSION PLATE CONNECTION TO THE CONCRETE MEDIAN OVER THE FINGER JOINTS AT PIERS 4W AND 12W."A" INDICATES NUMBER OF MISSING BOLTS. "B" INDICATES TOTAL NUMBER OF BOLTS. (ROUTINE REPAIR)

(8) THE LIGHTING FIXTURE AT TOP OF SOUTH PARAPET BETWEEN 8W AND 9W HAS MISSING PART OF ITS COVER. (ROUTINE REPAIR)

(9) POTHOLE AND /OR CRACKED AND DEPRESSED AREA IN ASPHALT WEARING SURFACE BETWEEN 9W–10W AND 11W–13W.(ROUTINE REPAIR)

(10) MISSING INSULATION MATERIAL AT THE 4" DIAMETER FIRE STANDPIPE AT THE SOUTH FASCIA NEAR PIER 20W. (ROUTINE REPAIR)

(11) MISSING NUTS ON THE TRAFFIC SIGNAL CONTROL BOX COVER ATTACHED TO THE SIGN STRUCTURE POST AT THE SOUTH SIDEWALK BETWEEN PIERS 9W AND 10W. (ROUTINE REPAIR)

(12) HEAVY ACCUMULATION OF ROADWAY DEBRIS AT SOUTH SIDEWALK BETWEEN 18W AND 19W. (ROUTINE REPAIR)

(13) SPALLED SIDEWALK CONCRETE PARAPET BETWEEN PIERS 11W–12W AND 16W–17W. SIZE AS SHOWN. (ROUTINE REPAIR)

LEGEND

(12) PIER NUMBER (AS PER PANY&NJ SYSTEM)

(Z) SPAN NUMBER (AS PER NYSDOT SYSTEM)

PHOTO TAKEN ABOVE DECK

CLEAR SCUPPER

CLOGGED SCUPPER (ROUTINE REPAIR)

LARGE SCUPPER

ASPHALT POTHOLE (ROUTINE REPAIR)

EXPANSION FINGER JOINT

STEEL PLATE

Sheet 3 Of 11

THE PORT AUTHORITY OF NY & NJ

2002 BIENNIAL INSPECTION

OF THE GOETHALS BRIDGE

Title

BIN 5523058

NEW JERSEY APPROACH

DEFICIENCY & PHOTO LOCATION PLAN
TOP OF DECK – 2
PIERS 8W TO 21W

No	Date	Revision	Approved

This drawing subject to conditions in contract. All inventions, ideas, designs and methods herein are reserved to Port Authority and may not be used without its written consent.

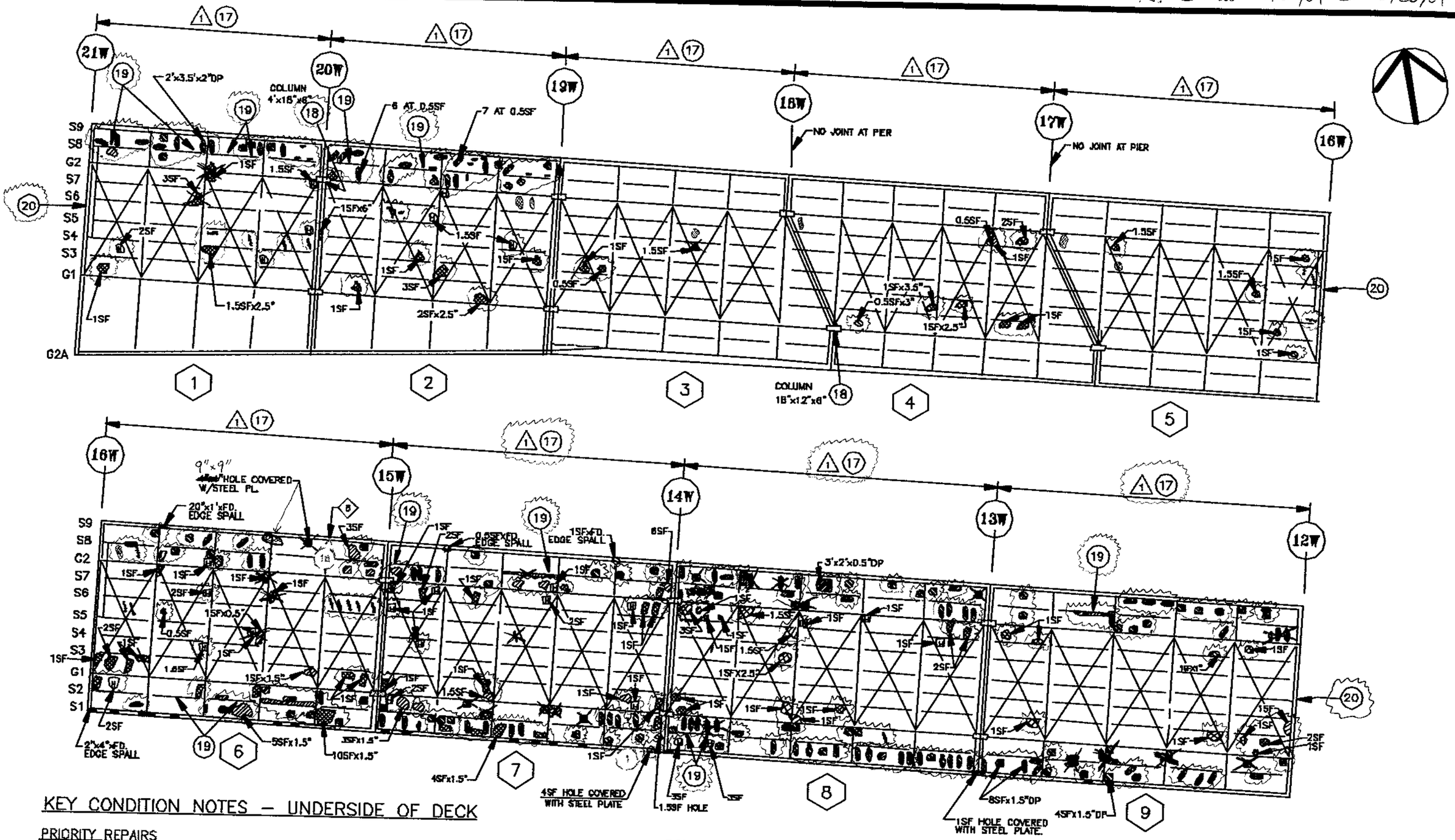
Designed by	Drawn by	Task Leader
	VB	CD

Date 11/01/02 Scale N.T.S.

Contract Number 405-99-01 Drawing Number 5523058-3

A. FODEN 5-20-04 & 5-21-04

Deficiency & photo location plan underside of deck - 1 Piers 21W to 12W Goethals N. Chao 5/24/04 & 5/26/04



KEY CONDITION NOTES – UNDERSIDE OF DECK

PRIORITY REPAIRS

(1) THE NORTH AND SOUTH SIDEWALKS EXHIBIT DELAMINATED AND SPALLED CONCRETE AT UNDERSIDE. SEE LEGEND BELOW. (PRIORITY REPAIR)

SPALLED CONCRETE WITHOUT EXPOSED REBARS AT THE UNDERSIDE OF NORTH AND SOUTH SIDEWALKS UP TO 3SF AND UP TO 1"DP. UNLESS OTHERWISE NOTED. (PRIORITY REPAIR)

SPALLED CONCRETE WITH EXPOSED REBARS AT THE UNDERSIDE OF NORTH AND SOUTH SIDEWALKS UP TO 3SF AND UP TO 2"DP

ROUTINE REPAIRS

(17) SPALLED, DELAMINATED OR HOLLOW CONCRETE AT THE UNDERSIDE OF DECK. SEE LEGEND BELOW. (ROUTINE REPAIR)

SPALLED CONCRETE WITHOUT EXPOSED REBARS UP TO 1" DEEP UNLESS OTHERWISE NOTED. (ROUTINE REPAIR)

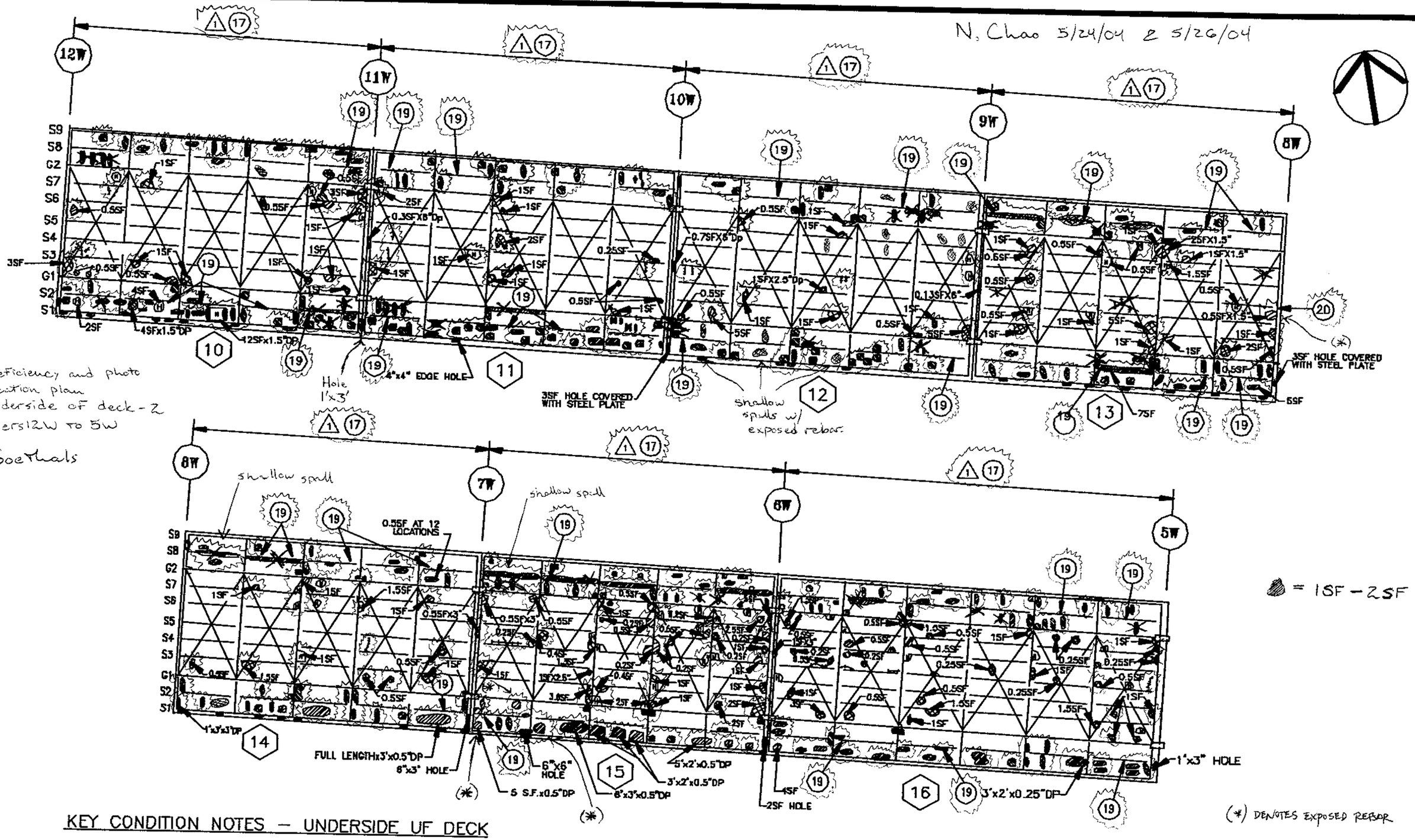
SPALLED CONCRETE WITH EXPOSED REBARS UP TO 2" DEEP UNLESS OTHERWISE NOTED. (ROUTINE REPAIR)

Note: Cracks along stringers potentially have been painted over.

LEGEND

C-11

N. Chao 5/24/04 & 5/26/04



Deficiency and photo location plan underside of deck - 2
Piers 12W to 5W

Goethals

KEY CONDITION NOTES – UNDERSIDE OF DECK

PRIORITY REPAIRS

(1) THE NORTH AND SOUTH SIDEWALKS EXHIBIT DELAMINATED AND SPALLED CONCRETE AT UNDERSIDE, SEE LEGEND BELOW. (PRIORITY REPAIR)

SPALLED CONCRETE WITHOUT EXPOSED REBARS AT THE UNDERSIDE OF NORTH AND SOUTH SIDEWALKS UP TO 3SF AND UP TO 1"DP. UNLESS OTHERWISE NOTED. (PRIORITY REPAIR)

SPALLED CONCRETE WITH EXPOSED REBARS AT THE UNDERSIDE

ROUTINE REPAIRS

(17) SPALLED, DELAMINATED OR HOLLOW CONCRETE AT THE UNDERSIDE OF DECK. SEE LEGEND BELOW. (ROUTINE REPAIR)

SPALLED CONCRETE WITHOUT EXPOSED REBARS UP TO 1" DEEP UNLESS OTHERWISE NOTED. (ROUTINE REPAIR)

SPALLED CONCRETE WITH EXPOSED REBARS UP TO

LEGEND

(LZ) PIER NUMBER (AS PER PANY&NJ SYSTEM)

(Z) SPAN NUMBER (AS PER NYSDOT SYSTEM)

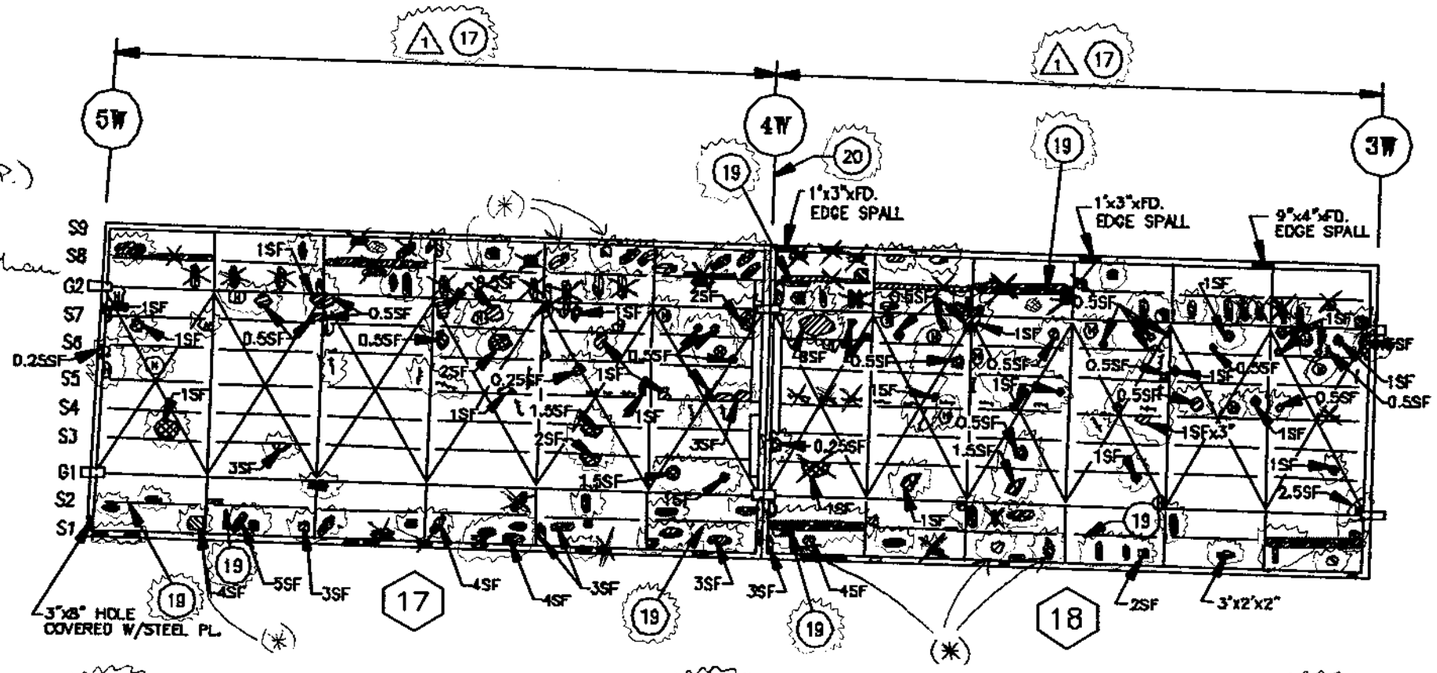
FINE CRACK WITH EFFLORESCENCE.

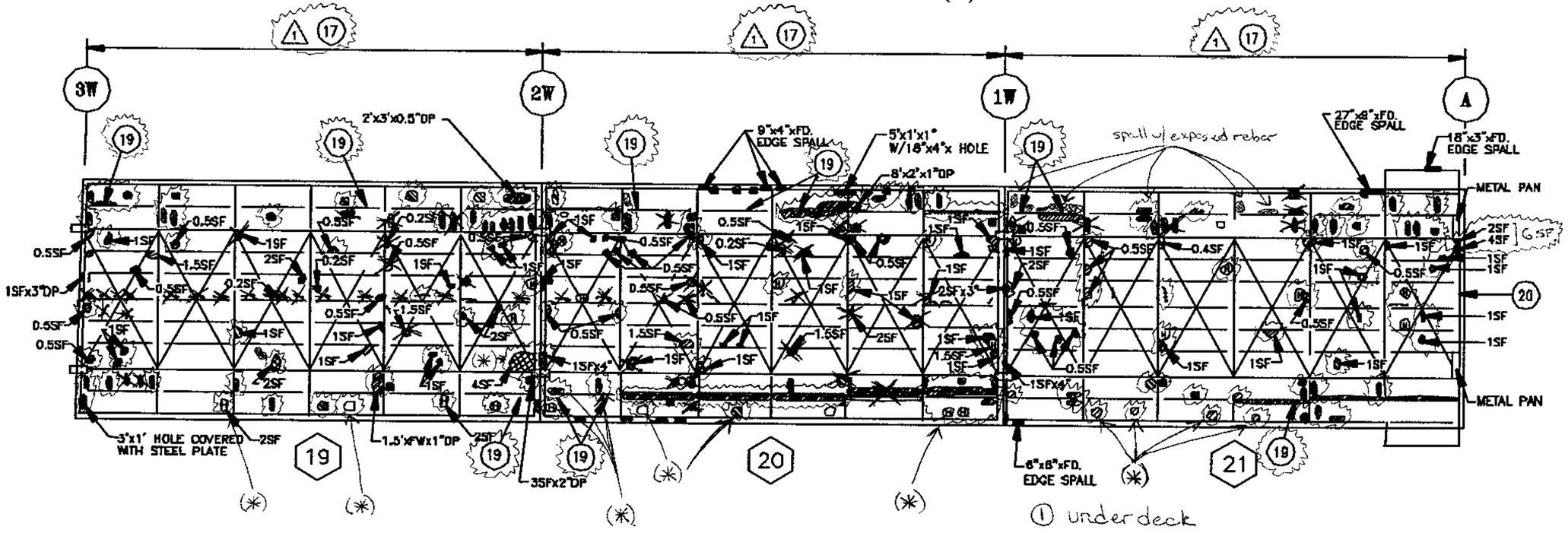
Deficiency & Photo Location Plan Underside of deck - 3 Piers 5W to A Goethals N. Chao 5/24/04 & 5/26/04

Notes:

① Areas indicating spalls are NOT to scale. (TYP.)

② Spalls are usually less than 1/4" deep. (TYP.)





① underdeck

Note: spall shows on S8 are typically found at the edge of the deck slab and middle of the safety walk, not directly on top of the stringers.

② All spalls marked have exposed rebar (TYP.) (*)

KEY CONDITION NOTES – UNDERSIDE OF DECK

PRIORITY REPAIRS

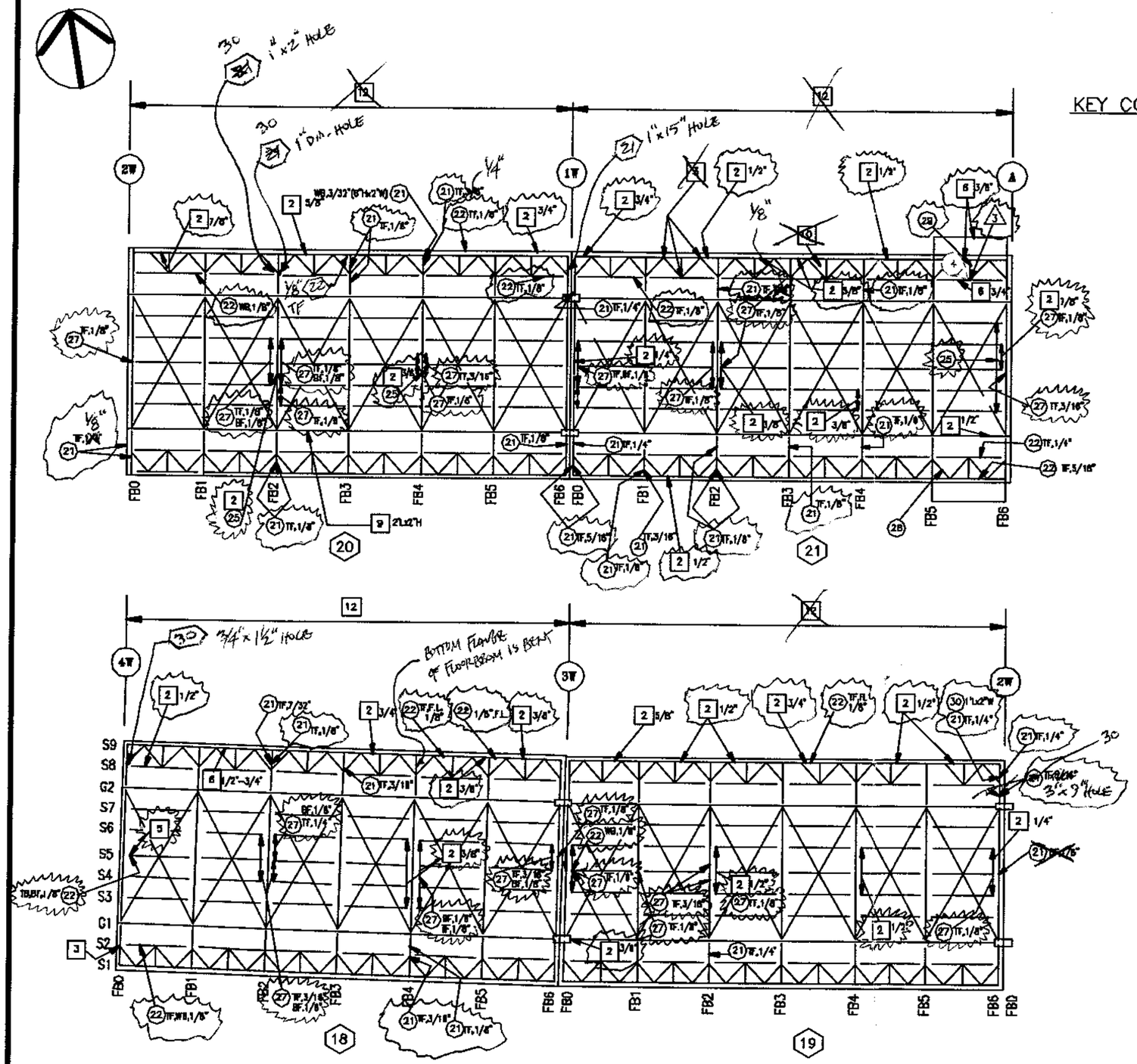
△1 THE NORTH AND SOUTH SIDEWALKS EXHIBIT DELAMINATED AND SPALLED CONCRETE AT UNDERSIDE, SEE LEGEND BELOW.

ROUTINE REPAIRS

(17) SPALLED, DELAMINATED OR HOLLOW CONCRETE AT THE UNDERSIDE OF DECK. SEE LEGEND BELOW. (ROUTINE REPAIR)

LEGEND

(12) PIER NUMBER (AS PER PANY&NJ SYSTEM)



KEY CONDITION NOTES – SUPERSTRUCTURE STEEL

PRIORITY REPAIRS

△3 CRACKED CONNECTION ANGLE BETWEEN STRINGER S8 AND DIAPHRAGM AT WEST OF PIER "A". (PRIORITY REPAIR)

ROUTINE REPAIRS

(21) THE OUTSTANDING LEG OF THE FLANGE AND/OR THE WEB OF THE FLOORBEAM CANTILEVERED BRACKET EXHIBITS SIGNIFICANT SECTION LOSS (1/8" OR MORE), LOCATION AND AMOUNT OF LOSS AS SHOWN. (ROUTINE REPAIR)

(22) THE FLANGE AND/OR WEB OF THE STRINGER EXHIBITS SIGNIFICANT SECTION LOSS (1/8" OR MORE) LOCATION AND AMOUNT OF LOSS AS SHOWN. (ROUTINE REPAIR)

(25) FILL THE GAP BETWEEN THE CONCRETE DECK AND THE TOP FLANGES OF THE STRINGERS, FLOORBEAMS AND GIRDERS TO PROVIDE FULL SUPPORT OF THE DECK. (ROUTINE REPAIR)

(27) THE TOP AND/OR BOTTOM FLANGE OF FLOORBEAM AT MIDSPAN EXHIBITS SIGNIFICANT SECTION LOSS (1/8" OR MORE), LOCATION AND AMOUNT OF LOSS AS SHOWN. (ROUTINE REPAIR)

(28) THE WEB OF THE DIAPHRAGM BETWEEN STRINGERS S9–S8 NEAR PIER "A" EXHIBITS 6" DIAMETER AREA OF PIN HOLES AND SEVERE SECTION LOSS. (ROUTINE REPAIR) (ADJACENT TO S8)

(30) THE OUTSTANDING LEG OF THE TOP FLANGE OF THE FLOORBEAM CANTILEVERED BRACKET EXHIBITS SMALL HOLES IN NON-CRITICAL AREAS. SIZE AS SHOWN. (ROUTINE REPAIR)

REPAIRS NOT REQUIRED

[2] IMPACT RUST BETWEEN THE TOP FLANGE OF THE STRINGERS, FLOORBEAMS OR GIRDERS AND THE CONCRETE DECK. AMOUNT AS SHOWN.

[3] THE GUSSET PLATE FOR THE SIDEWALK BRACING ANGLES UNDER BOTH SIDEWALKS EXHIBITS UP TO 1/8" OF SECTION LOSS.

[5] THE EAST VERTICAL STIFFENER OF THE FLOORBEAM AT PIER 4W NEAR STRINGER S5 EXHIBITS 1/8" OF SECTION LOSS.

[6] GAP BETWEEN THE TOP FLANGE OF STRINGERS S1 & S8 AND THE CONCRETE DECK. SIZE AS SHOWN.

[9] THE GIRDER WEB EXHIBITS UP TO 1/4" PITTING. THE SIZE IS AS SHOWN.

[10] THE NORTH SIDEWALK BRACING ANGLES BETWEEN PIERS A & 1W EXHIBIT UP TO 3/16" OF SECTION LOSS.

[12] ALL STEEL MEMBERS EXHIBIT MINOR SECTION LOSS. (<1/8")

LEGEND

(LZ) PIER NUMBER (AS PER PANY&NJ SYSTEM)

(Z) SPAN NUMBER (AS PER NYSDOT SYSTEM)

PHOTO TAKEN BELOW DECK

THE PORT AUTHORITY OF NY & NJ

2002 BIENNIAL INSPECTION

OF THE GOETHALS BRIDGE

Title

BIN 552305B

NEW JERSEY APPROACH

DEFICIENCY & PHOTO LOCATION PLAN
SUPERSTRUCTURE STEEL – 1
PIERS 'A' TO 4W

No	Date	Revision	Approved

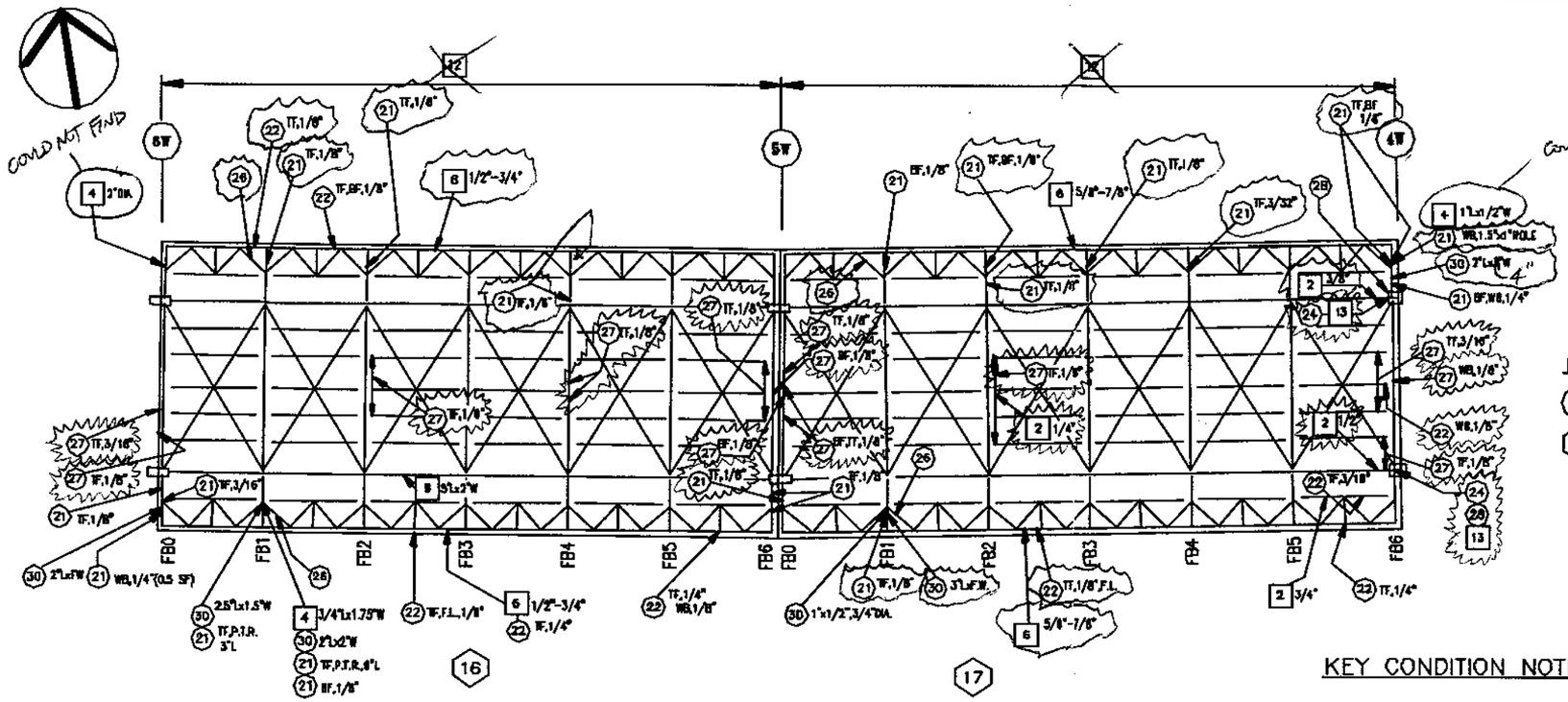
This drawing subject to conditions in contract. All inventions, ideas, designs and methods herein are reserved to Port Authority and may not be used without its written consent.

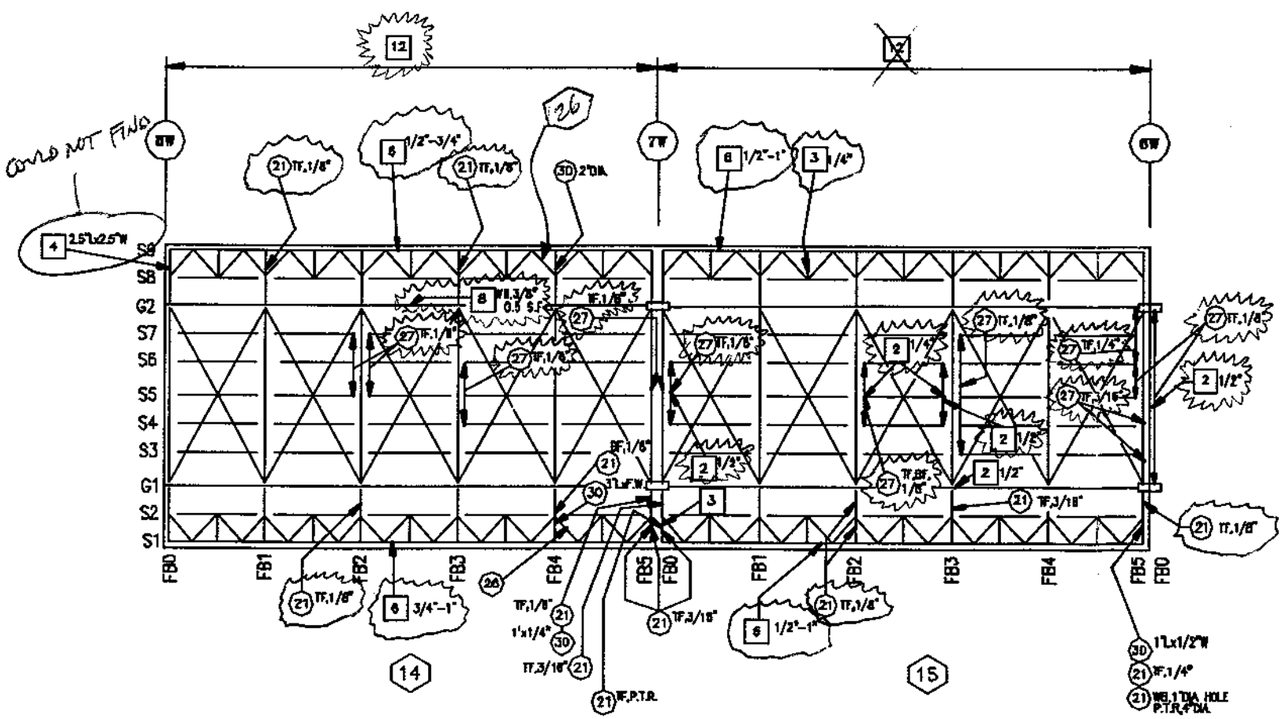
Designed by	Drawn by	Task Leader
	VD	CD

Date 11/01/02 Scale N.T.S.

Contract Number 405-99-01 Drawing Number 552305B-7

R. SZATKOWSKI 5/24/04





LEGEND

(1Z) PIER NUMBER (AS PER PANYANJ SYSTEM)

(Z) SPAN NUMBER (AS PER NYSDOT SYSTEM)

KEY CONDITION NOTES – SUPERSTRUCTURE STEEL

ROUTINE REPAIRS

(21) THE OUTSTANDING LEG OF THE FLANGE AND/OR THE WEB OF THE FLOORBEAM CANTILEVERED BRACKET EXHIBITS SIGNIFICANT SECTION LOSS (1/8" OR MORE). LOCATION AND AMOUNT OF LOSS AS SHOWN. (ROUTINE REPAIR)

(22) THE FLANGE AND/OR WEB OF THE STRINGER EXHIBITS SIGNIFICANT SECTION LOSS (1/8" OR MORE) LOCATION AND AMOUNT OF LOSS AS SHOWN. (ROUTINE REPAIR)

(24) THE NORTH AND SOUTH BEARINGS OVER PIER 4W EXHIBIT BUILT-UP IMPACTED RUST UNDER THE ROCKER. (ROUTINE REPAIR)

(26) MISSING SIDEWALK BRACING ANGLES. (ROUTINE REPAIR)

(27) THE TOP AND/OR BOTTOM FLANGE OF FLOORBEAM AT MIDSPAN EXHIBITS SIGNIFICANT SECTION LOSS (1/8" OR MORE). LOCATION AND AMOUNT OF LOSS AS SHOWN. (ROUTINE REPAIR)

(28) UP TO 80% SECTION LOSS TO NORTH-WEST BEARING ANCHOR BOLT NUT OF THE SOUTHWEST BEARING OVER PIER 4W. (ROUTINE REPAIR)

(30) THE OUTSTANDING LEG OF THE TOP FLANGE OF THE FLOORBEAM CANTILEVERED BRACKET EXHIBITS SMALL HOLES IN NON-CRITICAL AREAS. SIZE AS SHOWN. (ROUTINE REPAIR)

REPAIRS NOT REQUIRED

[2] IMPACT RUST BETWEEN THE TOP FLANGE OF THE STRINGERS, FLOORBEAMS OR GIRDERS AND THE CONCRETE DECK. AMOUNT AS SHOWN.

[3] THE GUSSET PLATE FOR THE SIDEWALK BRACING ANGLES UNDER BOTH SIDEWALKS EXHIBITS UP TO 1/8" OF SECTION LOSS.

[4] THE WEB OF THE FLOORBEAM CANTILEVERED BRACKET IS RUSTED THROUGH. SIZE AS SHOWN.

[6] GAP BETWEEN THE TOP FLANGE OF STRINGERS S1 & S9 AND THE CONCRETE DECK. SIZE AS SHOWN.

[8] THE GIRDER TOP FLANGE AND/OR THE WEB EXHIBITS UP TO 1/8" SECTION LOSS.

[9] THE GIRDER WEB EXHIBITS UP TO 1/4" PITTING. THE SIZE IS AS SHOWN.

[12] ALL STEEL MEMBERS EXHIBIT MINOR SECTION LOSS. (<1/8")

[13] THE BEARINGS ARE SLIGHTLY OVEREXTENDED OVER PIERS 4W AND 13W.

THE PORT AUTHORITY OF NY & NJ

2002 BIENNIAL INSPECTION

OF THE GOETHALS BRIDGE

Title

BIN 552305B

NEW JERSEY APPROACH

DEFICIENCY & PHOTO LOCATION PLAN SUPERSTRUCTURE STEEL – 2 PIERS 4W TO 8W

No	Date	Revision	Approved

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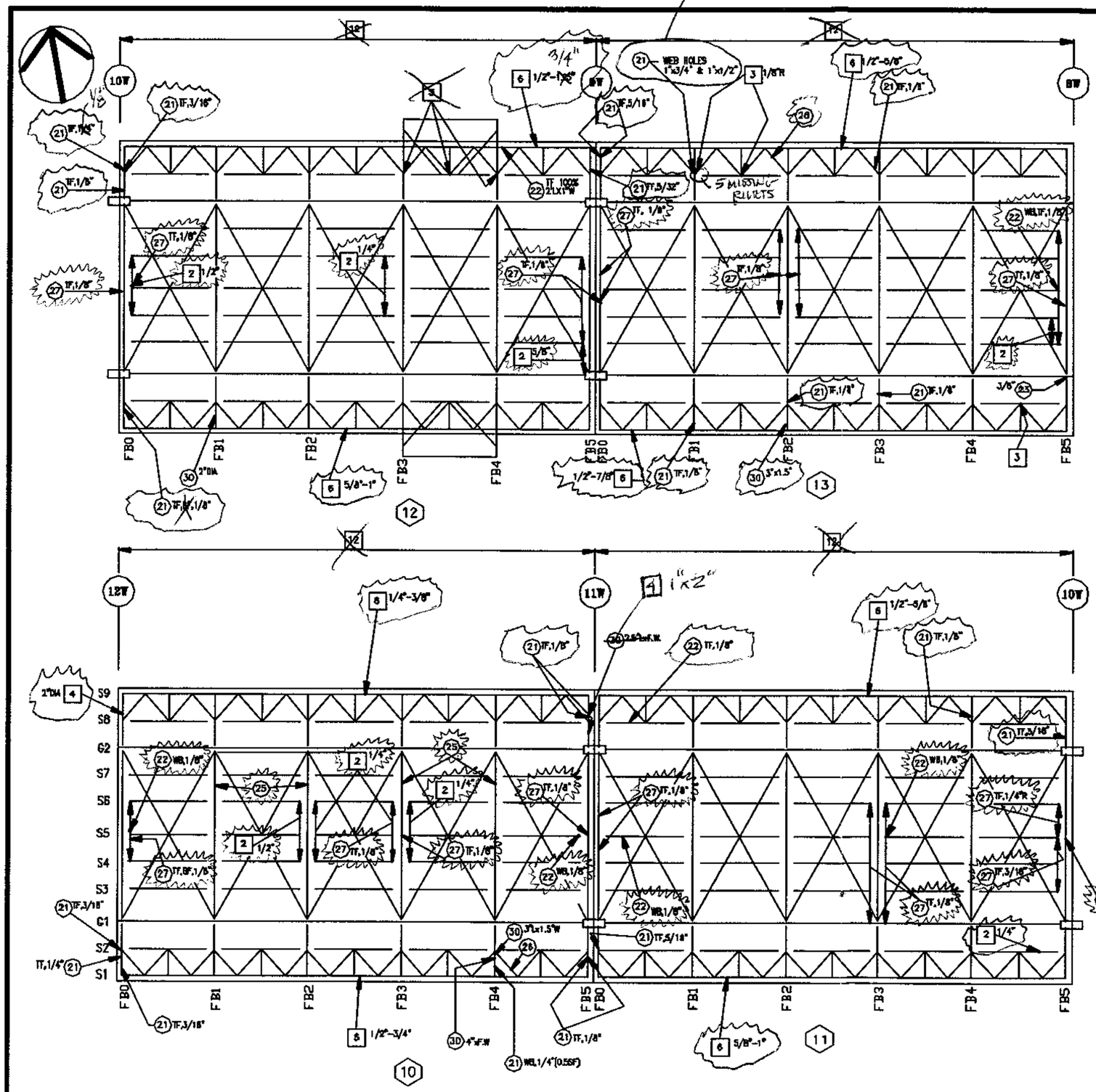
Designed by	Drawn by	Task Leader
	VD	CD

Date 11/01/02 Scale N.T.S.

Contract Number 405-99-1 Drawing Number 552305B-8

R. SZATKOWSKI 5/24/04



KEY CONDITION NOTES

SUPERSTRUCTURE STEEL

ROUTINE REPAIRS

(21) THE OUTSTANDING LEG OF THE FLANGE AND/OR THE WEB OF THE FLOORBEAM CANTILEVERED BRACKET EXHIBITS SIGNIFICANT SECTION LOSS (1/8" OR MORE). LOCATION AND AMOUNT OF LOSS AS SHOWN. (ROUTINE REPAIR)

(22) THE FLANGE AND/OR WEB OF THE STRINGER EXHIBITS SIGNIFICANT SECTION LOSS (1/8" OR MORE) LOCATION AND AMOUNT OF LOSS AS SHOWN. (ROUTINE REPAIR)

(23) 1/8" TO 1/2" IMPACTED RUST BETWEEN THE OUTSTANDING LEGS OF THE GIRDER BEARING STIFFENERS ANGLES AT PIERS 8W AND 12W. (ROUTINE REPAIR)

(25) FILL THE GAP BETWEEN THE CONCRETE DECK AND THE TOP FLANGES OF THE STRINGERS, FLOORBEAMS AND GIRDERS TO PROVIDE FULL SUPPORT OF THE DECK. (ROUTINE REPAIR)

(26) MISSING SIDEWALK BRACING ANGLES. (ROUTINE REPAIR)

(27) THE TOP AND/OR BOTTOM FLANGE OF FLOORBEAM AT MIDSPAN EXHIBITS SIGNIFICANT SECTION LOSS (1/8" OR MORE), LOCATION AND AMOUNT OF LOSS AS SHOWN. (ROUTINE REPAIR)

(30) THE OUTSTANDING LEG OF THE TOP FLANGE OF THE FLOORBEAM CANTILEVERED BRACKET EXHIBITS SMALL HOLES IN NON-CRITICAL AREAS. SIZE AS SHOWN. (ROUTINE REPAIR)

REPAIRS NOT REQUIRED

[2] IMPACT RUST BETWEEN THE TOP FLANGE OF THE STRINGERS, FLOORBEAMS OR GIRDERS AND THE CONCRETE DECK. AMOUNT AS SHOWN.

[3] THE GUSSET PLATE FOR THE SIDEWALK BRACING ANGLES UNDER BOTH SIDEWALKS EXHIBITS UP TO 1/8" OF SECTION LOSS.

[4] THE WEB OF THE FLOORBEAM CANTILEVERED BRACKET IS RUSTED THROUGH. SIZE AS SHOWN.

[6] GAP BETWEEN THE TOP FLANGE OF STRINGERS S1 & S9 AND THE CONCRETE DECK. SIZE AS SHOWN.

[12] ALL STEEL MEMBERS EXHIBIT MINOR SECTION LOSS. (<1/8")

LEGEND

(12) PIER NUMBER (AS PER PANY&NJ SYSTEM)

(7) SPAN NUMBER (AS PER NYSDOT SYSTEM)

THE PORT AUTHORITY OF NY & NJ

2002 BIENNIAL INSPECTION

OF THE GOETHALS BRIDGE

Title

BIN 552305B

NEW JERSEY APPROACH

DEFICIENCY & PHOTO LOCATION PLAN
SUPERSTRUCTURE STEEL – 3
PIERS 8W TO 12W

No	Date	Revision	Approved

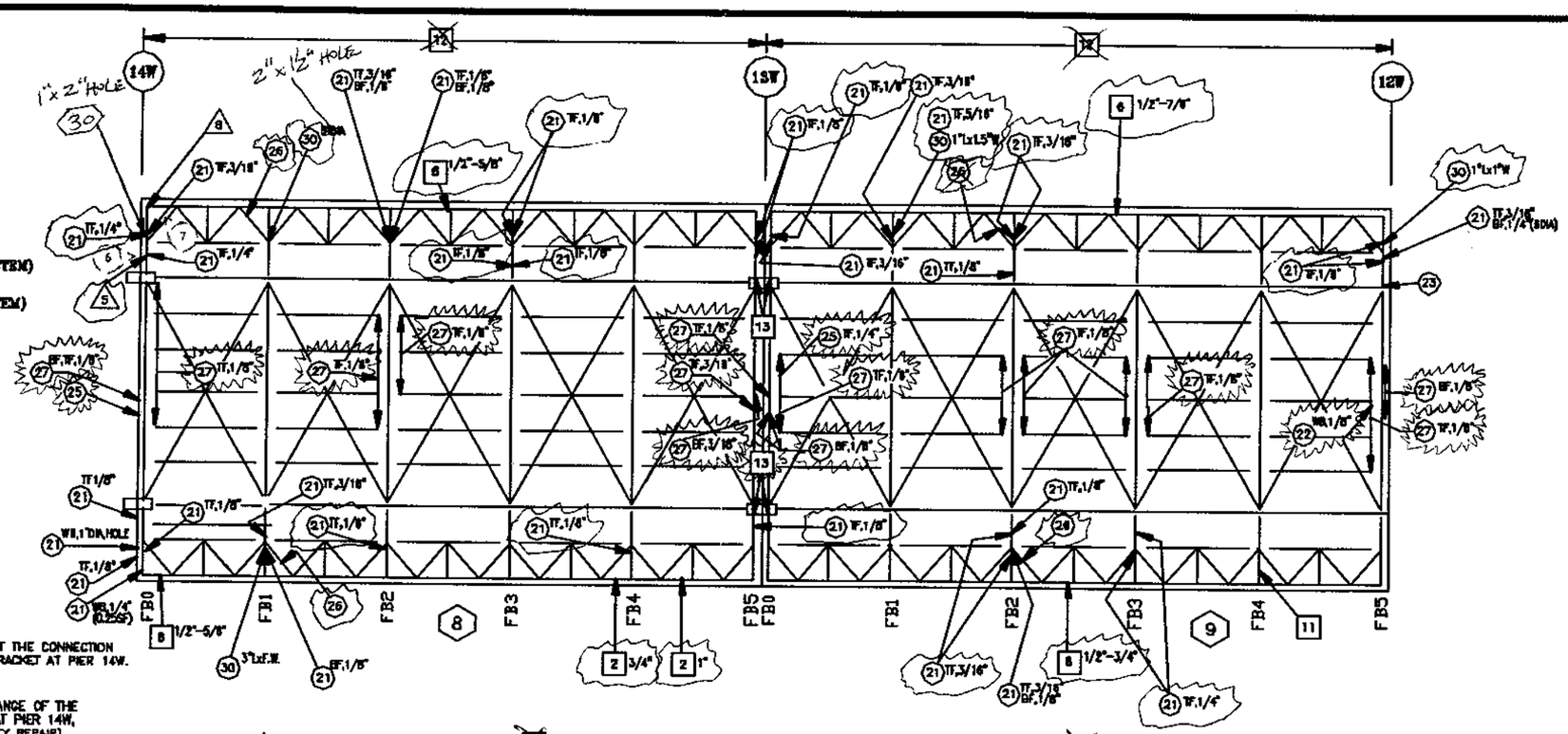
This drawing subject to conditions in contract. All inventions, ideas, designs and methods herein are reserved to Port Authority and may not be used without its written consent.

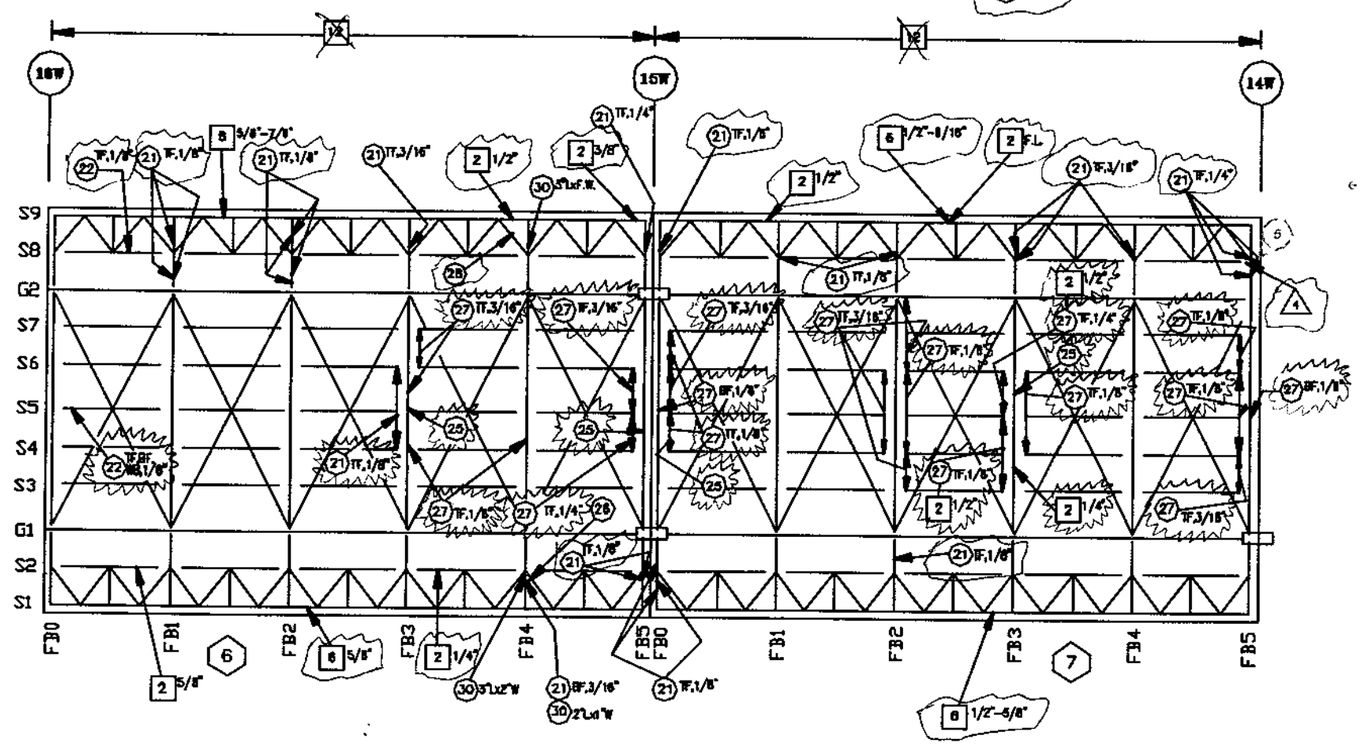
Designed by	Drawn by	Task Leader
	VD	CD

Date 11/01/02 Scale N.T.S.

Contract Number 405-99-1 Drawing Number 552305B-9

R. SZATKOWSKI 5/25/04





LEGEND

- (12) PIER NUMBER (AS PER PANY&NJ SYSTEM)
- (2) SPAN NUMBER (AS PER NYSDOT SYSTEM)
- PHOTO TAKEN BELOW DECK

KEY CONDITION NOTES
SUPERSTRUCTURE STEEL

PRIORITY REPAIRS

(4) SEVERELY DETERIORATED WEB OF STRINGER S8 AT THE CONNECTION TO THE NORTHWEST CANTILEVERED FLOORBEAM BRACKET AT PIER 14W. (PRIORITY REPAIR)

(5) DETERIORATED OUTSTANDING LEG OF THE TOP FLANGE OF THE NORTHEAST CANTILEVERED FLOORBEAM BRACKET AT PIER 14W, BETWEEN GIRDER G2 AND STRINGER S8. (PRIORITY REPAIR)

(8) MISSING BOLTS AT THE WEB CONNECTION BETWEEN STRINGER S8 AND THE NORTHEAST CANTILEVERED FLOORBEAM BRACKET AT PIER 14W. (PRIORITY REPAIR)

ROUTINE REPAIRS

(21) THE OUTSTANDING LEG OF THE FLANGE AND/OR THE WEB OF THE FLOORBEAM CANTILEVERED BRACKET EXHIBITS SIGNIFICANT SECTION LOSS (1/8" OR MORE), LOCATION AND AMOUNT OF LOSS AS SHOWN. (ROUTINE REPAIR)

(22) THE FLANGE AND/OR WEB OF THE STRINGER EXHIBITS SIGNIFICANT SECTION LOSS (1/8" OR MORE) LOCATION AND AMOUNT OF LOSS AS SHOWN. (ROUTINE REPAIR)

(23) 1/8" TO 1/2" IMPACTED RUST BETWEEN THE OUTSTANDING LEGS OF THE GIRDER BEARING STIFFENERS ANGLES AT PIERS 8W AND 12W. (ROUTINE REPAIR)

(25) FILL THE GAP BETWEEN THE CONCRETE DECK AND THE TOP FLANGES OF THE STRINGERS, FLOORBEAMS AND GIRDERS TO PROVIDE FULL SUPPORT OF THE DECK. (ROUTINE REPAIR)

(26) MISSING SIDEWALK BRACING ANGLES. (ROUTINE REPAIR)

(27) THE TOP AND/OR BOTTOM FLANGE OF FLOORBEAM AT MIDSPAN EXHIBITS SIGNIFICANT SECTION LOSS (1/8" OR MORE), LOCATION AND AMOUNT OF LOSS AS SHOWN. (ROUTINE REPAIR)

(30) THE OUTSTANDING LEG OF THE TOP FLANGE OF THE FLOORBEAM CANTILEVERED BRACKET EXHIBITS SMALL HOLES IN NON-CRITICAL AREAS. SIZE AS SHOWN. (ROUTINE REPAIR)

REPAIRS NOT REQUIRED

[2] IMPACT RUST BETWEEN THE TOP FLANGE OF THE STRINGERS, FLOORBEAMS OR GIRDERS AND THE CONCRETE DECK. AMOUNT AS SHOWN.

[8] GAP BETWEEN THE TOP FLANGE OF STRINGERS S1 & S9 AND THE CONCRETE DECK. SIZE AS SHOWN.

[11] THE BOTTOM FLANGE OF THE FLOORBEAM CANTILEVERED BRACKET HAS IMPACT DAMAGE AND IS DEFLECTING 1/8".

[12] ALL STEEL MEMBERS EXHIBIT MINOR SECTION LOSS. (<1/8")

[13] THE BEARINGS ARE SLIGHTLY OVEREXTENDED OVER PIERS 4W AND 13W.

THE PORT AUTHORITY OF NY & NJ

2002 BIENNIAL INSPECTION

OF THE GOETHALS BRIDGE

Title

BIN 552305B

NEW JERSEY APPROACH

DEFICIENCY & PHOTO LOCATION PLAN
SUPERSTRUCTURE STEEL – 4
PIERS 12W TO 16W

No	Date	Revision	Approved

This drawing subject to conditions in contract. All inventions, ideas, designs and methods herein are reserved to Port Authority and may not be used without its written consent.

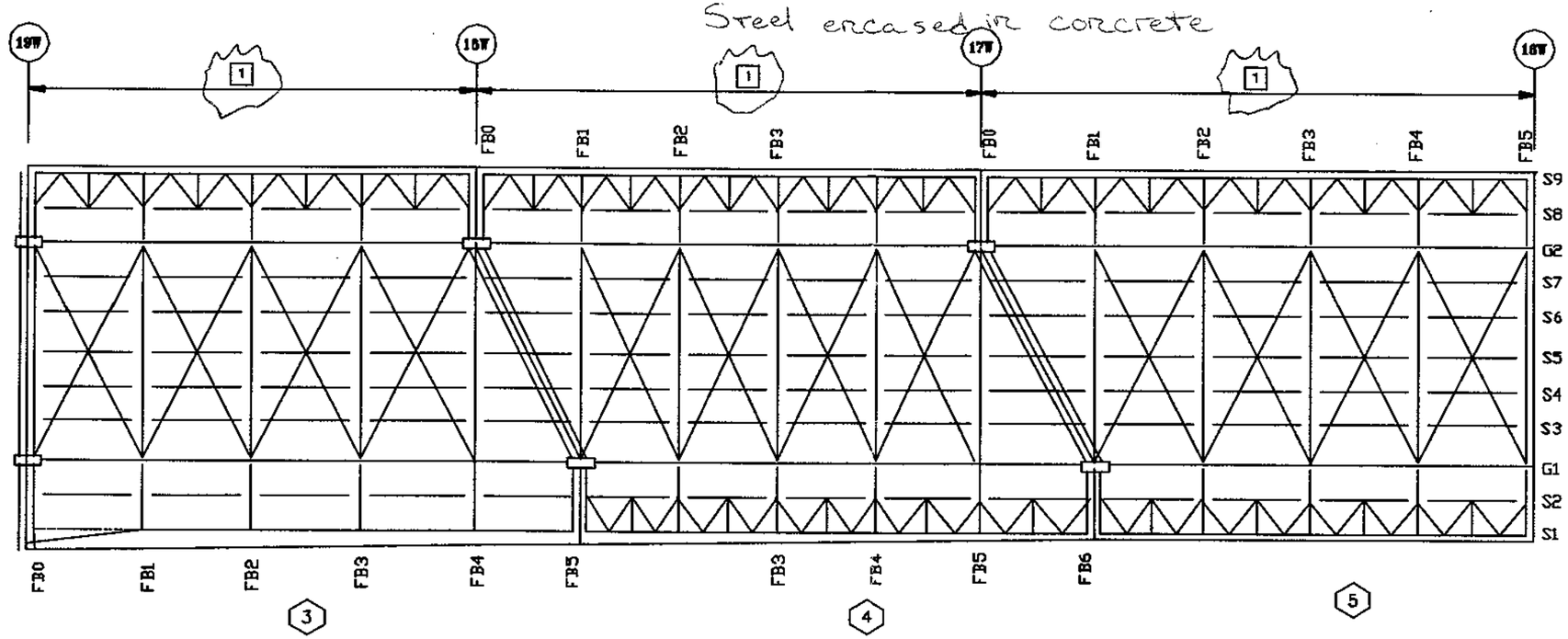
Designed by	Drawn by	Task Leader
	VD	CD

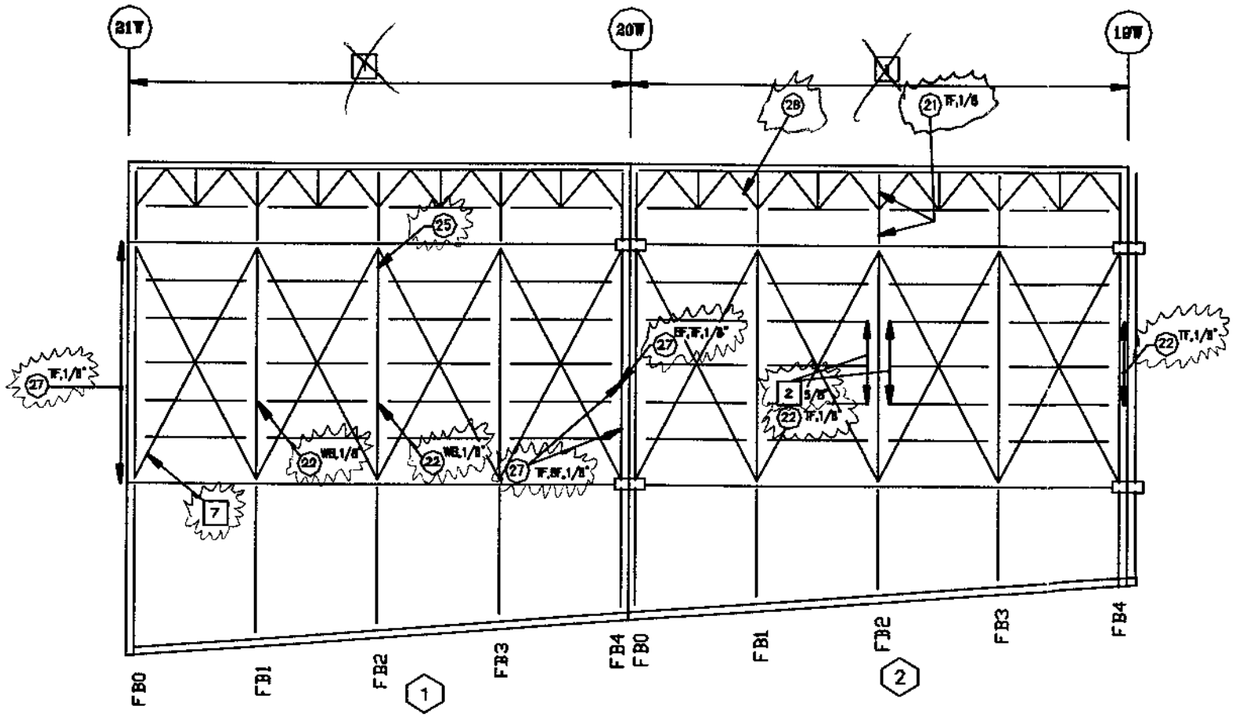
Date 11/01/02 Scale N.T.S.

Contract Number 405-99-1 Drawing Number 552305B-10

R. SZOSTKOWSKI 5/25/04

Steel encased in concrete





KEY CONDITION NOTES – SUPERSTRUCTURE STEEL

ROUTINE REPAIRS

(21) THE OUTSTANDING LEG OF THE FLANGE AND/OR THE WEB OF THE FLOORBEAM CANTILEVERED BRACKET EXHIBITS SIGNIFICANT SECTION LOSS (1/8" OR MORE). LOCATION AND AMOUNT OF LOSS AS SHOWN. (ROUTINE REPAIR)

(22) THE FLANGE AND/OR WEB OF THE STRINGER EXHIBITS SIGNIFICANT SECTION LOSS (1/8" OR MORE) LOCATION AND AMOUNT OF LOSS AS SHOWN. (ROUTINE REPAIR)

(25) FILL THE GAP BETWEEN THE CONCRETE DECK AND THE TOP FLANGES OF THE STRINGERS, FLOORBEAMS AND GIRDERS TO PROVIDE FULL SUPPORT OF THE DECK. (ROUTINE REPAIR)

(28) MISSING SIDEWALK BRACING ANGLES. (ROUTINE REPAIR)

(27) THE TOP AND/OR BOTTOM FLANGE OF FLOORBEAM AT MIDSPAN EXHIBITS SIGNIFICANT SECTION LOSS (1/8" OR MORE), LOCATION AND AMOUNT OF LOSS AS SHOWN. (ROUTINE REPAIR)

REPAIRS NOT REQUIRED

[1] ALL STEEL MEMBERS BETWEEN PIERS 18W AND 16W ARE ENCASED IN CONCRETE.

[2] IMPACT RUST BETWEEN THE TOP FLANGE OF THE STRINGERS, FLOORBEAMS OR GIRDERS AND THE CONCRETE DECK. AMOUNT AS SHOWN.

[7] THE CROSS BRACING ANGLE EXHIBITS UP TO 1/8" OF SECTION LOSS UNLESS OTHERWISE SPECIFIED.

LEGEND

(16) PIER NUMBER (AS PER PANY&NJ SYSTEM)

(2) SPAN NUMBER (AS PER NYSDOT SYSTEM)

THE PORT AUTHORITY OF NY & NJ

2002 BIENNIAL INSPECTION

OF THE GOETHALS BRIDGE

Title

BIN 552305B

NEW JERSEY APPROACH

DEFICIENCY & PHOTO LOCATION PLAN SUPERSTRUCTURE STEEL – 5

PIERS 16W TO 21W

No	Date	Revision	Approved

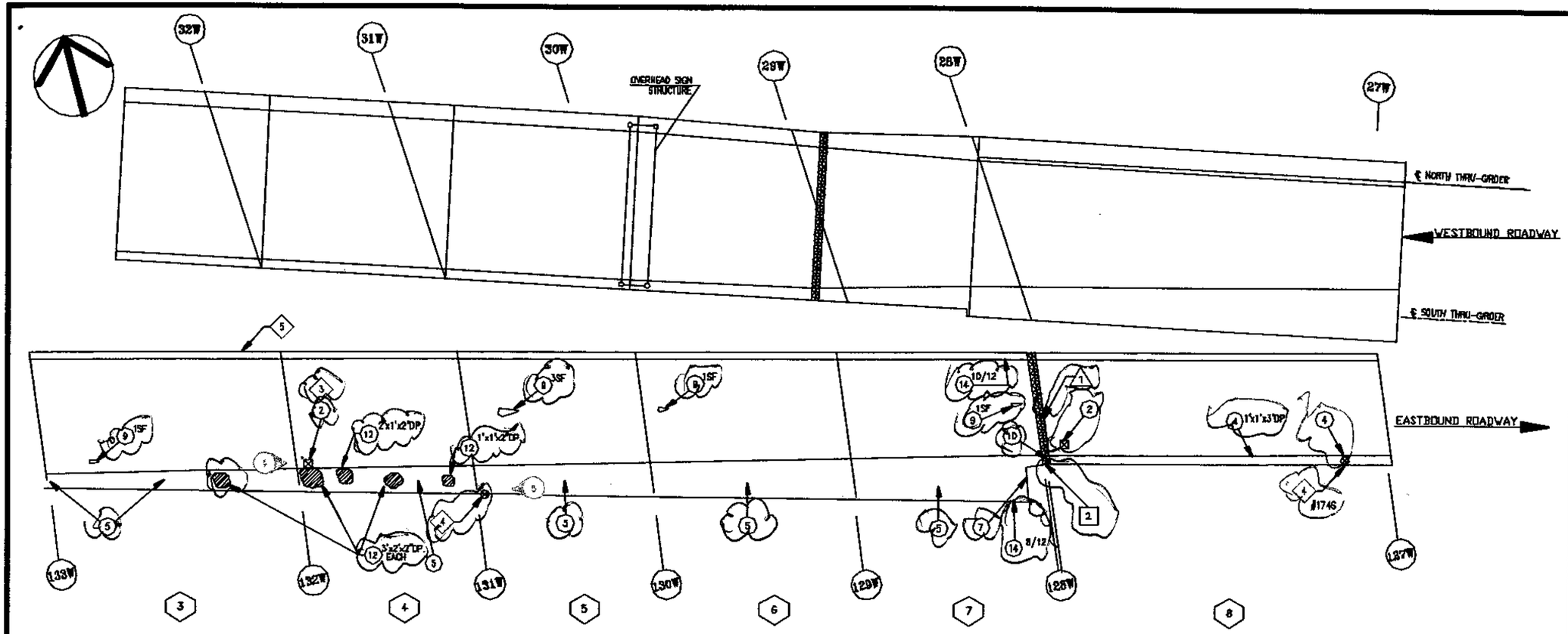
This drawing subject to conditions in contract. All inventions, ideas, designs and methods herein are reserved to Port Authority and may not be used without its written consent.

Designed by	Drawn by	Task Leader
	VD	CD

Date 11/01/02 Scale N.T.S.

Contract Number 403-99-1 Drawing Number 552305B-11

R. SZATKOWSKI 5/25/04



KEY CONDITION NOTES – TOP OF DECK

PRIORITY REPAIRS

1. UP TO 1" OF VERTICAL MISALIGNMENT AT THE FINGER JOINT OVER THE WEST ABUTMENT AND PIERS 128W AND 25W. (PRIORITY REPAIR)

SAFETY REPAIRS

3. BROKEN DRAINAGE GRATING ALONG THE SOUTH CURBLINE BETWEEN PIERS 131W AND 132W. (SAFETY REPAIR)
4. MISSING ACCESS COVER PLATE OR SCREWS AT THE LIGHT STANDARD WITH EXPOSED WIRES BETWEEN PIERS 21W–22W, 23W–24W, 127W–128W AND 130W–131W. (SAFETY REPAIR)
5. MISSING COVER TO THE ELECTRIC JUNCTION BOX WITH EXPOSED WIRES BETWEEN 21W–22W, 25W–127W AND 132W–133W, AND AT WEST APPROACH ROADWAY. (SAFETY REPAIR)

ROUTINE REPAIRS

2. CLOGGED ROADWAY SCUPPERS. (ROUTINE REPAIR)
4. SPALLED CONCRETE IN THE SOUTH PARAPET BETWEEN PIERS 25W–128W AND INCIPIENT SPALL IN THE SOUTH PARAPET NEAR PIER 127W. SIZE AS SHOWN. (ROUTINE REPAIR)
5. VEGETATION GROWTH AND DEBRIS ACCUMULATION BETWEEN SOUTH FASCIA AND PARAPET BETWEEN PIERS 128W AND 133W. (ROUTINE REPAIR)
7. WIDE VERTICAL CRACK IN SOUTH CONCRETE PARAPET BETWEEN PIERS 128W AND 129W. (ROUTINE REPAIR)
9. AREAS OF DEPRESSED AND CRACKED ASPHALT AND POTHOLES ON THE BRIDGE ROADWAY PAVEMENT. SIZE AS SHOWN. (ROUTINE REPAIR)
10. DISLODGED EXPANSION PLATE OVER SOUTH SAFETYWALK AT PIER 128W. (ROUTINE REPAIR)
12. SPALLS IN SOUTH SAFETYWALK BETWEEN PIERS 131W AND 133W. SIZE AS SHOWN. REFER TO LEGEND FOR THE SPALL SYMBOLS. (ROUTINE REPAIR)
14. A/B MISSING SCREWS TO ELECTRICAL JUNCTION BOXES. "A" INDICATES NUMBER OF MISSING SCREWS, "B" INDICATES TOTAL NUMBER OF SCREWS. (ROUTINE REPAIR)

REPAIRS NOT REQUIRED

2. THE STEEL ARMORED FINGER JOINT EXHIBITS LIGHT TO MODERATE RUST.

LEGEND

- (Z) PIER NUMBER (AS PER PANY&NJ SYSTEM)
- (Z) SPAN NUMBER (AS PER NJSDOT SYSTEM)
- PHOTO TAKEN ABOVE DECK
- CLOGGED SCUPPER (ROUTINE REPAIR)
- CLEAR SCUPPER
- EXPANSION FINGER JOINT
- STEEL PLATE
- POTHOLE/DEPRESSED ASPHALT PAVEMENT. (ROUTINE REPAIR)
- DELAMINATED/SPALLED CONCRETE WITH OR WITHOUT EXPOSED REBARS AT THE SOUTH SAFETY WALK. (ROUTINE REPAIR)

Sheet 3 of 10

THE PORT AUTHORITY OF NY & NJ

2002 BIENNIAL INSPECTION

OF THE GOETHALS BRIDGE

Title

BIN 3800071

NJ APPROACH

DEFICIENCY & PHOTO LOCATION PLAN
TOP OF DECK–2
PIERS 127W TO 133W

No	Date	Revision	Approved

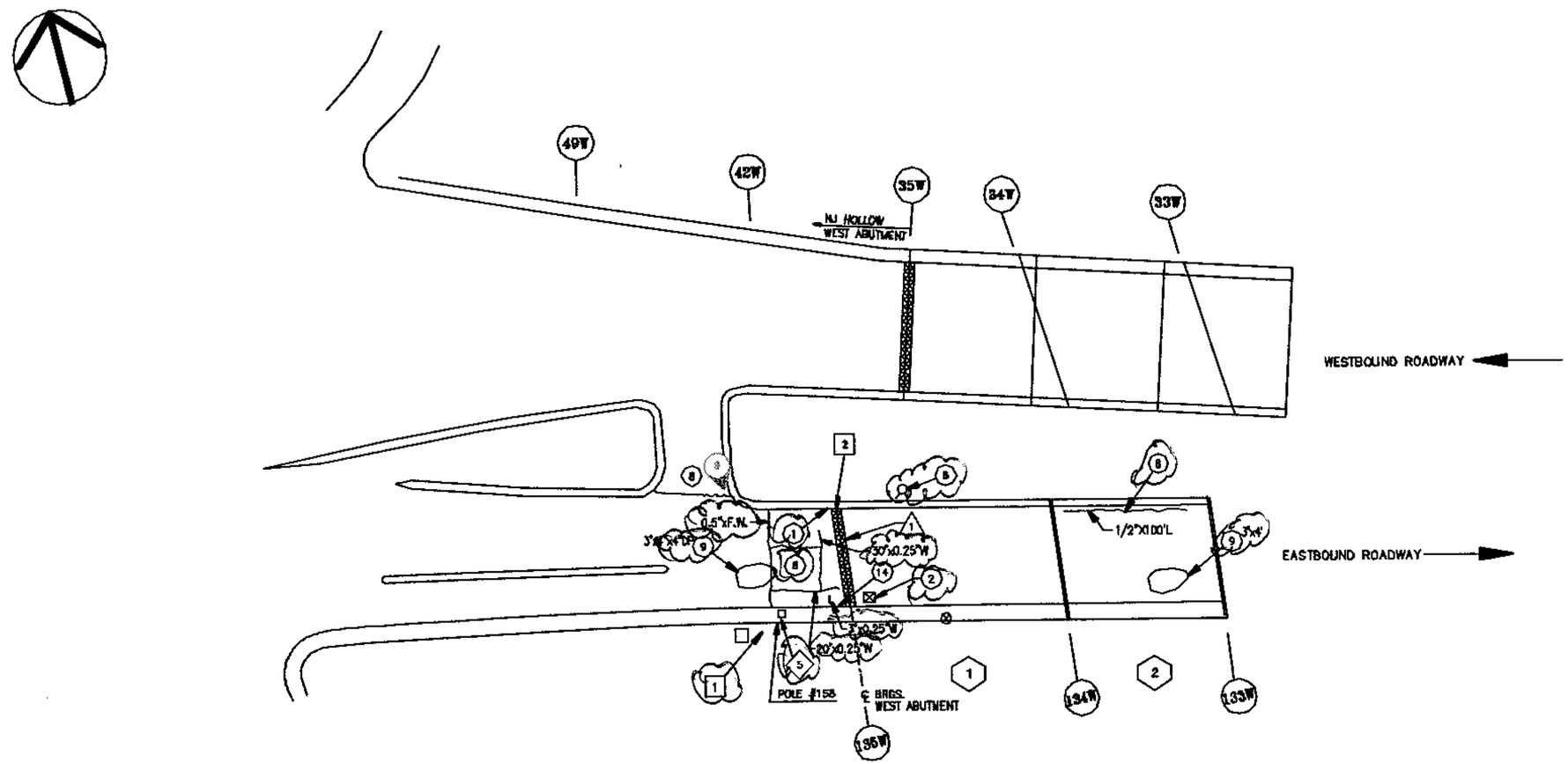
This drawing subject to conditions in contract. All inventions, ideas, designs and methods herein are reserved to Port Authority and may not be used without its written consent.

Designed by	Drawn by	Task Leader
	VD	CD

Date 11/01/02 Scale N.T.S.

Contract Number 405-98-01 Drawing Number 3800071-3

A. FODEN 5-20-04



KEY CONDITION NOTES

PRIORITY REPAIRS

1. UP TO 1" OF VERTICAL MISALIGNMENT AT THE FINGER JOINT OVER THE WEST ABUTMENT AND PIERS 128W AND 25W. (PRIORITY REPAIR)

SAFETY REPAIRS

5. MISSING COVER TO THE ELECTRIC JUNCTION BOX WITH EXPOSED WIRES BETWEEN 21W–22W, 25W–127W AND 132W–133W, AND AT WEST APPROACH ROADWAY. (SAFETY REPAIR)

ROUTINE REPAIRS

1. SETTLED CURB AND SAFETYWALK AT THE NORTH SIDE OF THE WEST APPROACH. (ROUTINE REPAIR)
2. CLOGGED ROADWAY SCUPPERS. (ROUTINE REPAIR)
6. DETERIORATED CASING AND INSULATION OF FIRE STANDPIPE AT THE NORTH SIDE BETWEEN PIER 134W AND WEST ABUTMENT. (ROUTINE REPAIR)
8. MEDIUM TO WIDE CRACKS IN THE WEST APPROACH AND SPAN 11 PAVEMENT. (ROUTINE REPAIR)
9. AREAS OF DEPRESSED AND CRACKED ASPHALT AND POTHOLES ON THE BRIDGE ROADWAY PAVEMENT. SIZE AS SHOWN. (ROUTINE REPAIR)
14. A/B MISSING SCREWS TO ELECTRICAL JUNCTION BOXES. "A" INDICATES NUMBER OF MISSING SCREWS, "B" INDICATES TOTAL NUMBER OF SCREWS. (ROUTINE REPAIR)

REPAIRS NOT REQUIRED

1. SHEARED OFF SIGN POST AT WEST APPROACH SOUTH EMBANKMENT.
2. THE STEEL ARMORED FINGER JOINT EXHIBITS LIGHT TO MODERATE RUST.

LEGEND

- Z — PIER NUMBER (AS PER PANY&NJ SYSTEM)
- Z — SPAN NUMBER (AS PER NJSDOT SYSTEM)
- PHOTO TAKEN ABOVE DECK
- CLOGGED SCUPPER (ROUTINE REPAIR)
- CLEAR SCUPPER
- EXPANSION FINGER JOINT
- STEEL PLATE
- CRACK IN APPROACH PAVEMENT. SIZE AS SHOWN. (ROUTINE REPAIR)
- POTHOLE/DEPRESSED ASPHALT PAVEMENT. (ROUTINE REPAIR)

THE PORT AUTHORITY OF NY & NJ

2002 BIENNIAL INSPECTION

OF THE GOETHALS BRIDGE

Title

BIN 3800071

NJ APPROACH

DEFICIENCY & PHOTO LOCATION PLAN
TOP OF DECK–3
PIER 133W TO WEST APPROACH

No	Date	Revision	Approved

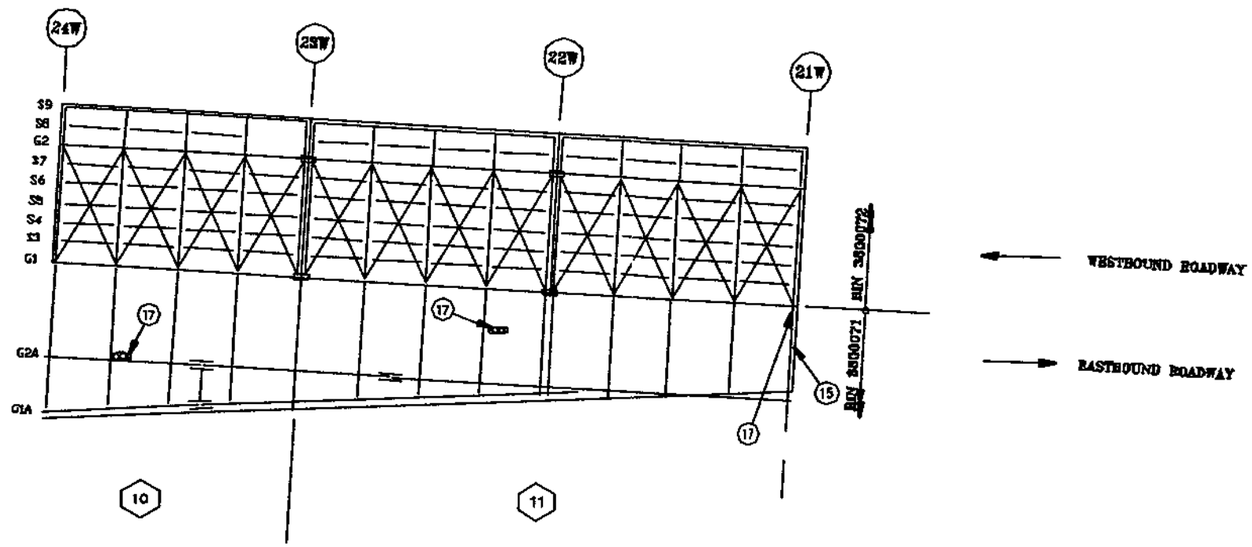
This drawing subject to conditions in contract. All inventions, ideas, designs and methods herein are reserved to Port Authority and may not be used without its written consent.

Designed by	Drawn by	Task Leader
	VD	CD

Date 11/01/02 Scale N.T.S.

Contract Number 405–99–D1 Drawing Number 3800071–4

A. FODEN 5-20-04



KEY CONDITION NOTES – UNDERSIDE OF DECK

ROUTINE REPAIRS

(15) CLOGGED DRAIN TROUGHS BELOW FINGER JOINTS AT PIERS 21W, 128W AND AT WEST ABUTMENT. (ROUTINE REPAIR)

(17) SPALLS/HOLLOW AREAS ON THE UNDERSIDE OF DECK AND SUBSTRUCTURE ELEMENTS. REFER TO LEGEND FOR SPALL SYMBOLS. (ROUTINE REPAIR)

LEGEND

(Z) PIER NUMBER (AS PER PANY&NJ SYSTEM)

(Z) SPAN NUMBER (AS PER NJSDOT SYSTEM)

DELAMINATED/SPALLED CONCRETE WITH OR WITHOUT EXPOSED REBARS. TOTAL AREA IS LESS THAN 3 S.F. (ROUTINE REPAIR)

THE PORT AUTHORITY OF NY & NJ

2002 BIENNIAL INSPECTION

OF THE GOETHALS BRIDGE

Title

BIN 3800071

NJ APPROACH

DEFICIENCY & PHOTO LOCATION PLAN UNDERSIDE OF DECK–1 PIERS 21W TO 24W

No	Date	Revision	Approved

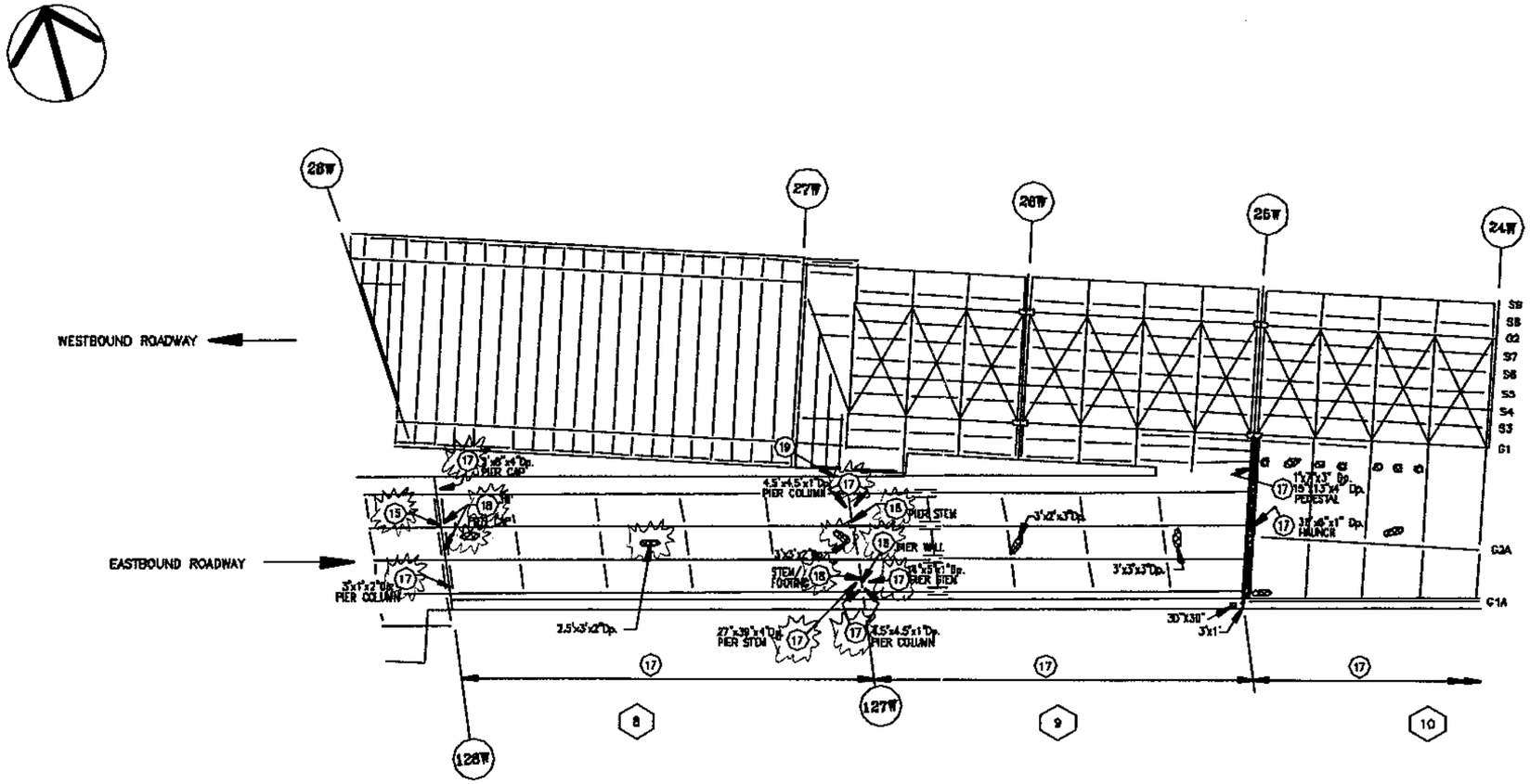
This drawing subject to conditions in contract. All inventions, ideas, designs and methods herein are reserved to Port Authority and may not be used without its written consent.

Designed by	Drawn by	Task Leader
	VD	CD

Date 11/01/02 Scale N.T.S.

Contract Number 405-99-01 Drawing Number 3800071–5

N - CHAP 05/26/04



KEY CONDITION NOTES – UNDERSIDE OF DECK

ROUTINE REPAIR

(15) CLOGGED DRAIN TROUGHS BELOW FINGER JOINTS AT PIERS 21W, 128W AND AT WEST ABUTMENT. (ROUTINE REPAIR)

(17) SPALLS/HOLLOW AREAS ON THE UNDERSIDE OF DECK AND SUBSTRUCTURE ELEMENTS. REFER TO LEGEND FOR SPALL SYMBOLS. (ROUTINE REPAIR)

(18) MEDIUM TO WIDE CRACKS AT PIERS 127W, 128W AND 134W. (ROUTINE REPAIR)

(19) DETERIORATED CASING AND INSULATION OF FIRE STANDPIPE BETWEEN PIERS 127W AND 128W. (ROUTINE REPAIR)

LEGEND

(Z) PIER NUMBER (AS PER PANY&NJ SYSTEM)

(Z) SPAN NUMBER (AS PER NJSDOT SYSTEM)

DELAMINATED/SPALLED CONCRETE WITH OR WITHOUT EXPOSED REBARS. TOTAL AREA IS LESS THAN 3 S.F. (ROUTINE REPAIR)

XX DELAMINATED/SPALLED CONCRETE WITH OR WITHOUT EXPOSED REBARS. AREA GREATER THAN 3SF. (XX DENOTES SIZE OF SPALL) (ROUTINE REPAIR)

THE PORT AUTHORITY OF NY & NJ

2002 BIENNIAL INSPECTION

OF THE GOETHALS BRIDGE

Title

BIN 3800071

NJ APPROACH

DEFICIENCY & PHOTO LOCATION PLAN UNDERSIDE OF DECK–2

PIERS 24W TO 128W

No | Date | Revision | Approved

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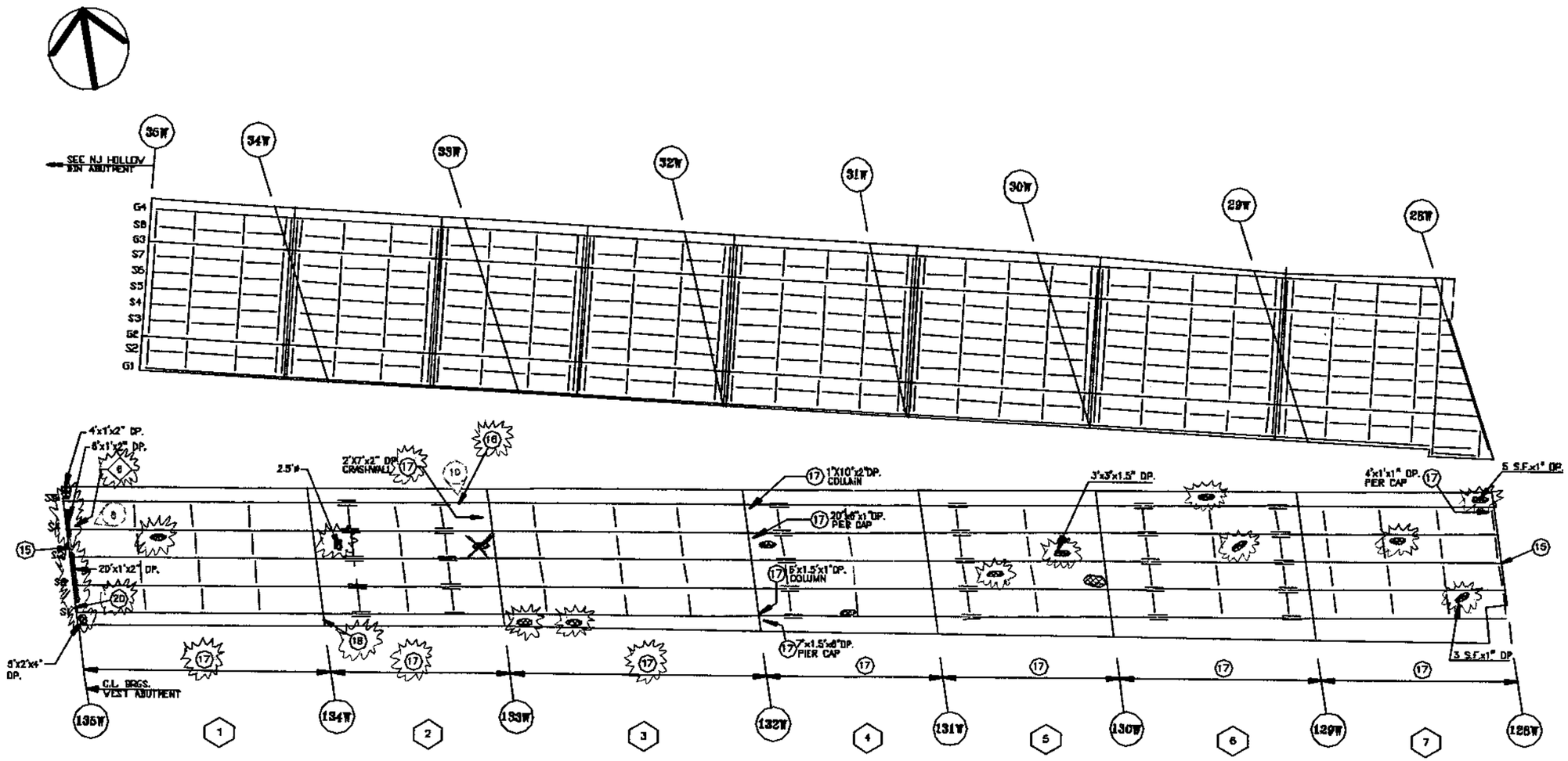
Designed by	Drawn by	Task Leader
	VD	CD

Date 11/01/02 Scale N.T.S.

Contract Number 403-99-01 Drawing Number 3800071–6

N - CWAO 05/26/04



KEY CONDITION NOTES – UNDERSIDE OF DECK

SAFETY REPAIR

(6) THE COVER PLATE OF THE ELECTRICAL JUNCTION BOX AT WEST ABUTMENT HAS 6 OF 8 SCREWS MISSING. (SAFETY REPAIR)

ROUTINE REPAIR

(15) CLOGGED DRAIN TROUGHS BELOW FINGER JOINTS AT PIERS 21W, 128W AND AT WEST ABUTMENT. (ROUTINE REPAIR)

(16) MISSING UTILITY CONDUIT SUPPORT CLAMP BOLT AT UNDERSIDE OF NORTH FASCIA BETWEEN PIERS 133W AND 134W. (ROUTINE REPAIR)

(17) SPALLS/HOLLOW AREAS ON THE UNDERSIDE OF DECK AND SUBSTRUCTURE ELEMENTS. REFER TO LEGEND FOR SPALL SYMBOLS. (ROUTINE REPAIR)

(18) MEDIUM TO WIDE CRACKS AT PIERS 127W, 128W AND 134W. (ROUTINE REPAIR)

(20) CLOGGED SCUPPER DOWNSPOUT ADJACENT TO WEST ABUTMENT. (ROUTINE REPAIR)

LEGEND

(Z) PIER NUMBER (AS PER PANY&NJ SYSTEM)

(Z) SPAN NUMBER (AS PER NJSDOT SYSTEM)

PHOTO TAKEN BELOW DECK

DELAMINATED/SPALLED CONCRETE WITH OR WITHOUT EXPOSED REBARS. TOTAL AREA IS LESS THAN 3 S.F. (ROUTINE REPAIR)

XX DELAMINATED/SPALLED CONCRETE WITH OR WITHOUT EXPOSED REBARS. AREA GREATER THAN 3SF. (XX DENOTES SIZE OF SPALL) (ROUTINE REPAIR)

Sheet 7 Of 10

THE PORT AUTHORITY OF NY & NJ

2002 BIENNIAL INSPECTION

OF THE GOETHALS BRIDGE

Title

BIN 3800071

NJ APPROACH

DEFICIENCY & PHOTO LOCATION PLAN UNDERSIDE OF DECK-3 PIER 128W TO 135W

No	Date	Revision	Approved

This drawing subject to conditions in contract. All inventions, ideas, designs and methods herein are reserved to Port Authority and may not be used without its written consent.

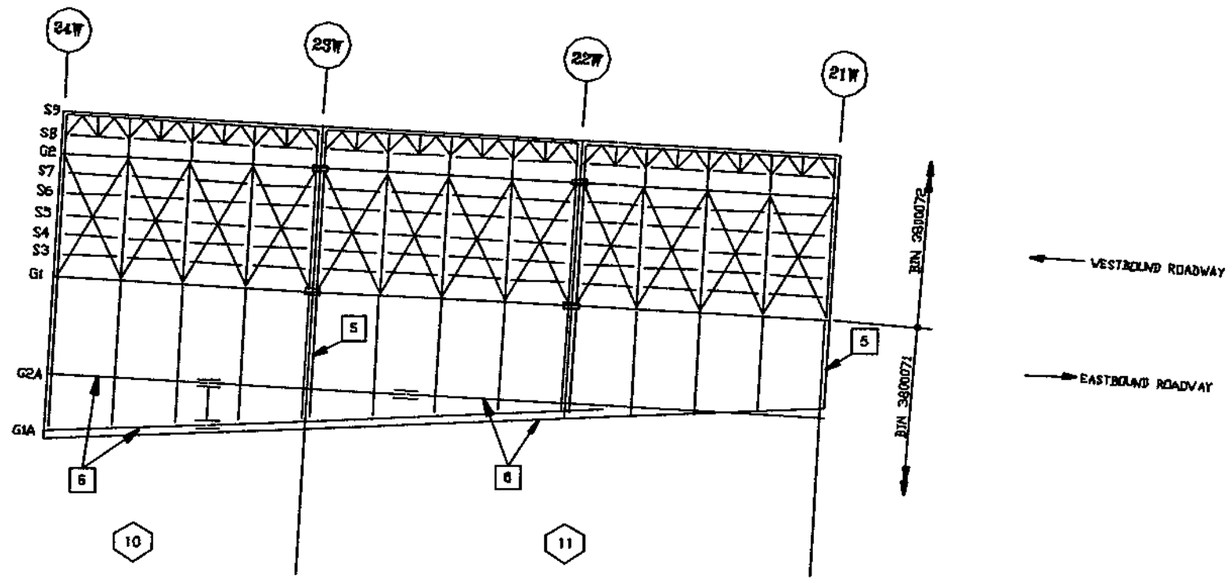
Designed by	Drawn by	Task Leader
	VD	CD

Date 11/01/02 Scale N.T.S.

Contract Number 405-99-D1 Drawing Number 3800071-7

N. CHAO D-12 05/26/04

PANY&NJ – QAD-2002



KEY CONDITION NOTES – SUPERSTRUCTURE STEEL

REPAIRS NOT REQUIRED

5 THE STEEL COLUMNS AND CAP BEAMS BETWEEN PIERS 21W AND 25W EXHIBIT LOCALIZED AREAS OF PITTING OF UP TO 1/8".

6 THE BOTTOM FLANGE OF GIRDERS G1A AND G2A EXHIBIT UP TO 1/2" DEEP PITTING.

LEGEND

(Z) PIER NUMBER (AS PER PANY&NJ SYSTEM)

(Z) SPAN NUMBER (AS PER NJSDOT SYSTEM)

THE PORT AUTHORITY OF NY & NJ

2002 BIENNIAL INSPECTION OF THE GOETHALS BRIDGE

Title

BIN 3800071

NJ APPROACH

DEFICIENCY & PHOTO LOCATION PLAN SUPERSTRUCTURE STEEL–1 PIERS 21W TO 24W

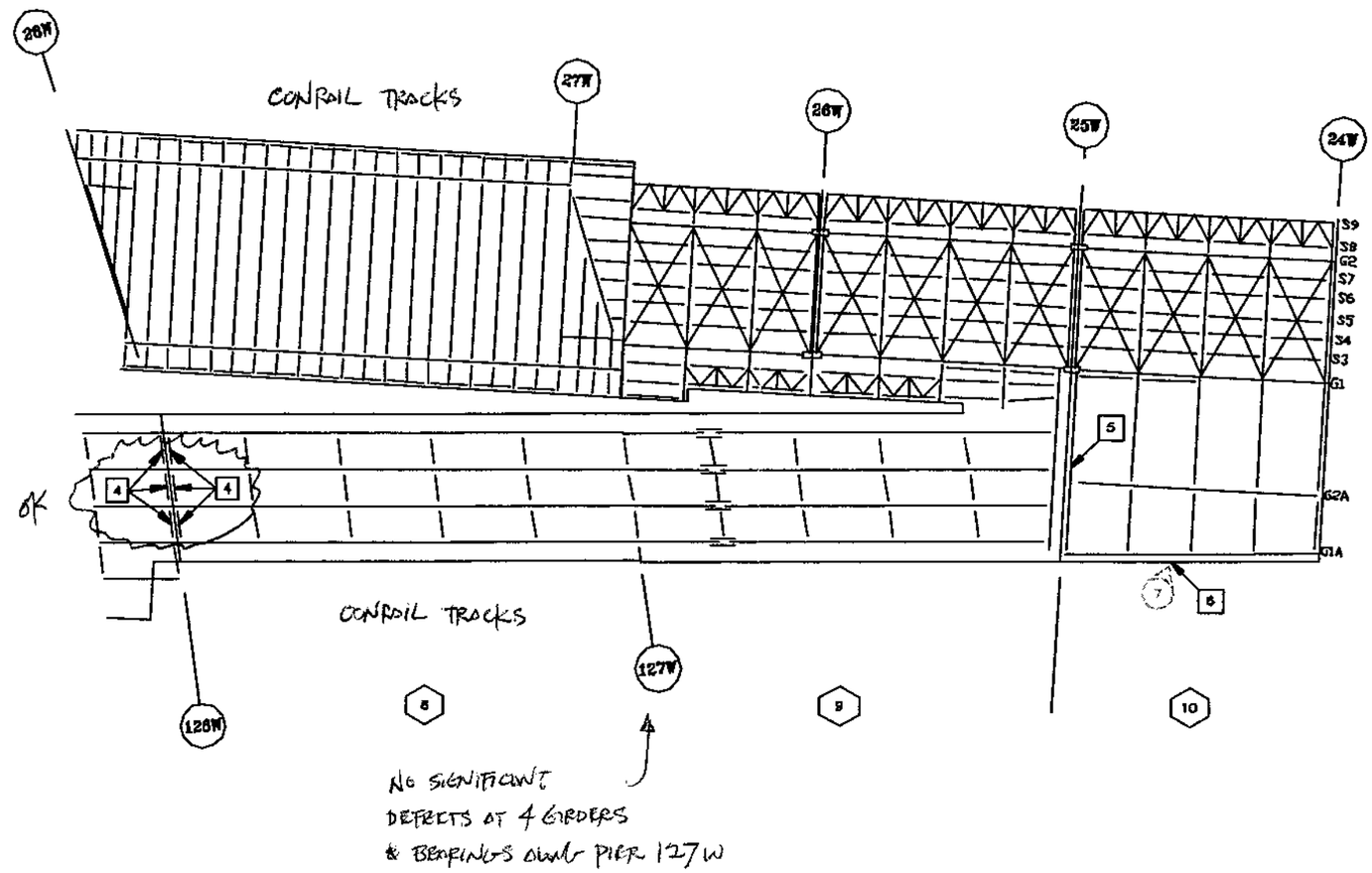
No	Date	Revision	Approved

This drawing subject to conditions in contract. All inventions, ideas, designs and methods herein are reserved to Port Authority and may not be used without its written consent.

Designed by	Drawn by	Task Leader
	VD	CD

Date 11/01/02 Scale N.T.S.

Contract Number 405-99-D1 Drawing Number 3800071–8



KEY CONDITION NOTES – SUPERSTRUCTURE STEEL

REPAIRS NOT REQUIRED

4 UP TO 1/16" SECTION LOSS TO END DIAPHRAGMS TOP FLANGES AT PIER 128W.

5 THE STEEL COLUMNS AND CAP BEAMS BETWEEN PIERS 21W AND 25W EXHIBIT LOCALIZED AREAS OF PITTING OF UP TO 1/8".

6 THE BOTTOM FLANGE OF GIRDERS G1A AND G2A EXHIBIT UP TO 1/2" DEEP PITTING.

LEGEND

Z PIER NUMBER (AS PER PANY&NJ SYSTEM)

Z SPAN NUMBER (AS PER NJSDOT SYSTEM)

PHOTO TAKEN BELOW DECK

Sheet 1 Of 10

THE PORT AUTHORITY OF NY & NJ

2002 BIENNIAL INSPECTION

OF THE GOETHALS BRIDGE

Title

BIN 3800071

NJ APPROACH

DEFICIENCY & PHOTO LOCATION PLAN SUPERSTRUCTURE STEEL-2 PIERS 24W TO 128W

No	Date	Revision	Approved

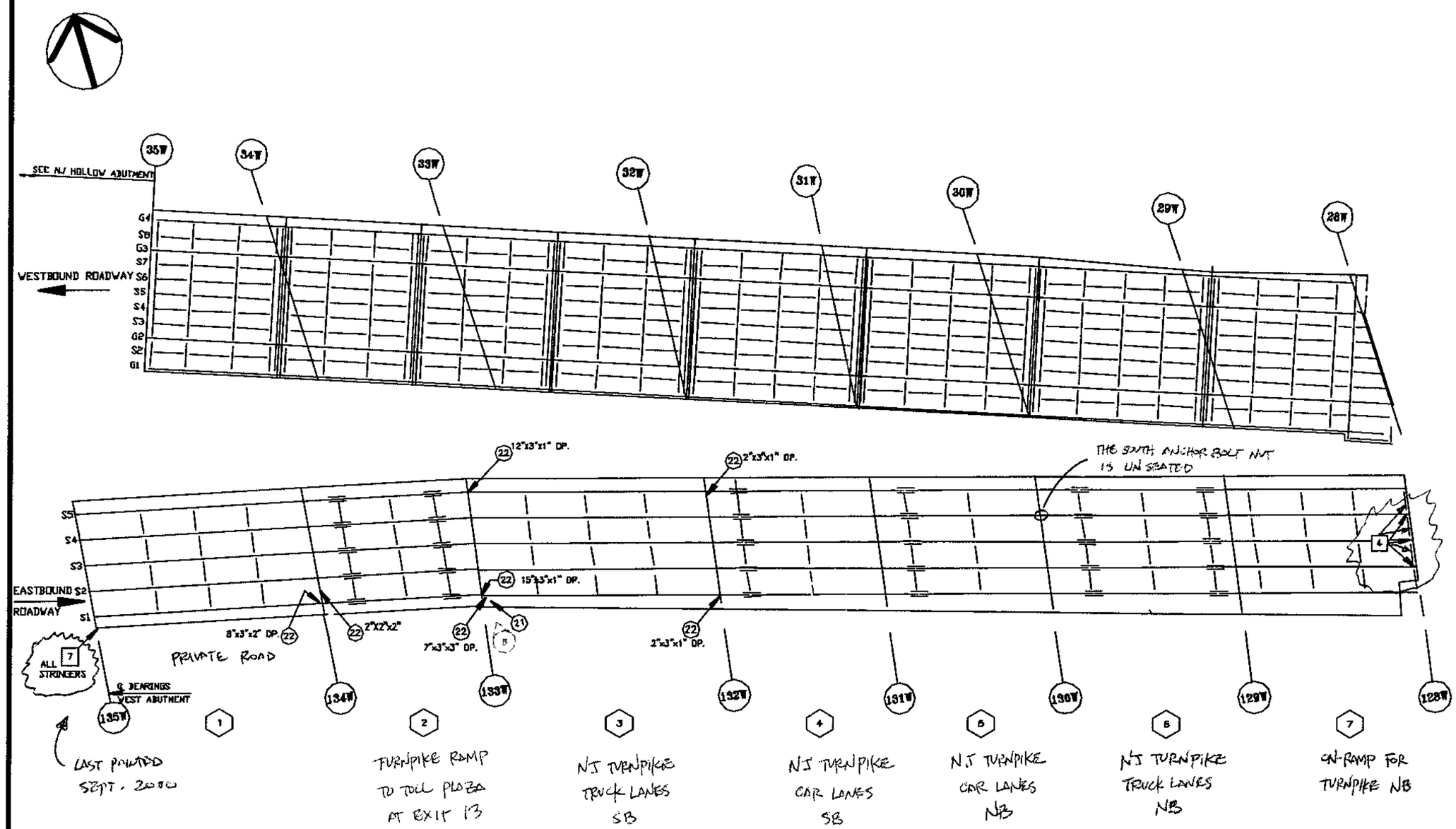
This drawing subject to conditions in contract. All inventions, ideas, designs and methods herein are reserved to Port Authority and may not be used without its written consent.

Designed by	Drawn by VD	Task Leader CD

Date 11/01/02 Scale N.T.S.

Contract Number 405-99-01 Drawing Number 3800071-9

R. SZATKOWSKI 5/26/04



KEY CONDITION NOTES – SUPERSTRUCTURE STEEL

ROUTINE REPAIR

(21) UNDERMINED BEARING BASE PLATE 3"x7" AT SOUTH EAST CORNER AND 1"x15" ALONG THE EAST EDGE WITH EXPOSED ANCHOR BOLT OF STRINGER S1 AT PIER 133W. (ROUTINE REPAIR)

(22) SPALLED GROUT PAD AROUND BEARING MASONRY PLATES AT PIERS 132W THRU 134W. SIZE OF SPALL AS SHOWN. (ROUTINE REPAIR)

REPAIRS NOT REQUIRED

[4] UP TO 1/16" SECTION LOSS TO NEWLY PAINTED END DIAPHRAGMS TOP FLANGES AT PIER 128W.

[7] UP TO 1/4" DEEP PITTING AT THE BOTTOM OF STRINGER WEB AND TOP OF BOTTOM FLANGES.

LEGEND

(Z) PIER NUMBER (AS PER PANY&NJ SYSTEM)

(Z) SPAN NUMBER (AS PER NJSDOT SYSTEM)

PHOTO TAKEN BELOW DECK

THE PORT AUTHORITY OF NY & NJ

2002 BIENNIAL INSPECTION

OF THE GOETHALS BRIDGE

Title

BIN 3800071

NJ APPROACH

DEFICIENCY & PHOTO LOCATION PLAN
SUPERSTRUCTURE STEEL-3
PIERS 128W TO 135W

No	Date	Revision	Approved

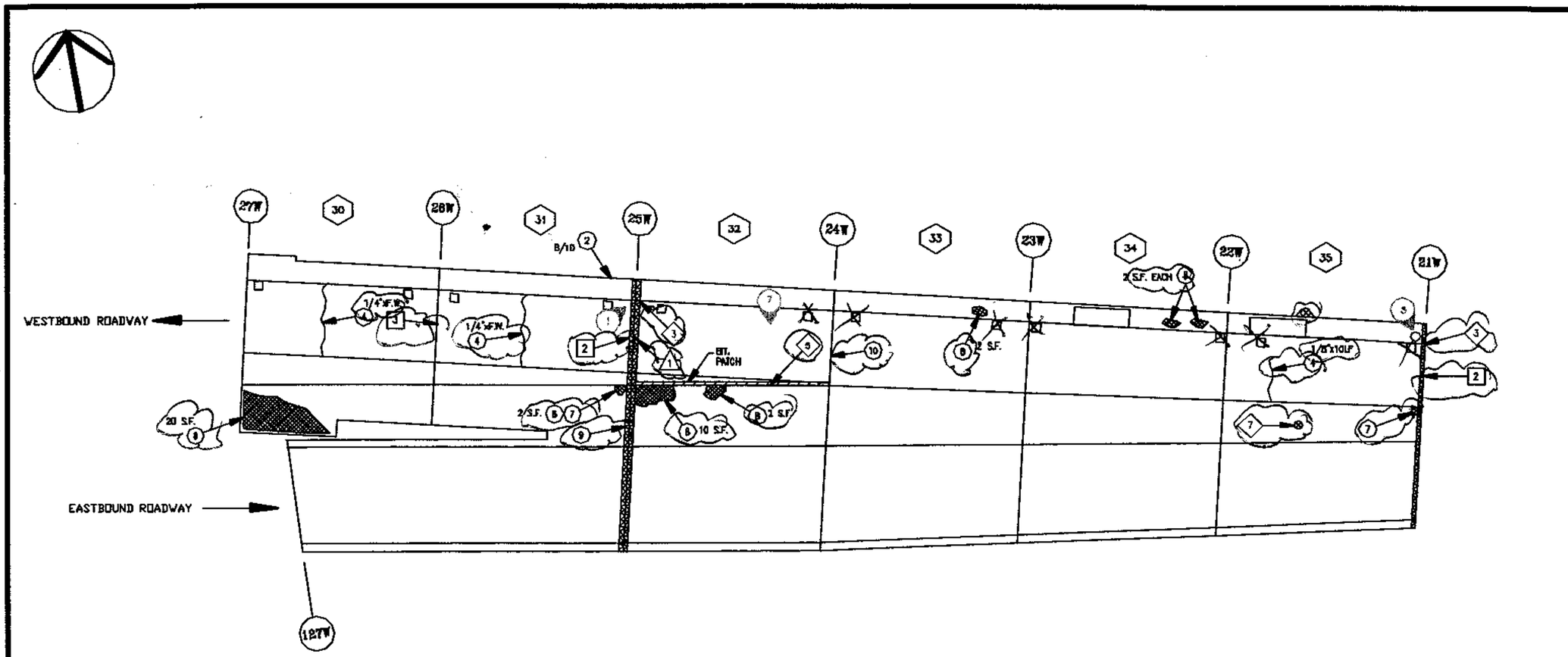
This drawing subject to conditions in contract. All inventions, ideas, designs and methods herein are reserved to Port Authority and may not be used without its written consent.

Designed by	Drawn by	Task Leader
	VD	CD

Date 11/01/02 Scale N.T.S.

Contract Number 405-99-01 Drawing Number 3800071-10

R. SZOTKOWSKI 5-26-04



KEY CONDITION NOTES – TOP OF DECK

PRIORITY REPAIR

(1) UP TO 1" OF VERTICAL MISALIGNMENT AT THE FINGER JOINT OVER THE PIERS AT 25W, 29W AND 35W. (PRIORITY REPAIR)

SAFETY REPAIRS

(3) MISSING STEEL EXPANSION PLATES AT THE CONCRETE PARAPET AT PIERS 21W AND 25W. (SAFETY REPAIR)

(5) MISSING BRIDGE MOUNTED GUIDE RAIL IN OPEN AREA ALONG SOUTH CURB BETWEEN PIERS 24W AND 25W. (SAFETY REPAIR)

(7) MISSING ACCESS COVER PLATE AT BASE OF LIGHT STANDARD WITH EXPOSED WIRES. (SAFETY REPAIR)

ROUTINE REPAIRS

(2) A/B MISSING SCREWS FOR ELECTRICAL JUNCTION BOX COVER PLATE AT THE NORTH PARAPET. "A" INDICATES NUMBER OF MISSING SCREWS. "B" INDICATES TOTAL NUMBER OF SCREWS. (ROUTINE REPAIR)

(4) MEDIUM TO WIDE CRACKS IN WEST APPROACH ROADWAY AND IN THE CONCRETE AND ASPHALT WEARING SURFACE ON THE DECK. SIZE AS SHOWN. (ROUTINE REPAIR)

(7) SPALLED PORTION OF SOUTH CURB AT PIERS 21W AND 25W. (ROUTINE REPAIR)

(8) SPALLED CONCRETE AT SIDEWALK/SAFETY WALK BETWEEN PIERS 22W–27W AND 42W–43W. SIZE AS SHOWN. (ROUTINE REPAIR)

(9) RUSTED AND DELAMINATED STEEL JOINT AT SOUTH SIDEWALK OVER PIER 25W. (ROUTINE REPAIR)

(10) DETERIORATED AND LOOSE JOINT FILLER MATERIAL AT PIER 24W. (ROUTINE REPAIR)

REPAIRS NOT REQUIRED

[2] THE STEEL ARMORED FINGER JOINTS AT PIERS 21W, 29W AND 35W EXHIBIT LIGHT TO MODERATE RUST.

[3] BENT STEEL DECK JOINT IN RIGHT LANE AT PIER 26W.

LEGEND

(Z) PIER NUMBER (AS PER PANY&NJ SYSTEM)

(Z) SPAN NUMBER (AS PER NJSDOT SYSTEM)

PHOTO TAKEN ABOVE DECK

XX DELAMINATED/SPALLED CONCRETE WITH OR WITHOUT EXPOSED REBARS. (XX DENOTES SIZE OF SPALL) (ROUTINE REPAIR)

CLEAR SCUPPER

EXPANSION FINGER JOINT

STEEL PLATE

CRACK (ROUTINE REPAIR)

Sheet 2 Of 11

THE PORT AUTHORITY OF NY & NJ

2002 BIENNIAL INSPECTION OF THE GOETHALS BRIDGE

Title

BIN 3800072

NJ APPROACH

DEFICIENCY & PHOTO LOCATION PLAN TOP OF DECK–1 PIERS 21W TO 27W

No	Date	Revision	Approved

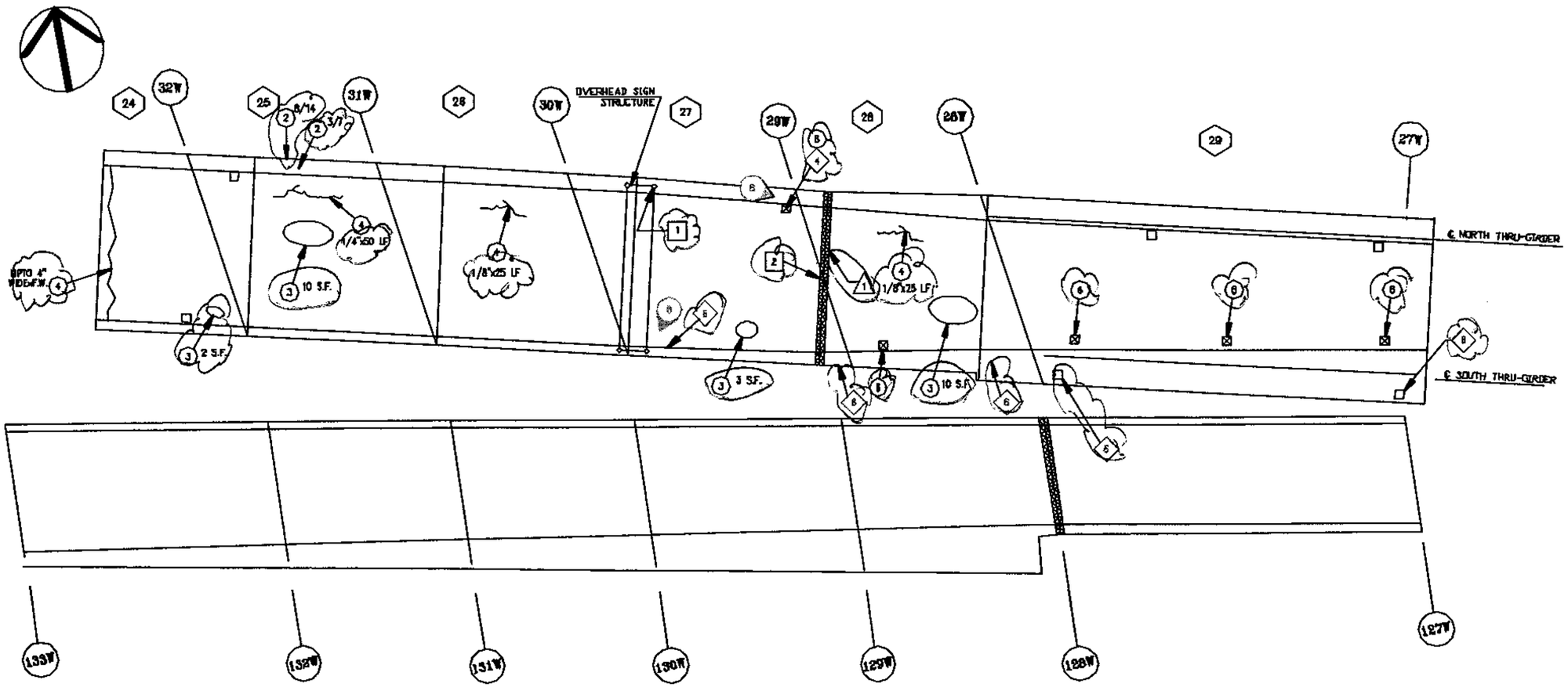
This drawing subject to conditions in contract. All inventions, ideas, designs and methods herein are reserved to Port Authority and may not be used without its written consent.

Designed by	Drawn by	Task Leader
	VD	CD

Date 11/01/02 Scale N.T.S.

Contract Number 405–99–01 Drawing Number 3800072–2

A. FODEN 5-21-04



KEY CONDITION NOTES – TOP OF DECK

PRIORITY REPAIRS

△1 UP TO 1" OF VERTICAL MISALIGNMENT AT THE FINGER JOINT OVER THE PIERS AT 25W, 29W AND 35W. (PRIORITY REPAIR)

SAFETY REPAIRS

◇4 BROKEN DRAINAGE GRATING BETWEEN PIERS 29W AND 30W. (SAFETY REPAIR)

◇6 MISSING ELECTRICAL JUNCTION BOX COVER PLATE WITH EXPOSED WIRES IN PARAPET BETWEEN PIERS 27W–30W AND 35W–42W. (SAFETY REPAIR)

ROUTINE REPAIRS

(2)A/B MISSING SCREWS FOR ELECTRICAL JUNCTION BOX COVER PLATE AT THE NORTH PARAPET. "A" INDICATES NUMBER OF MISSING SCREWS. "B" INDICATES TOTAL NUMBER OF SCREWS. (ROUTINE REPAIR)

(3) POTHOLES AND AREAS OF CRACKED AND DEPRESSED ASPHALT. (ROUTINE REPAIR)

(4) MEDIUM TO WIDE CRACKS IN WEST APPROACH ROADWAY AND IN THE CONCRETE AND ASPHALT WEARING SURFACE ON THE DECK. SIZE AS SHOWN. (ROUTINE REPAIR)

(6) CLOGGED ROADWAY SCUPPERS. (ROUTINE REPAIR)

REPAIRS NOT REQUIRED

[1] THE BASEPLATE FOR THE SIGN SUPPORT ON THE NORTH FASCIA BETWEEN PIERS 29W AND 30W HAS A SHORT HAIRLINE CRACK AT ONE ANCHOR BOLT.

[2] THE STEEL ARMORED FINGER JOINTS AT PIERS 21W, 29W AND 35W EXHIBIT LIGHT TO MODERATE RUST.

LEGEND

(Z) PIER NUMBER (AS PER PANY&NJ SYSTEM)

⬡Z SPAN NUMBER (AS PER NJSDOT SYSTEM)

PHOTO TAKEN ABOVE DECK

⊠ CLOGGED SCUPPER (ROUTINE REPAIR)

□ CLEAR SCUPPER

EXPANSION FINGER JOINT

STEEL PLATE

CRACK (ROUTINE REPAIR)

POTHOLES/DEPRESSED ASPHALT PAVEMENT (ROUTINE REPAIR)

Sheet 3 of 11

THE PORT AUTHORITY OF NY & NJ

2002 BIENNIAL INSPECTION

OF THE GOETHALS BRIDGE

Title

BIN 3800072

NJ APPROACH

DEFICIENCY & PHOTO LOCATION PLAN
TOP OF DECK–2
PIERS 27W TO 32W

No	Date	Revision	Approved

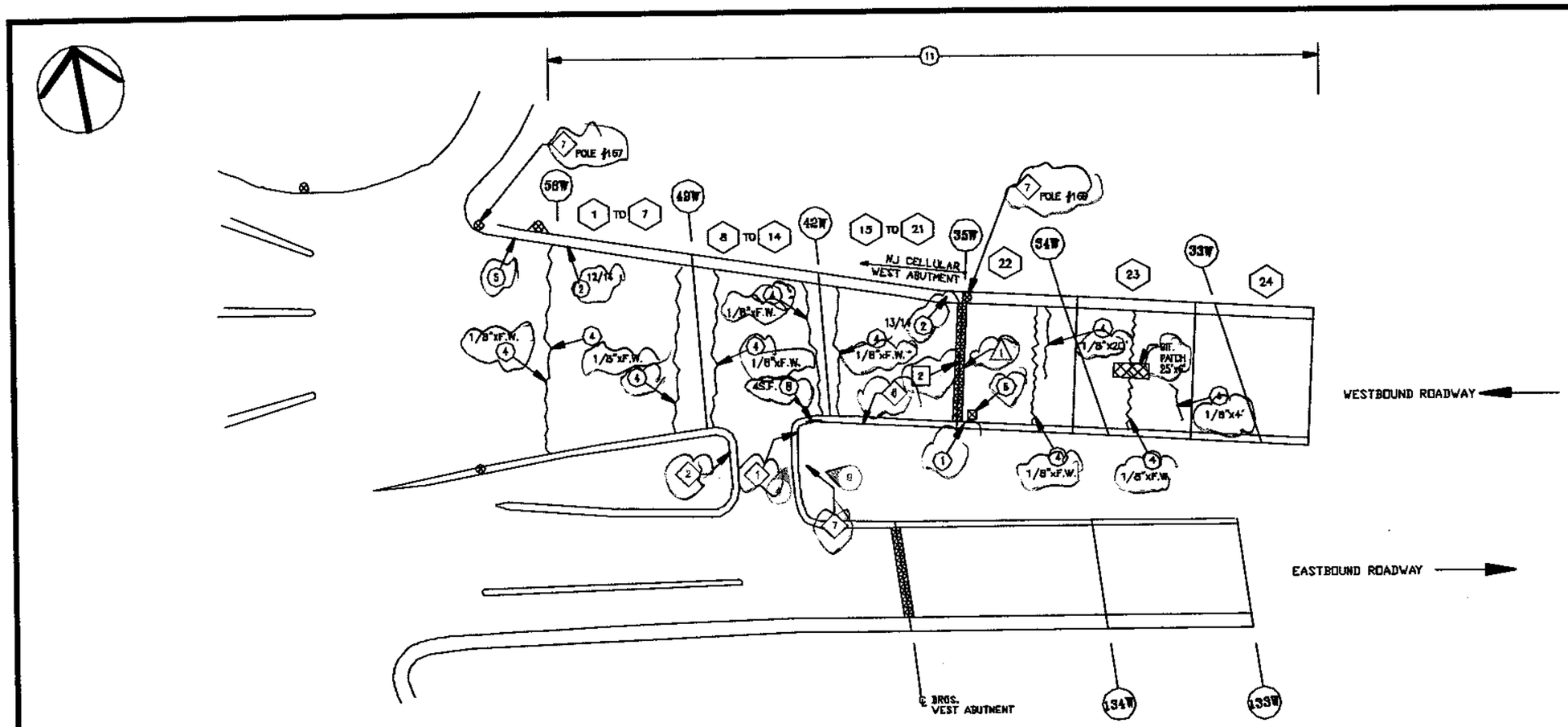
This drawing subject to conditions in contract. All inventions, ideas, designs and methods herein are reserved to Port Authority and may not be used without its written consent.

Designed by	Drawn by	Task Leader
	VD	CD

Date 11/01/02 Scale N.T.S.

Contract Number 405–99–01 Drawing Number 3800072–3

A. FODEN 5-21-04



KEY CONDITION NOTES – TOP OF DECK

PRIORITY REPAIR

1. UP TO 1" OF VERTICAL MISALIGNMENT AT THE FINGER JOINT OVER THE PIERS AT 25W, 29W AND 35W. (PRIORITY REPAIR)

SAFETY REPAIR

1. IMPACT DAMAGE AT GUIDE RAIL AT THE TURN AROUND. (SAFETY REPAIR)
2. INADEQUATE GUIDE RAIL ATTACHMENT TO CONCRETE PARAPET AT TURN AROUND. (SAFETY REPAIR)
6. MISSING ELECTRICAL JUNCTION BOX COVER PLATE WITH EXPOSED WIRES IN PARAPET BETWEEN PIERS 27W–30W AND 38W–42W. (SAFETY REPAIR)
7. MISSING ACCESS COVER PLATE AT BASE OF LIGHT STANDARD WITH EXPOSED WIRES. (SAFETY REPAIR)

ROUTINE REPAIR

1. MISSING EXPANSION PLATE AT THE SOUTH SIDEWALK JOINT OVER PIER 35W. (ROUTINE REPAIR)
2. A/B MISSING SCREWS FOR ELECTRICAL JUNCTION BOX COVER PLATE AT THE NORTH PARAPET. "A" INDICATES NUMBER OF MISSING SCREWS. "B" INDICATES TOTAL NUMBER OF SCREWS. (ROUTINE REPAIR)
4. MEDIUM TO WIDE CRACKS IN WEST APPROACH ROADWAY AND IN THE CONCRETE AND ASPHALT WEARING SURFACE ON THE DECK. SIZE AS SHOWN. (ROUTINE REPAIR)
5. SETTLED NORTHWEST APPROACH CONCRETE CURB AT THE WEST APPROACH. (ROUTINE REPAIR)
6. CLOGGED ROADWAY SCUPPERS. (ROUTINE REPAIR)
8. SPALLED CONCRETE AT SIDEWALK/SAFETY WALK BETWEEN PIERS 22W–27W AND 42W–43W. SIZE AS SHOWN. (ROUTINE REPAIR)
11. ACCUMULATED DEBRIS AT THE SAFETY WALKS IN SPANS 1 THRU 24. (ROUTINE REPAIR)

REPAIRS NOT REQUIRED

2. THE STEEL ARMORED FINGER JOINTS AT PIERS 21W, 29W AND 35W EXHIBIT LIGHT TO MODERATE RUST.

LEGEND

- (Z) PIER NUMBER (AS PER PANY&NJ SYSTEM)
- (Z) SPAN NUMBER (AS PER NJSDOT SYSTEM)
- PHOTO TAKEN ABOVE DECK
- DELAMINATED/SPALLED CONCRETE WITH OR WITHOUT EXPOSED REBARS. TOTAL AREA IS LESS THAN 3 S.F. (ROUTINE REPAIR)
- CLOGGED SCUPPER (ROUTINE REPAIR)
- CLEAR SCUPPER
- EXPANSION FINGER JOINT
- STEEL PLATE
- CRACK (ROUTINE REPAIR)

THE PORT AUTHORITY OF NY & NJ

2002 BIENNIAL INSPECTION

OF THE GOETHALS BRIDGE

Title

BIN 3800072

NJ APPROACH

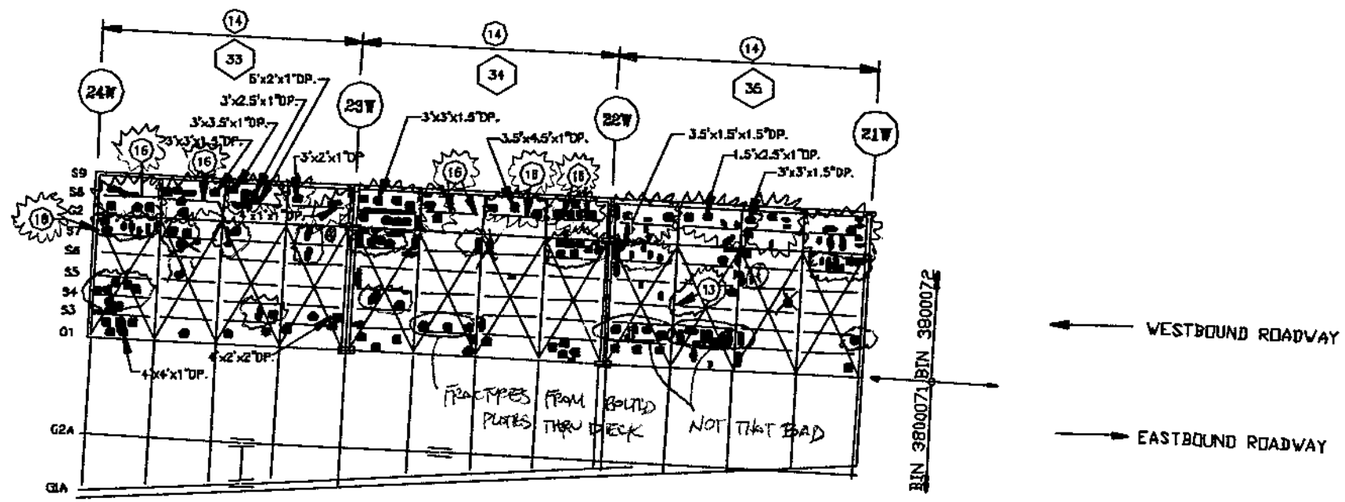
DEFICIENCY & PHOTO LOCATION PLAN
TOP OF DECK–3
PIERS 32W TO 56W

No	Date	Revision	Approved

This drawing subject to conditions in contract. All inventions, ideas, designs and methods herein are reserved to Port Authority and may not be used without its written consent.

Designed by	Drawn by VD	Task Leader CD
Date 11/01/02	Scale N.T.S.	
Contract Number 405–99–01	Drawing Number 3800072–4	

A. FODEN 5-21-04



KEY CONDITION NOTES – UNDERSIDE OF DECK

ROUTINE REPAIR

(13) OPEN CONDUIT BOX WITH EXPOSED WIRES AT THE UNDERSIDE OF DECK BETWEEN PIERS 21W AND 22W. (ROUTINE REPAIR)

(14) SPALLED/HOLLOW/DELAMINATED CONCRETE AT THE UNDERSIDE OF DECK AND SUBSTRUCTURE ELEMENTS. REFER TO LEGEND FOR SPALL SYMBOLS. (ROUTINE REPAIR)

(16) LARGE SPALLED WITH EXPOSED REBARS IN VERTICAL FACE OF CONCRETE DECK AT CURBLINE STRINGER S8. (ROUTINE REPAIR)

(18) IMPACTED RUST AT DOUBLE ANGLES UNDER THE CATWALK AT PIER 24W. (ROUTINE REPAIR)

LEGEND

(Z) PIER NUMBER (AS PER PANY&NJ SYSTEM)

(Z) SPAN NUMBER (AS PER NJSDOT SYSTEM)

DELAMINATED/SPALLED CONCRETE WITH OR WITHOUT EXPOSED REBARS. TOTAL AREA IS LESS THAN 3 S.F. (ROUTINE REPAIR)

XX DELAMINATED/SPALLED CONCRETE WITH OR WITHOUT EXPOSED REBARS. (XX DENOTES SIZE OF SPALL) (ROUTINE REPAIR)

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THE PORT AUTHORITY OF NY & NJ

2002 BIENNIAL INSPECTION

OF THE GOETHALS BRIDGE

Title

BIN 3800072

NJ APPROACH

DEFICIENCY & PHOTO LOCATION PLAN UNDERSIDE OF DECK-1 PIERS 21W TO 24W

No	Date	Revision	Approved

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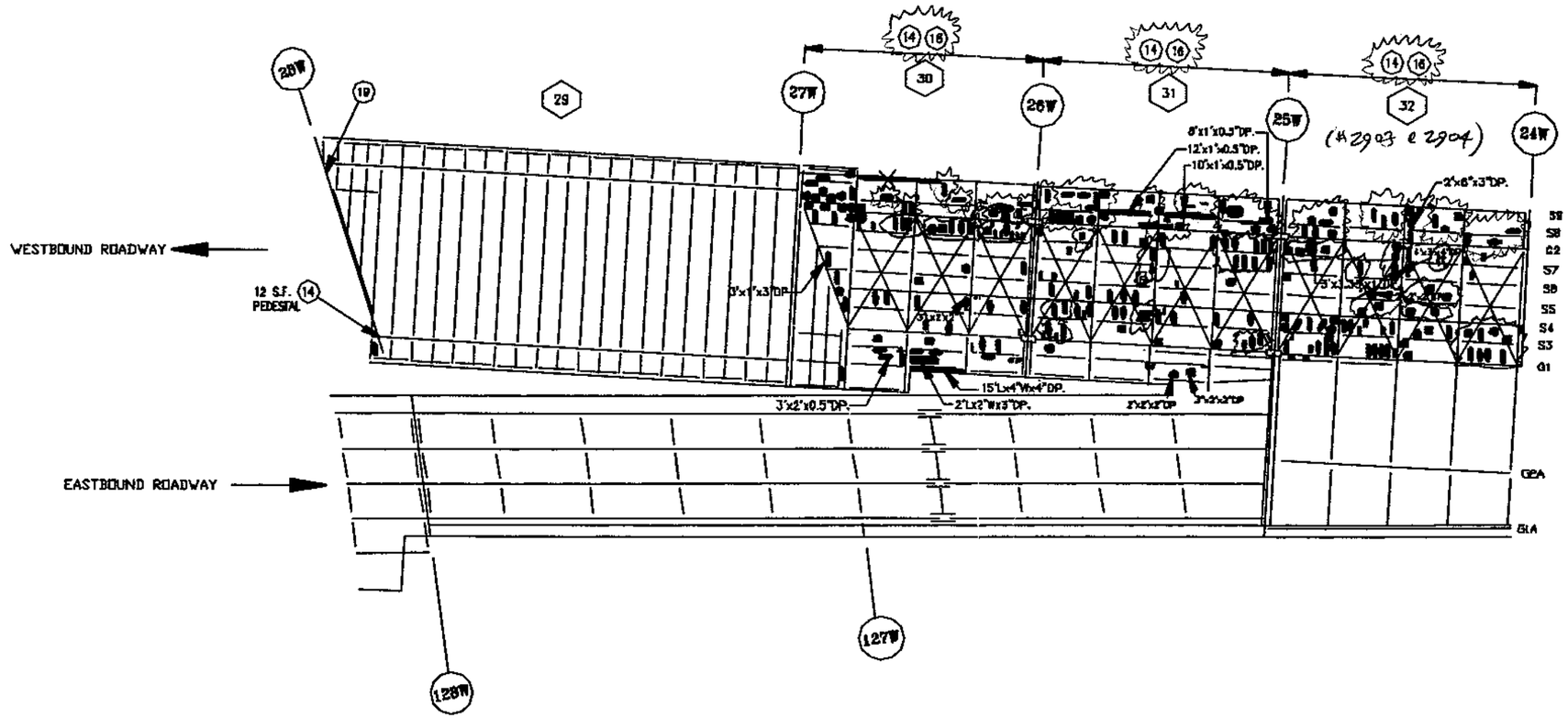
Designed by	Drawn by	Task Leader
	VD	CD

Date 11/01/02 Scale N.T.S.

Contract Number 405-99-01 Drawing Number 3800072-5

N. CHOO 5/24/04 R. SZATKOWSKI 5/26/04

MOST EXPOSED REBAR AT THE UNDERDECK IS DUE TO INSUFFICIENT CONCRETE COVER, AND NOT DUE TO CONCRETE DETERIORATION.



KEY CONDITION NOTES – UNDERDIDE OF DECK

ROUTINE REPAIR

(14) SPALLED/HOLLOW/DELAMINATED CONCRETE AT THE UNDERSIDE OF DECK AND SUBSTRUCTURE ELEMENTS. REFER TO LEGEND FOR SPALL SYMBOLS. (ROUTINE REPAIR)

(16) LARGE SPALLED WITH EXPOSED REBARS IN VERTICAL FACE OF CONCRETE DECK AT CURBLINE STRINGER S8. (ROUTINE REPAIR)

(19) HEAVY VEGETATION GROWTH AT EAST FACE OF PIER 28W. (ROUTINE REPAIR)

LEGEND

(Z) PIER NUMBER (AS PER PANY&NJ SYSTEM)

(Z) SPAN NUMBER (AS PER NJSDOT SYSTEM)

DELAMINATED/SPALLED CONCRETE WITH OR WITHOUT EXPOSED REBARS. TOTAL AREA IS LESS THAN 3 S.F. (ROUTINE REPAIR)

XX DELAMINATED/SPALLED CONCRETE WITH OR WITHOUT EXPOSED REBARS. (XX DENOTES SIZE OF SPALL) (ROUTINE REPAIR)

Sheet 8 Of 11

THE PORT AUTHORITY OF NY & NJ

2002 BIENNIAL INSPECTION

OF THE GOETHALS BRIDGE

Title

BIN 3800072

NJ APPROACH

DEFICIENCY & PHOTO LOCATION PLAN UNDERSIDE OF DECK–2 PIERS 24W TO 28W

No	Date	Revision	Approved

This drawing subject to conditions in contract. All inventions, ideas, designs and methods herein are reserved to Port Authority and may not be used without its written consent.

Designed by	Drawn by	Task Leader
	VD	CD

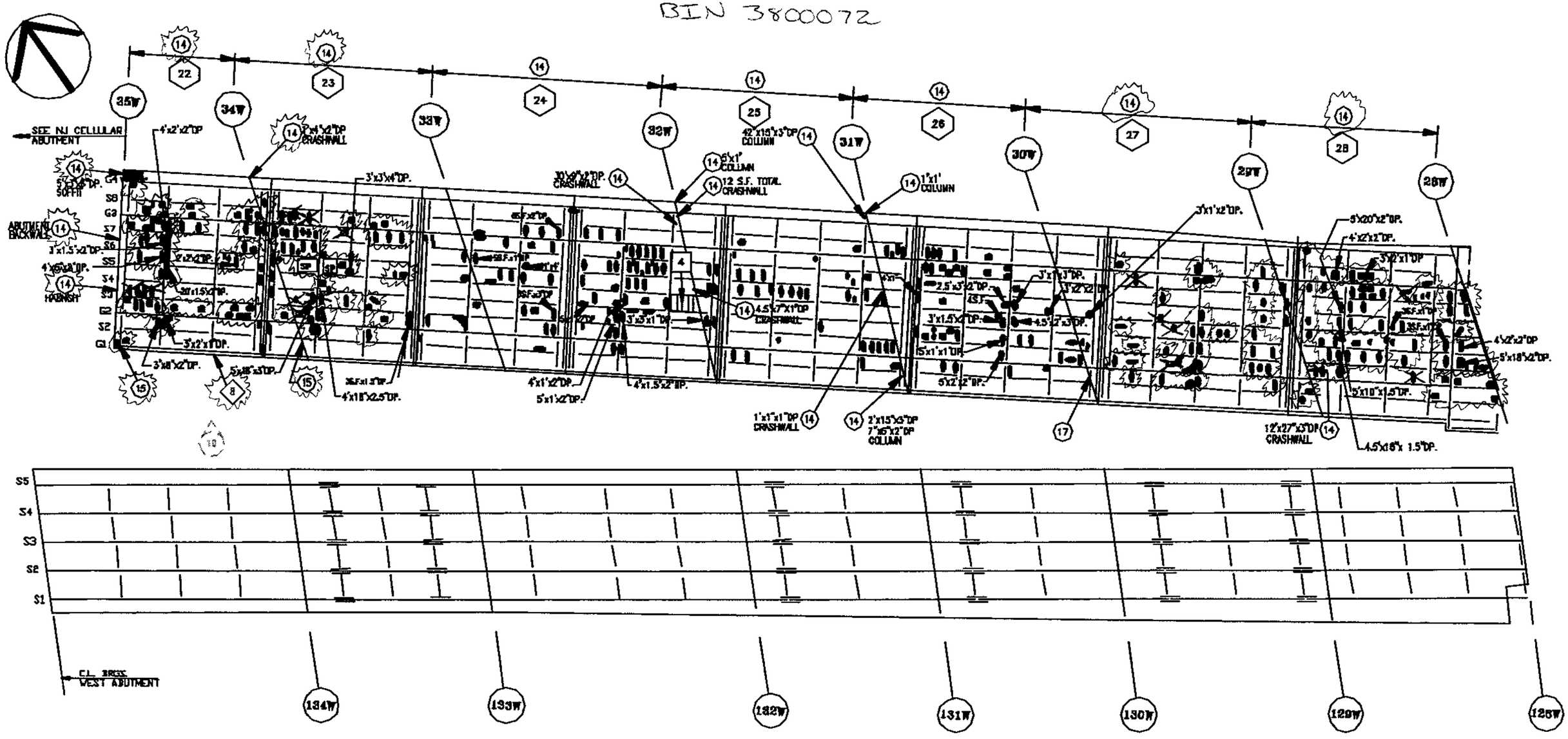
Date 11/01/02 Scale N.T.S.

Contract Number 405-99-01 Drawing Number 3800072-6

N. CHAO 5/24/04 R. SZATKOWSKI 5/26/04

2002 Biennial Inspection of Goethals Bridge Underside of Deck - 3 Piers 28W to 35W N. Chao 5/26/04

BIN 3800072



KEY CONDITION NOTES – UNDERSIDE OF DECK

SAFETY REPAIR

(8) MISSING VERTICAL UNDER CLEARANCE SIGN BETWEEN PIERS 34W AND 35W. (SAFETY REPAIR)

ROUTINE REPAIRS

(14) SPALLED/HOLLOW/DELAMINATED CONCRETE AT THE UNDERSIDE OF DECK AND SUBSTRUCTURE ELEMENTS. REFER TO LEGEND FOR SMALL SYMBOLS

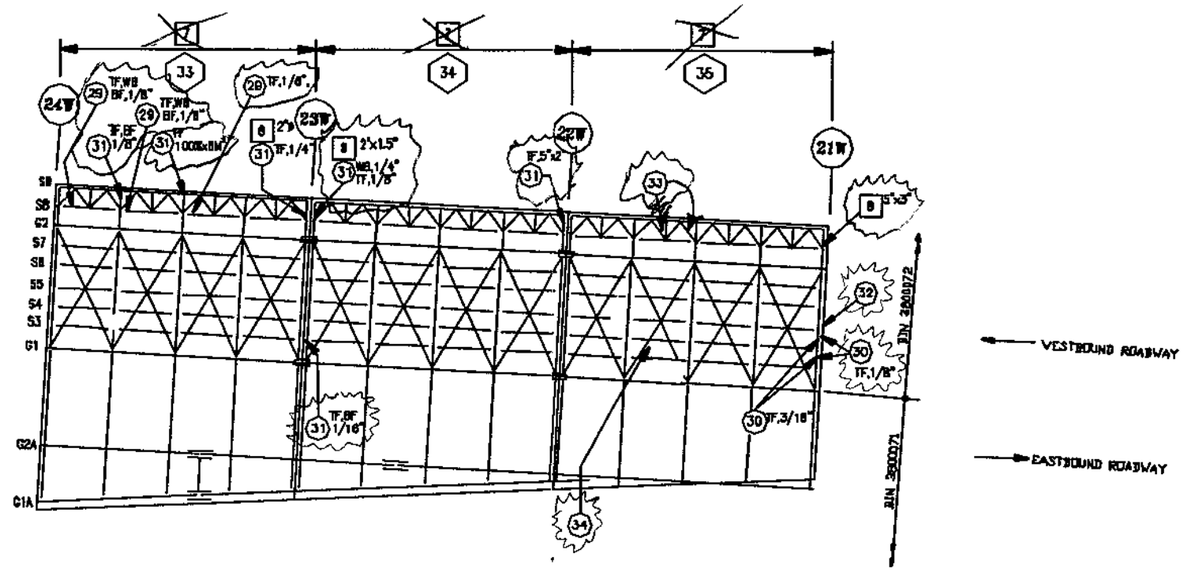
REPAIR NOT REQUIRED

[4] S.I.P. FORMS REMAIN WEST OF PIER 32W BETWEEN S4 AND S5.

LEGEND

(Z) PIER NUMBER (AS PER PANY&NJ SYSTEM)

E-13



KEY CONDITION NOTES – SUPERSTRUCTURE STEEL

ROUTINE REPAIR

(29) FLANGES AND/OR WEB OF STRINGERS EXHIBIT SIGNIFICANT SECTION LOSS (1/8" OR MORE). LOCATION AND AMOUNT OF LOSS AS SHOWN. (ROUTINE REPAIR)

(30) FLANGES AND/OR WEB OF FLOORBEAMS EXHIBIT SIGNIFICANT SECTION LOSS (1/8" OR MORE). LOCATION AND AMOUNT OF LOSS AS SHOWN. (ROUTINE REPAIR)

(31) OUTSTANDING LEGS OF THE FLANGES AND/OR WEBS OF THE FLOORBEAM CANTILEVERED BRACKETS EXHIBIT SIGNIFICANT SECTION LOSS (1/8" OR MORE). LOCATION AND AMOUNT OF LOSS AS SHOWN. (ROUTINE REPAIR)

(32) HOLES THRU EAST VERTICAL WEB STIFFENER OF END FLOORBEAM AT PIER 21W. (ROUTINE REPAIR)

(33) MISSING NORTH SIDEWALK LATERAL BRACING ANGLE BETWEEN PIERS 21W AND 22W ADJACENT TO LIGHT POLE SUPPORT. (ROUTINE REPAIR)

(34) THE DIAPHRAGM SUPPORT BEAMS BELOW MEDIAN LIGHT STANDARD BETWEEN PIERS 21W AND 22W EXHIBIT UP TO 100% SECTION LOSS. (ROUTINE REPAIR)

REPAIR NOT REQUIRED

[7] STEEL MEMBERS EXHIBIT MINOR SECTION LOSS. (<1/8")

[8] RUSTED THROUGH WEB OF FLOORBEAM CANTILEVER BRACKET.

LEGEND

(Z) PIER NUMBER (AS PER PANY&NJ SYSTEM)

(Z) SPAN NUMBER (AS PER NJSDOT SYSTEM)

Sheet 8 Of 11

THE PORT AUTHORITY OF NY & NJ

2002 BIENNIAL INSPECTION OF THE GOETHALS BRIDGE

Title

BIN 3800072

NJ APPROACH

DEFICIENCY & PHOTO LOCATION PLAN SUPERSTRUCTURE STEEL-1 PIERS 21W TO 24W

No	Date	Revision	Approved

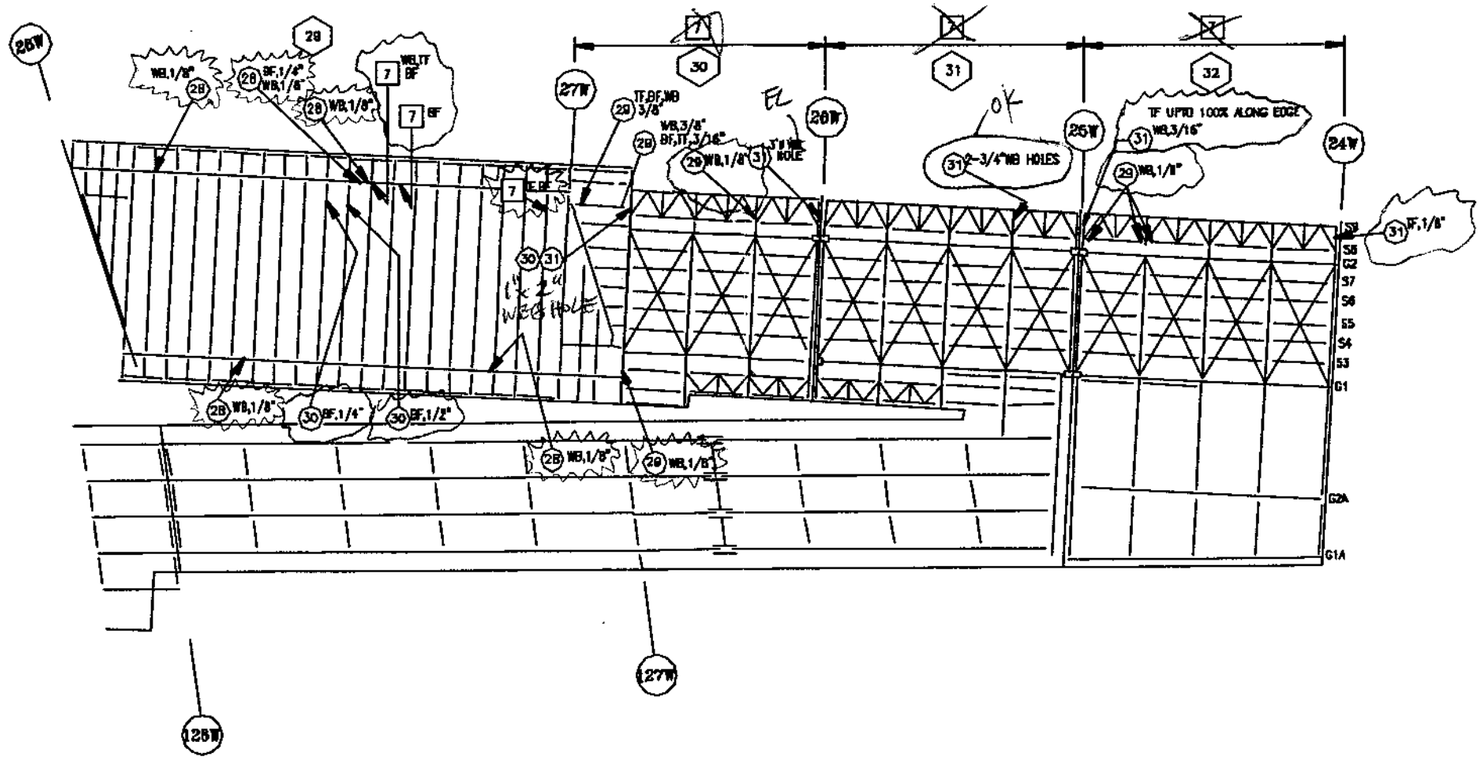
This drawing subject to conditions in contract. All inventions, ideas, designs and methods herein are reserved to Port Authority and may not be used without its written consent.

Designed by	Drawn by	Task Leader
	VD	CD

Date 11/01/02 Scale N.T.S.

Contract Number 405-99-01 Drawing Number 3800072-B

R. SZATKOWSKI 5/25/04



KEY CONDITION NOTES – SUPERSTRUCTURE STEL

ROUTINE REPAIRS

(28) SECTION LOSS AT FLANGES AND/OR WEB OF GIRDERS IN SPAN 29 (1/8" OR MORE). AMOUNT OF LOSS AS SHOWN. (ROUTINE REPAIR)

(29) FLANGES AND/OR WEB OF STRINGERS EXHIBIT SIGNIFICANT SECTION LOSS (1/8" OR MORE). LOCATION AND AMOUNT OF LOSS AS SHOWN.(ROUTINE REPAIR)

(30) FLANGES AND/OR WEB OF FLOORBEAMS EXHIBIT SIGNIFICANT SECTION LOSS (1/8" OR MORE). LOCATION AND AMOUNT OF LOSS AS SHOWN.(ROUTINE REPAIR)

(31) OUTSTANDING LEGS OF THE FLANGES AND/OR WEBS OF THE FLOORBEAM CANTILEVERED BRACKETS EXHIBIT SIGNIFICANT SECTION LOSS (1/8" OR MORE). LOCATION AND AMOUNT OF LOSS AS SHOWN. (ROUTINE REPAIR)

REPAIR NOT REQUIRED

[7] STEEL MEMBERS EXHIBIT MINOR SECTION LOSS. (<1/8")

LEGEND

(Z) PIER NUMBER (AS PER PANY&NJ SYSTEM)

⟨Z⟩ SPAN NUMBER (AS PER NJSDOT SYSTEM)

Sheet 9 Of 11

THE PORT AUTHORITY OF NY & NJ

2002 BIENNIAL INSPECTION

OF THE GOETHALS BRIDGE

Title

BIN 3800072

NJ APPROACH

DEFICIENCY & PHOTO LOCATION PLAN SUPERSTRUCTURE STEEL-2 PIERS 24W TO 28W

No	Date	Revision	Approved

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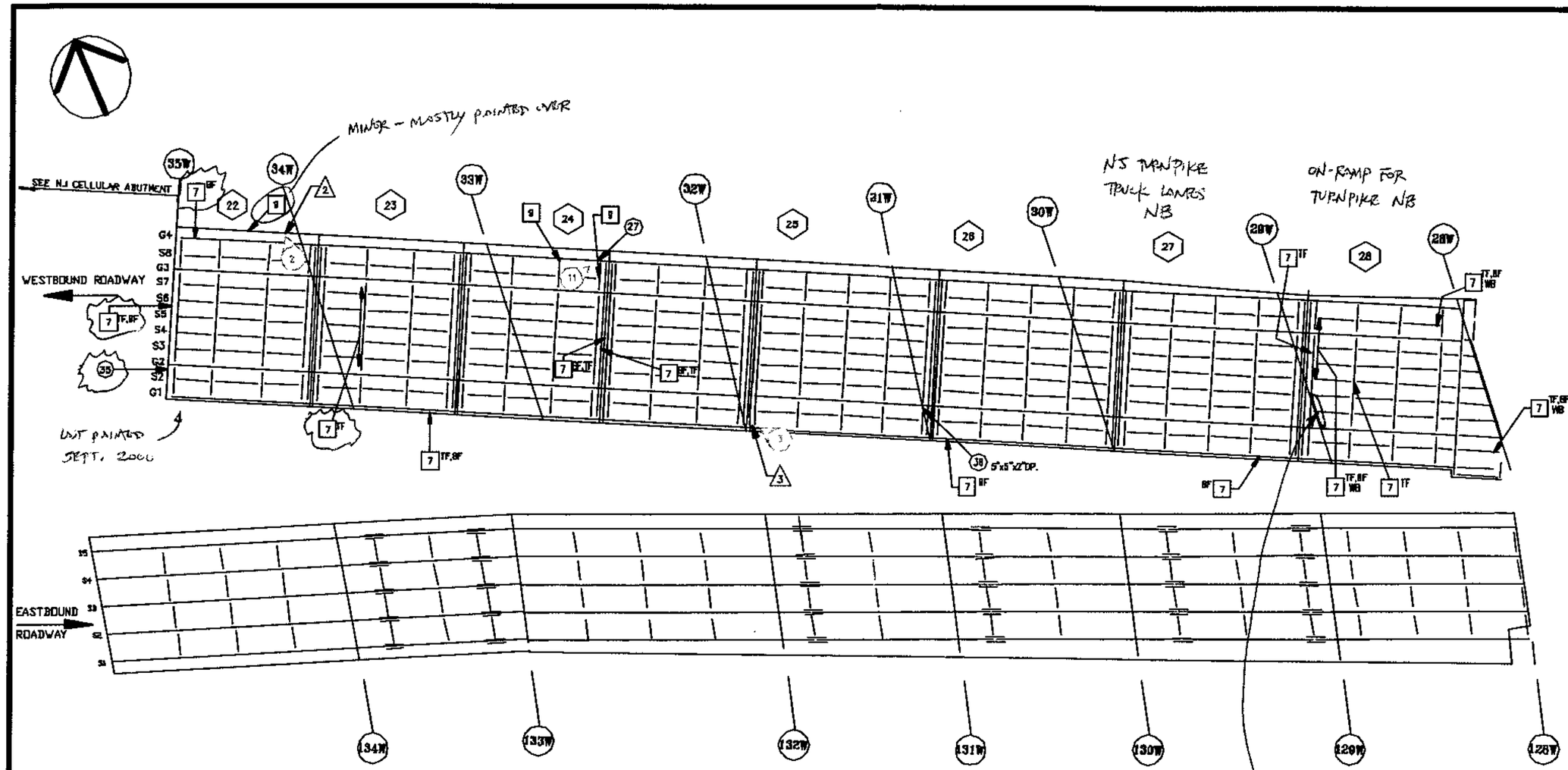
Designed by	Drawn by	Task Leader
	VD	CD

Date 11/01/02 Scale N.T.S.

Contract Number 405-99-01 Drawing Number 3800072-9

R. SZATKOWSKI 5/25/04 & 5/26/04



LARGE SPALL ALONG EAST SIDE OF PIER BASE 3½' HIGH x 12' LONG x 3" DEEP WITH EXPOSED REBAR AND CRUMBLING CONCRETE (#2894 & 2895) (#2896)

KEY CONDITION NOTES – SUPERSTRUCTURE STEEL

PRIORITY REPAIR

△2 CRACKED WELD AND HEAVY CORROSION AT THE SIGN SUPPORT STRUCTURE AT THE NORTH PARAPET BETWEEN PIERS 34W AND 35W. (PRIORITY REPAIR)

△3 CRACKED WELD OF THE FLOORBEAM CONNECTION PLATE TO GIRDER G1 WEB AT THE TOP OF THE PLATE AT PIER 32W. (PRIORITY REPAIR)

ROUTINE REPAIRS

(27) WELD CRACK BETWEEN THE FLOORBEAM VERTICAL CONNECTION PLATE TO THE TOP OF THE BOTTOM FLANGE OF GIRDER G4. LENGTH OF CRACK 3 1/8" (FULL LENGTH OF WELD). (ROUTINE REPAIR)

(35) THE BOTTOM FLANGE OF FLOORBEAM AT PIER 35W EXHIBITS UP TO 100% SECTION LOSS. (ROUTINE REPAIR)

(36) SPALLED CEMENT GROUT PAD AROUND BEARING MASONRY PLATE AT PIER 31W. (ROUTINE REPAIR)

REPAIRS NOT REQUIRED

[7] STEEL MEMBERS EXHIBIT MINOR SECTION LOSS. (<1/8")

[9] COLLISION SCRAPES PRESENT ON BOTTOM FLANGE OF THE NORTH EXTERIOR GIRDER BETWEEN PIERS 34W & 35W AND 32W & 33W.

LEGEND

(Z) PIER NUMBER (AS PER PANY&NJ SYSTEM)

⬡Z SPAN NUMBER (AS PER NJSDOT SYSTEM)

PHOTO TAKEN BELOW DECK

GENERAL NOTES

1. PIN & HANGER ASSEMBLY WITH RETROFITTED TIE RODS PRESENT BETWEEN PIERS 38W AND 29W.
2. TIE RODS PRESENT ALONG BOTTOM FLANGE OF GIRDER 3 BETWEEN PIERS 29W AND 30W.

THE PORT AUTHORITY OF NY & NJ

2002 BIENNIAL INSPECTION OF THE GOETHALS BRIDGE

Title

BIN 3800072

NJ APPROACH

DEFICIENCY & PHOTO LOCATION PLAN SUPERSTRUCTURE STEEL-3 PIERS 28W TO 35W

No	Date	Revision	Approved

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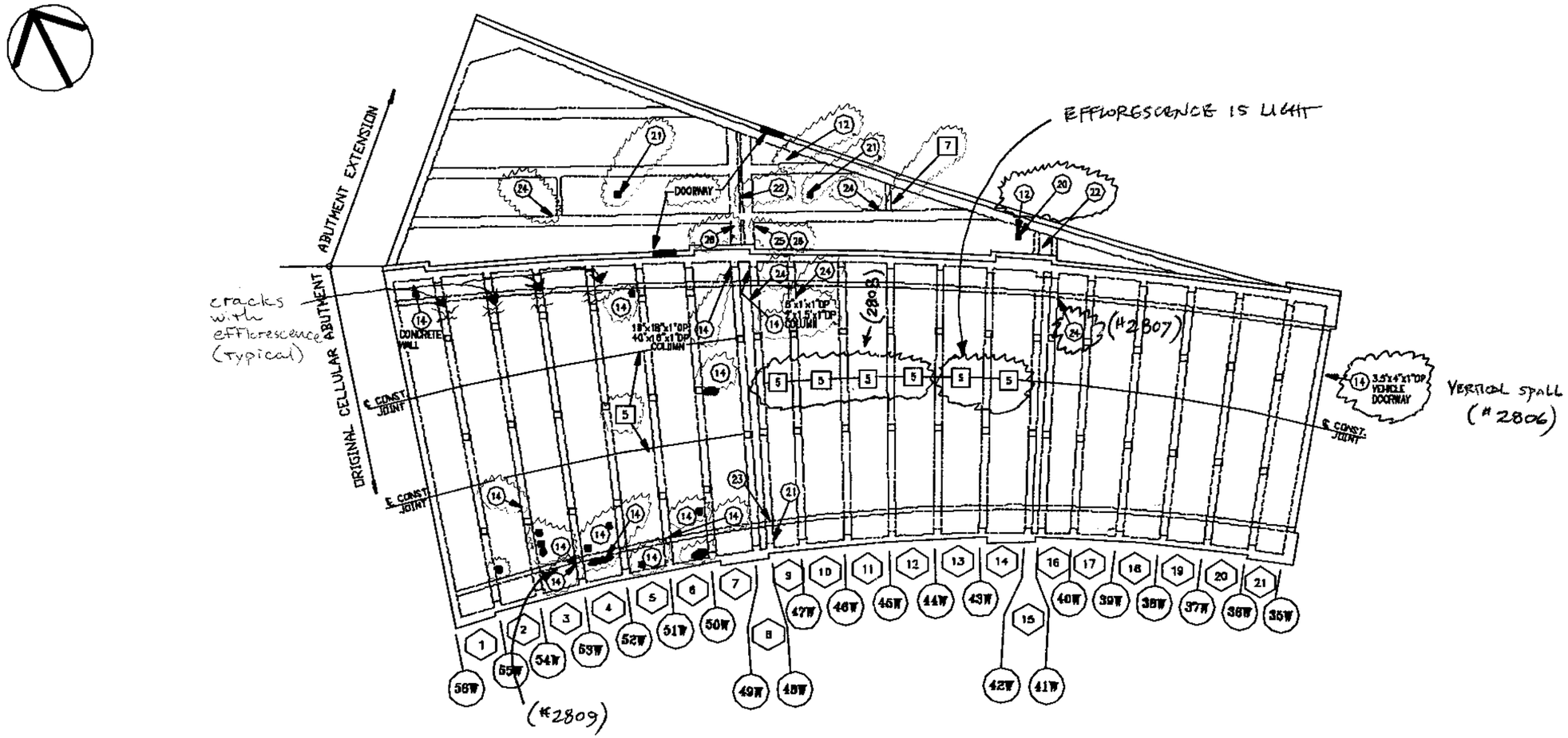
Designed by	Drawn by	Task Leader
	VO	CD

Date 11/01/02 Scale N.T.S.

Contract Number 405-93-01 Drawing Number 3800072-10

R. SLATKOWSKI 5-26-04



KEY CONDITION NOTES – CELLULAR ABUTMENT

ROUTINE REPAIRS

(12) SEVERE SCALING AT INTERIOR FACE OF NORTH WALL OF ABUTMENT EXTENSION. (ROUTINE REPAIR)

(14) SPALLED/HOLLOW/DELAMINATED CONCRETE AT THE UNDERSIDE OF DECK AND SUBSTRUCTURE ELEMENTS. REFER TO LEGEND FOR SPALL SYMBOLS. (ROUTINE REPAIR)

(20) BROKEN LIGHT FIXTURES IN THE NJ CELLULAR ABUTMENT BETWEEN PIERS 42W AND 43W. (ROUTINE REPAIR)

(21) LIGHT BULBS FOR LIGHT FIXTURE IN THE NJ CELLULAR ABUTMENT NOT FUNCTIONING. (ROUTINE REPAIR)

(22) DETERIORATED AND MISSING JOINT FILLER BETWEEN DECK SLABS IN THE NJ CELLULAR ABUTMENT EXTENSION. (ROUTINE REPAIR)

(23) RANDOM CRACKING WITH EFFLORESCENCE AND STALACTITES IN WEST FACE OF PIER 48W NEAR SOUTH INTERIOR WALL OF CELLULAR ABUTMENT. (ROUTINE REPAIR)

(24) MEDIUM WIDTH CRACKS AT THE CROSS BEAMS BETWEEN THE PIERS IN THE ABUTMENT EXTENSION AND AT THE PIER CAP BEAMS. (ROUTINE REPAIR)

(25) STEEL COLUMNS WITH SIGNIFICANT SECTION LOSS (UP TO 1/8") AT PIERS 48W AND 49W IN THE CELLULAR ABUTMENT EXTENSION. (ROUTINE REPAIR)

(28) SPALLS IN REINFORCED CONCRETE FLOORBEAMS AT PIERS 48W AND 49W. (ROUTINE REPAIR)

REPAIRS NOT REQUIRED

[5] MODERATE TO HEAVY EFFLORESCENCE ALONG THE LONGITUDINAL CONSTRUCTION JOINTS AND FINE RANDOM CRACKS WITH WATER MOISTURE THROUGHOUT UNDERSIDE OF CELLULAR ABUTMENT.

[7] STEEL MEMBERS EXHIBIT MINOR SECTION LOSS. (<1/8")

LEGEND

(Z) PIER NUMBER (AS PER PANY&NJ SYSTEM)

⟨Z⟩ SPAN NUMBER (AS PER NJSDOT SYSTEM)

DELAMINATED/SPALLED CONCRETE WITH OR WITHOUT EXPOSED REBARS. TOTAL AREA IS LESS THAN 3 S.F. (ROUTINE REPAIR)

XX DELAMINATED/SPALLED CONCRETE WITH OR WITHOUT EXPOSED REBARS. (XX DENOTES SIZE OF SPALL) (ROUTINE REPAIR)

THE PORT AUTHORITY OF NY & NJ

2002 BIENNIAL INSPECTION

OF THE GOETHALS BRIDGE

Title

BIN 3800072

NJ APPROACH

DEFICIENCY & PHOTO LOCATION PLAN
CELLULAR ABUTMENT
PIERS 35W TO 56W

No	Date	Revision	Approved

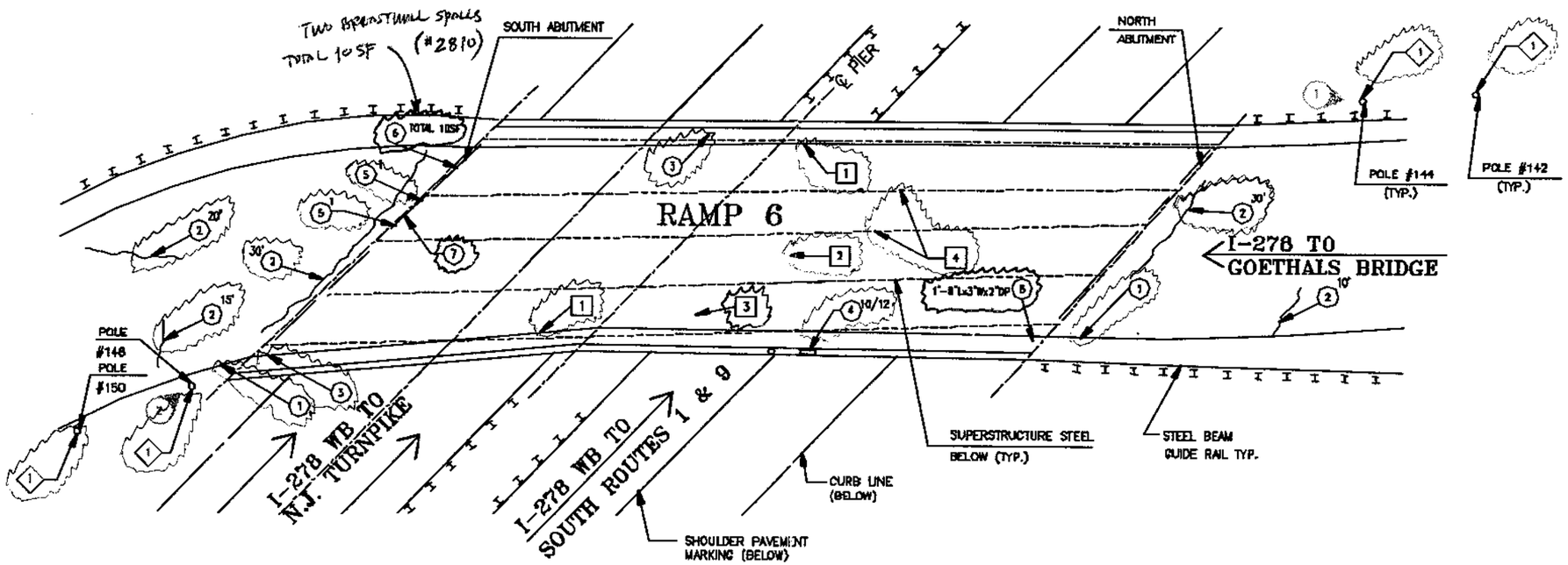
This drawing subject to conditions in contract. All inventions, ideas, designs and methods herein are reserved to Port Authority and may not be used without its written consent.

Designed by	Drawn by	Task Leader
	VD	CD

Date 11/01/02 Scale N.T.S.

Contract Number 405-98-01 Drawing Number 3800072-11

R. SZATKOWSKI 5-19-04



STRUCTURE IS IN OVERALL GOOD CONDITION.

KEY CONDITION NOTES

SAFETY REPAIRS

TOP OF DECK

◇1 MISSING COVER PLATE AT THE BASE OF THE LIGHT STANDARD WITH EXPOSED WIRES AT BOTH APPROACH ROADWAYS. (SAFETY REPAIR)

ROUTINE REPAIRS

TOP OF DECK

(1) SETTLED CURB AND SAFETY WALK. (ROUTINE REPAIR)

(2) MEDIUM TO WIDE CRACKS IN ASPHALT PAVEMENT. LENGTH AS SHOWN. (ROUTINE REPAIR)

(3) SPALLS AT ISOLATED AREAS ON THE SAFETYWALKS. (ROUTINE REPAIR)

(4)A/B MISSING SCREWS ON ELECTRICAL JUNCTION BOX AT THE EAST CONCRETE PARAPET "A" INDICATES NUMBER OF MISSING SCREWS. "B" INDICATES TOTAL NUMBER OF SCREWS. (ROUTINE REPAIR)

ROUTINE REPAIRS

UNDERSIDE OF DECK

(5)x MISSING DRAINAGE TROUGH SUPPORT NUT AT THE SOUTH ABUTMENT BACKWALL. "x" INDICATE NUMBER OF MISSING NUTS. (ROUTINE REPAIR)

(6) SPALL AND DELAMINATED CONCRETE ON THE STEM OF THE SOUTH ABUTMENT. SIZE AS NOTED. (ROUTINE REPAIR)

(7) BROKEN LIGHT FIXTURE AT THE SOUTH ABUTMENT. (ROUTINE REPAIR)

(8) SPALL AT THE UNDERSIDE OF DECK WITH EXPOSED REBARS NEAR THE NORTH ABUTMENT. SIZE AS SHOWN. (ROUTINE REPAIR)

REPAIRS NOT REQUIRED

TOP OF DECK

[1] RUSTED STEEL FACED CURB.

UNDERSIDE OF DECK

[2] MISSING PORTION OF S.I.P. FORM AT THE UNDERSIDE OF DECK.

[3] ISOLATED AREA OF RUSTING IN THE S.I.P. FORM.

SUPERSTRUCTURE STEEL

[4] MINOR COLLISION SCRAPE MARKS AT STRINGER BOTTOM FLANGE.

LEGEND

PHOTO TAKEN ABOVE DECK

CRACK IN APPROACH PAVEMENT. SIZE AS SHOWN. (ROUTINE REPAIR)

Sheet 1 Of 1

THE PORT AUTHORITY OF NY & NJ

2002 BIENNIAL INSPECTION OF THE GOETHALS BRIDGE

Title

BIN 3800002

RAMP 6

DEFICIENCY & PHOTO LOCATION PLAN

No	Date	Revision	Approved

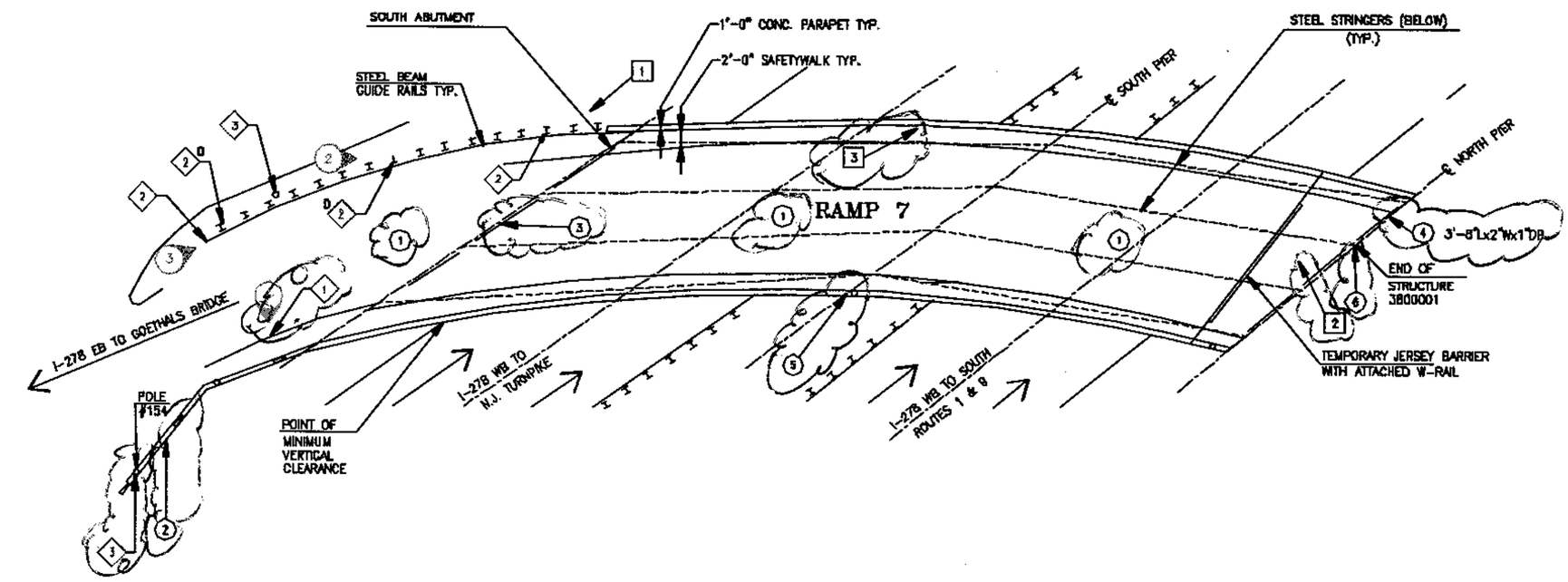
This drawing subject to conditions in contract. All inventions, ideas, designs and methods herein are reserved to Port Authority and may not be used without its written consent.

Designed by	Drawn by	Task Leader
	VD	CD

Date 11/01/02 Scale N.T.S.

Contract Number 405-99-01 Drawing Number 3800002-1

R. SZATKOWSKI 5-19-04



KEY CONDITION NOTES

SAFETY REPAIRS

TOP OF DECK

1. MISSING JUNCTION BOX COVER WITH EXPOSED WIRES AT THE SOUTHEAST APPROACH CONCRETE PARAPET. (SAFETY REPAIR)
2. DAMAGED GUIDE RAIL AT TWO PLACES AND SUBSTANDARD GUIDE RAIL TRANSITION ZONE AND END TERMINAL AT THE WEST SIDE OF THE SOUTH APPROACH. "D" INDICATES IMPACT DAMAGE TO GUIDE RAIL. (SAFETY REPAIR)
3. MISSING COVER PLATE AT THE BASE OF THE LIGHT STANDARD WITH EXPOSED ELECTRICAL WIRES AT THE WEST AND EAST SIDE OF THE SOUTH APPROACH. (SAFETY REPAIR)

ROUTINE REPAIRS

TOP OF DECK

1. WIDE CRACKS THROUGHOUT THE ASPHALT WEARING SURFACE ON TOP OF DECK AND SOUTH APPROACH. (ROUTINE REPAIR)
2. MISSING SCREWS ON THE ELECTRICAL JUNCTION BOX AT THE SOUTHEAST APPROACH CONCRETE PARAPET. (ROUTINE REPAIR)
3. INSTALL A CONCRETE SAFETY BARRIER AT THE SOUTH END OF BRIDGE. (ROUTINE REPAIR)

UNDERSIDE OF DECK

4. SPALL WITH EXPOSED REBAR AT THE EDGE OF THE NORTH PIER CAP, SIZE AS SHOWN. (ROUTINE REPAIR)
5. SAPLING AT EAST COLUMN OF THE SOUTH PIER. (ROUTINE REPAIR)
6. WATER PONDING AT BLOCKOUTS FOR BEARINGS. (ROUTINE REPAIR)

REPAIR NOT REQUIRED

TOP OF DECK

1. SOUTHWEST EMBANKMENT IS SLUMPED 4".
2. TOP OF CONCRETE DECK IS EXPOSED DUE TO LACK OF BITUMINOUS OVERLAY.
3. CONSTRUCTION DEBRIS ATOP BRIDGE SAFETY WALK.

LEGEND

PHOTO TAKEN ABOVE DECK

GENERAL NOTE

1. THIS STRUCTURE IS NOT OPEN TO TRAFFIC SINCE ADJACENT STRUCTURE (RAMP B) WAS NEVER CONSTRUCTED.

Sheet 1 Of 1

THE PORT AUTHORITY OF NY & NJ

2002 BIENNIAL INSPECTION OF THE GOETHALS BRIDGE

Title

BIN 3800001
RAMP 7

DEFICIENCY & PHOTO LOCATION PLAN

No	Date	Revision	Approved

This drawing subject to conditions in contract. All inventions, ideas, designs and methods herein are reserved to Port Authority and may not be used without its written consent.

Designed by	Drawn by	Task Leader
	VD	CD

Date 11/01/02 Scale N.T.S.

Contract Number 405-99-01 Drawing Number 3800001-1

A. FODEN 5-19-04

Appendix A.2
Assessment of Bridge Rehabilitation Needs and Maintenance Costs to Extend the Life of the Existing Bridge for Life Span Comparable to Design Life for Proposed Replacement Bridge

GOETHALS BRIDGE REPLACEMENT (GBR)
ENVIRONMENTAL IMPACT STATEMENT (EIS)

Assessment of Bridge Rehabilitation Needs and Maintenance Costs to Extend the Life of the Existing Bridge for Life Span Comparable to Design Life for Proposed Replacement Bridge

April 2006

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Assessment of Bridge Rehabilitation Needs and Maintenance Costs to Extend the Life of the Existing Bridge for Life Span Comparable to Design Life of Proposed Replacement Bridge

Executive Summary

The Goethals Bridge currently carries two 10'-0' wide lanes of traffic in each direction, and has no emergency shoulders. This roadway width and lack of shoulders, combined with a sharp dogleg in the New Jersey approach to the main span, make the Goethals Bridge functionally obsolete for current and future vehicular and truck traffic. In addition, due to normal deterioration, the bridge will require significant rehabilitation and will also require remediation to address current design live load, seismic and ship collision code requirements, as well as current security requirements.

Consequently, the Port Authority of New York and New Jersey (Port Authority) has proposed replacing the existing Goethals Bridge with a new 6-lane bridge south of the existing span. For the Goethals Bridge Replacement (GBR) Environmental Impact Statement (EIS), potentially reasonable and feasible alternatives for addressing the purpose and need of the proposed replacement project are being considered. Through the study's alternatives screening analysis, reconfiguration and rehabilitation of the existing Goethals Bridge, coupled with construction of a new parallel bridge, has been deemed inappropriate for further study, based on that alternative's inability to address key elements of the project purpose and need[1] while incurring increasingly high costs to extend the existing bridge's life span.

In 1995, the existing Goethals Bridge was determined by the New Jersey Historic Preservation Office (NJHPO) and New York State Historic Preservation Office (NYSHPO) to be eligible for listing on the National Register of Historic Places. Therefore, as part of the Section 106 consultation process with the NJHPO and NYSHPO,[2] which is being conducted concurrently with the GBR EIS, this report has been prepared to document the activities and associated costs that would be necessary to rehabilitate and maintain the existing Goethals Bridge for an additional 100 years, beyond near-term rehabilitation that will be necessary in approximately 2010. This additional life span is consistent with the design life proposed for a Goethals Bridge replacement. This report focuses on necessary rehabilitation and maintenance activities and related costs, in partial fulfillment of the evaluation and documentation required regarding the rationale and justification for proposed demolition and replacement of the existing bridge[3].

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[1] The purpose and need for the proposed project, and the related project goals, are defined in the *Draft Scoping Document for EIS Preparation in Conjunction with Proposed Replacement of the Goethals Bridge*, dated August 10, 2004, and are described on the project website at www.goethalseis.com. The existing span, even once reconfigured, would not conform to current design standards, would not address issues of functional obsolescence and structural integrity, and could not accommodate adequate measures to conform to current security requirements.

[2] The Section 106 consultation process is in accordance with the National Historic Preservation Act regulations, which require initiation of consultation during the earliest stages of project planning.

[3] This report will be appended to and summarized in the *Historic Bridge Alternatives Analysis Report* required by the NJHPO, regarding description of a modified rehabilitation alternative for the existing bridge, which seeks to preserve the character-defining elements of the bridge while introducing significant changes. While this report focuses on assessment of bridge

It is assumed that a rehabilitated Goethals Bridge would be supplemented with construction of a parallel structure to the north or south of the existing Goethals Bridge,[4] in order to address the inadequate capacity of the existing Goethals Bridge for future traffic volumes. A new parallel structure would provide three 12'-0" travel lanes with a 12'-0" right shoulder and a 10'-6" left shoulder. After completion of the new structure, retrofit of the existing structure would begin, and all traffic would be diverted to the new structure for several years until the retrofit is completed. After completion of reconstruction activities, traffic would become one way on each of the two structures. Contingent on findings in the project's design process, the toll collection facilities could be reconfigured to accommodate these changes.

Retrofitting of the existing bridge would include a new deck, structural repairs, as required, seismic retrofit, and improved ship collision protection. A new deck would provide three 12'-0" lanes, a 4'-0" right shoulder, and a 2'-0" left shoulder. These new shoulder widths would be less than adequate, such that accidents or other incidents involving a stopped vehicle would result in traffic backups and delays, and maintenance and repair activities would still require taking a lane out of service. In addition, the dogleg on the New Jersey approach, which adversely affects truck maneuverability on the approach, would remain. On the approaches, the shoulder widths could be increased to meet the current AASHTO-recommended shoulder widths of 10'-0", left and right, but the section through the truss spans cannot be widened due to the existing truss width.

While a parallel three-lane structure built to the north or south of the existing bridge would be situated to avoid placing piers in the Arthur Kill, for navigational and environmental reasons, the existing pier protection system for the existing Goethals Bridge would remain in the navigable channel. It would require improved pier protection, significant strengthening to increase capacity, and continued maintenance, while remaining vulnerable to ship collisions. This study includes the costs of both pier strengthening and future pier maintenance.

Based on previous analyses conducted in support of the GBR EIS[5] and studies conducted by the Port Authority, this assessment assumes that a major rehabilitation of the existing Goethals Bridge would need to be performed in approximately 7 to 10 years from now. For purposes of this assessment, the rehabilitation work is assumed to take place in 2010 to ensure timely attention to the projected deterioration and related need to rehabilitate the structure. The cost of this rehabilitation is estimated at $228 million[6] in 2005 dollars.

The life-cycle cost analysis of bridge rehabilitation is based on the activities and associated costs that would be necessary to rehabilitate and maintain the existing Goethals Bridge for an additional 100 years beyond the near-term rehabilitation in 2010 (i.e., the costs associated with a 100-year service life, until 2110), consistent with the design life for a new parallel structure. These life cycle costs are estimated at $432 million in 2005 dollars (Net Present Value).

rehabilitation and maintenance activities and related costs, potential environmental impacts of a modified rehabilitation alternative will be addressed within the *Historic Bridge Alternatives Analysis Report*.

[4] See GBR EIS, Task I, *Technical Memorandum: Preliminary Alternatives, Final,* February 2005.

[5] *Task B – Structural Inspection Report, Final,* July 28, 2004.

[6] All estimated costs have been rounded to the nearest million dollars.

Depending on the specific nature of each of the maintenance repairs, the frequency of this work would vary from 10 to 50 years.

Therefore, the total estimated cost to rehabilitate and maintain and thus extend the life of the existing Goethals Bridge until 2110 is $660 million (Net Present Value - 2005 dollars).

This report does not address the initial cost nor the life-cycle costs of a new parallel bridge, nor does it address the life-cycle costs of toll facility reconfiguration, user costs, or agency costs.

1.0 BACKGROUND

In May 1995, the United States Coast Guard (USCG) issued a Draft Environmental Impact Statement/Draft Section 4(f) Statement for the Staten Island Bridges Program – Modernization and Capacity Enhancement Project (SIBP DEIS). The DEIS evaluated several alternatives to accommodate increased vehicular traffic through the Goethals Bridge corridor. The Port Authority's proposed action was to construct a new, three-lane parallel bridge immediately south of the existing Goethals Bridge and to modernize and modify the existing bridge, including its New York and New Jersey approaches, to carry three lanes of traffic. The new bridge was proposed to carry eastbound traffic while the existing structure would carry westbound traffic. While the existing bridge's pier protection system would remain in the navigable waterway, the new bridge's pier protection system was proposed to be outside the navigable waterway. The proposed modifications to the existing Goethals Bridge considered in the studies conducted in the mid-1990s included the following:

- Replacement of the existing concrete roadway deck
- Re-configuration of the existing bridge (main span and approach spans) to one-way operation with three 12'-0" wide travel lanes with a 4'-0" right shoulder and a 2'-0" left shoulder. These shoulder widths would be well below the 10'-0" widths recommended by AASHTO.
- Widening of the existing sidewalk to provide for a walkway/bikeway;
- Rehabilitation or replacement of the existing deck joints and drainage system
- Repair of deteriorated structural elements, and
- Modifications to the traffic control systems, signs and pavement markings.

In the ten years since issuance of the 1995 DEIS,[7] the Port Authority has issued 22 construction contracts for a variety of repairs to the Goethals Bridge. The value of the construction contracts, in total dollars summed for all 22 contracts awarded, is $104 million. The majority of the work performed was for structural deck and pavement repairs, removal of lead paint and repainting of the truss spans, and pier repairs. The largest of the contracts was for the rehabilitation of the deck and structural steel and replacement of the sidewalks. That contract in the amount of $63 million was awarded in July of 2004 and is currently under construction. The current forecast of total cost is $71 million. The purpose of the current contract is to patch the existing deck and perform miscellaneous repairs to the steel stringers, floorbeams and brackets. It is estimated that the repairs will extend the life of the 78-year old deck approximately 7 to 10 years, at which time the deck will have to be replaced.

Based upon the amount of deterioration of the existing bridge and the estimated costs to repair and maintain the aging structure, the Port Authority revised its proposed action from

[7] The Final Environmental Impact Statement (FEIS) for the Staten Island Bridges Program – Modernization and Capacity Enhancement Project (SIBP FEIS) was issued in 1997.

rehabilitating the existing structure to demolishing the bridge and replacing it with a new 6-lane structure (or new twin 3-lane structures) in generally the same alignment.[8]

The studies for the ongoing GBR EIS have concluded that rehabilitation of the existing bridge would not address the defined project purpose and need and, therefore, is not a reasonable alternative for detailed evaluation in the Draft EIS. This report has been prepared, in partial fulfillment of Section 106 consultation with the NJHPO and NYSHPO, regarding the rationale and justification for proposed demolition and replacement of the existing bridge, which has been deemed eligible for listing on the National Register of Historic Places. The report documents an objective assessment of the rehabilitation activities and related costs that would be required to extend the useful life of the existing bridge, comparable to the design life of the proposed replacement bridge, i.e., an additional 100 years, until 2110.

The focus of this assessment is the life-cycle cost to convert the existing Goethals Bridge to a structure carrying three lanes of traffic in one direction, to upgrade the bridge to current design live loads and current seismic codes, to upgrade the bridge to current security requirements, and to maintain the bridge for 100 years. This assessment does not address life-cycle costs of the toll plaza area, as that is common to all potential alternatives; life-cycle costs of the proposed new parallel structure; travelers' delay costs associated with temporary traffic diversions due to temporary use of the new bridge for two-way traffic; and life-cycle costs associated with demolition of the existing bridge and its replacement with a new 6-lane structure in lieu of building a parallel 3-lane structure and rehabilitation of the existing bridge.

2.0 BRIDGE REPAIR HISTORY

The construction of the Goethals Bridge was completed 78 years ago, in 1928. A review of the repair contracts for the bridge for the past 18 years, from 1987 to 2005, for which detailed data are available, indicates that a total of approximately $121 million (or about $6.7 million per year) has been spent maintaining the structure. A substantial portion of the total $121 million (about $93 million) has been spent since 2001 to repaint the main span (the approaches had been repainted in an earlier contract), replace the existing sidewalks, and perform miscellaneous structural and deck repairs. A list of the repair contracts in the 18-year period follows:

Contract Number	Contract Title	Award Date	Award Price
AKG-165	Rigid Pavement Repairs	Oct-87	$69,932
AKG-180	Repr of Mod lateral brace &Mortar pads/paint stl	Sep-91	$190,000
AKG-166	NY Appr So Sidewalk Rehab	Mar-92	$522,000
AKG-181A	Rehabilitation of Main Span Piers A Through D and the Piers to the NJ Turnpike Ramp	Sep-92	$284,920

[8] In addition to the ongoing deterioration and associated repair costs of the existing Goethals Bridge, the purpose and need underlying the Port Authority's proposal to construct a replacement bridge includes consideration of: a) the existing bridge's functional obsolescence; b) the need for seismic retrofitting of the bridge's substructure and superstructure; c) its deficiency as a reliable transportation link in the NY/NJ region; d) deteriorating traffic conditions and relatively high accident levels on the bridge; and e) the limitations posed by the existing structure's configuration/design for maximizing traffic flow improvements from EZPass technology, providing dedicated space for potential future transit service and other options to single-occupant-vehicle commutation, providing safe and reliable access for trucks, and providing safe and secure pedestrian and bicycle access across the bridge. The purpose and need for the proposed project, and the related project goals, are defined in the *Draft Scoping Document for EIS Preparation in Conjunction with Proposed Replacement of the Goethals Bridge*, dated August 10, 2004, and are described on the project website at www.goethalseis.com.

Contract Number	Contract Title	Award Date	Award Price
AKG-186	Eastbound Paving	Sep-92	$350,000
AKG-197	Engineering Inspection Beneath the Median Barrier	Apr-93	$87,000
AKG-274.022	NY&NJ Viaducts Lead Based Paint Removal and Repainting	May-98	$12,291,000
AKG-191	Rehab of Sign Structures and Light Structures	Aug-93	$134,000
AKG-196	Replace CLF under NY Approach	May-94	$79,445
AKG-110.031	Toll Plaza Pavement Rehabilitation	Aug-94	$2,520,101
AKG-274.011	Pin and Hangar Redundant Support System	Oct-95	$196,630
AKG-274.006	Deck and Steel Rehabilitation at Median Barrier	Dec-95	$2,896,170
AKG-190	Rehab of Hollow Abutments on the Approach Spans	Mar-96	$845,300
AKG-994.901 (WO#5)	Miscellaneous Priority Repairs	Sep-96	$736,000
AKG-212	Sidewalk Repairs	Apr-97	$500,000
AKG-214	Miscellaneous Concrete Repairs to the Maintenance and Administration Buildings	Sep-97	$119,000
AKG-220	Repaving Westbound NJ Ramps and NY Approach Roadway	Nov-97	$834,810
AKG-227	Micro-surfacing of the Goethals Bridge	Aug-98	$647,500
AKG-221	Rehabilitation of Eastbound New Jersey Approach Roadway	Sep-98	$798,286
AKG-211A	Modifications to the New York Abutment Garage	Apr-99	$167,200
AKG-229	Westbound New York Approach Roadway Resurfacing	Jun-99	$122,125
AKG-218	Structural Repairs of Pier D	Oct-99	$1,006,260
AK-154	Maintenance Pavement Repairs Via Work Order	May-00	$100,000
AKG-235	Wetland and Mitigation planting and Maintenance at Pier D	May-01	$239,000
AKG-274.068	Removal of Lead Based Paint and Repainting Truss Span and Structural Steel Rehabilitation	Jun-01	$18,425,000
AK-155	Rehabilitation of Bridge Lighting Systems, CCTV Feeders and Miscellaneous Structures (Goethals portion)	Sep-01	$10,000,000
AKG-184	Rehabilitation of Span 28 on the NJ Approach Span	Apr-04	$175,000
AKG-274.094	Rehabilitation of Deck, Structural Steel and Replacement of Sidewalk	Jul-04	$63,212,000
AK-162	Maintenance Pavement Repairs Via Work Order	Oct-04	$200,000

In addition, the Port Authority has indicated that, in 2003, 17 deck joint failures at the bridge required emergency repairs, the costs for which have not been provided and, therefore, are not included in the total cost cited above.

Rehabilitation contracts were performed on the bridge in the 1960s and early 1980s, prior to the 18-year period for which data are provided above. In the 1960s, six repair contracts were completed, including the replacement of the asphalt overlay, deck repairs, expansion and deflection joint repairs and miscellaneous steel repairs. In 1981 and 1982, two major contracts were awarded to replace the asphalt overlay, perform deck repairs, and reseal the joints.

As stated previously, a major rehabilitation contract is currently underway. The current contract includes patching of the existing deck. Despite this ongoing deck repair and the fact that maintenance work is regularly performed on the bridge, the anticipated remaining life for the current deck is only 7 to 10 years, after which the deck will need to be replaced.

In addition to deck replacement, repair costs for the bridge are expected to increase in future years as the piers, abutments and the superstructure deteriorate.

3.0 LIVE LOAD CAPACITY

The load carrying capacity of bridges is generally expressed in terms of a truck of a given weight and axle configuration, as defined by the American Association of State Highway and Transportation Officials (AASHTO). For tractor trailers, the AASHTO designation is an HS truck, which is a three-axle tractor trailer. Most highway bridges in the United States are designed for HS-20-44 or HS-25-44 trucks that weigh 72,000 lbs and 90,000 lbs, respectively.

According to a Level 1 load rating that was part of the 1996 Biennial Inspections, the existing Goethals Bridge, at that time, had an as-inspected live load capacity of HS 21.7 Inventory and HS 33.3 Operating. The Inventory rating was based on the Working Stress Method and the Operating rating was based on the Load Factor Method. This rating was determined using the 1994 AASHTO *Manual for the Condition Evaluation of Bridges* and an average yield stress of 39,000 psi, based on coupon tests. If the coupon tests had not been considered, the Live Load ratings would have been HS 15.5 Inventory and HS 26.1, both based on the Load Factor Method. The 2004 biennial inspection reported deterioration to floorbeams, floorbeam connections, stringer connections, and stringer webs. This deterioration could affect the live load capacity of the bridge. However, these deficiencies are being addressed under Contract AKG-274.094: Goethals Bridge, Rehabilitation of Deck, Structural Steel and Replacement of Sidewalks.

A review of the design criteria for the proposed replacement bridge or a parallel bridge structure indicated that the new bridge would be designed to carry an AASHTO HL-93 live load, in accordance with the AASHTO Load and Resistance Factor Design (LRFD) Bridge Design Specifications. It is assumed that as part of the redecking, the existing bridge would be strengthened to accommodate this same live load, also using the LRFD specifications. The extent of this strengthening would need to be determined via detailed evaluation; while the bridge was designed for four lanes of traffic and has a greater than HS-20 rating, as discussed above, the reconfigured roadway would be limited to three design lanes of traffic, at least on the main span, due to the width restriction of the truss. On the approaches, however, there is a possibility to strengthen the structure and widen the roadway to increase the shoulder widths. If the approach roadway widths were increased to 48 feet,[9] the approaches would need to be designed for four lanes of traffic, which would likely require considerable structural modification to accommodate the live load increase of an HL-93 loading. As discussed below, retrofit may also be required to improve the fatigue life[10] of various members. Cost associated with the possible strengthening is discussed below.

4.0 SUBSTANDARD FEATURES

The most significant substandard features of the existing bridge are the 10'-0" width of the two travel lanes in each direction, and the absence of emergency shoulders. These substandard conditions would be partially mitigated were the deck to be reconfigured to provide three 12'-0"

[9] Roadway width of 48 feet comprised of four lanes at 12”-0” each, as proposed in the Port Authority’s *Goethals Bridge Replacement Study for Roadway and Sidewalk Decks* (April 2001, re-issued March 2002) and in the *SIBP DEIS* Volume 2 of 2 (Part 1) Appendix A, Figure 4.21(B) (May 1995).

[10] The fatigue life of a bridge is an estimate of how long the members of a bridge can withstand the effects of stresses imposed by traffic loads. Fatigue life, which is related primarily to steel bridges, is subject to many variables, most significantly the volume and weight of vehicles using the bridge, and can be extended by repair or replacement of fatigue-sensitive members.

wide lanes in one direction, plus two shoulders, in combination with a new parallel bridge of three travel lanes in the opposing direction. However, the proposed shoulder widths of 4'-0" right and 2'-0" left would still be inadequate to provide a breakdown lane and inadequate to allow maintenance crews to access the bridge without needing a lane shut-down.

While a significant improvement over the existing 10'-0" wide lanes and absence of shoulders, the new roadway associated with a one-way configuration would not meet current standards of the AASHTO Policy on Geometric Design of Highway Streets, as referenced in the AASHTO *Standard Specifications for Highway Bridges* and AASHTO *LRFD Bridge Design Specifications.* The 2004 AASHTO *Policy on Geometric Design, Chapter 8, Viaduct Freeways Without Ramps*, recommends lane widths of 12'-0" and right and left shoulder widths of 10'-0" for viaducts with six lanes, three in each direction, which would apply in this case. Both the proposed 4'-0" wide right and 2'-0" wide left shoulders would be well below the AASHTO recommendations for 10-foot-wide left and right shoulders.

In addition, a 7,700-foot radius horizontal curve in the alignment of the New Jersey approach span (which is sometimes referred to as a dogleg) at a point approximately 2,300 feet from the western bridge abutment would remain as a substandard feature, principally affecting the maneuverability of truck traffic.

5.0 REQUIRED REHABILITATION, UPGRADES AND MAINTENANCE TO EXTEND LIFE 100 YEARS

5.1 Deck Rehabilitation/Retrofit for One Directional Operation/Repairs

The existing bridge deck is 78 years old and is at the end of its useful life. The ongoing rehabilitation contract will extend the life of the deck by 7 to 10 years. In order to retrofit the existing bridge to carry three 12'-0" wide lanes traveling in a single direction, the following items of work would have to be performed:

- Reconstruct the entire bridge deck (main spans and approach spans) to remove the current median barrier and curbs and provide a new reinforced concrete deck to carry three 12'-0" wide lanes with a 4'-0" wide right shoulder and a 2'-0" wide left shoulder;
- Widen the existing sidewalk to provide for a walkway/bikeway;
- Rehabilitate the structure for seismic loads, in accordance with FHWA guidelines;
- Retrofit and shore up the existing piers for an extended life and improved ship collision protection;
- Maintain the substructure, including the pier protection; and
- Modify the existing traffic control systems, signs, and pavement markings.

Two of the retrofit needs – replacement of the entire deck due to increased deck deterioration and shoring up of the existing piers – have become evident since the SIBP EIS was prepared. The other retrofit items of work are similar to those proposed in the 1995 DEIS. It is assumed that the bridge deck would be replaced at the same time that the deck would be reconfigured, were it to be coupled with a new parallel 3-lane bridge. The deck replacement costs are based on cost

estimates that were generated as part of the Port Authority's *Goethals Bridge Replacement Study for Roadway and Sidewalk Decks* (April 2001, reissued March 2002). The costs have been modified, as described herein, to account for changes to the priced scheme, as well as to increases in costs and deterioration. The costs for deck replacement have been compared to a recently bid project in the New York/New Jersey metropolitan region. The deck replacement study used a price of $95 per square foot for replacement of the concrete deck; this cost has been escalated for this assessment to a current price (2005) of $113 per square foot.[11]

There are two options for the construction of the new deck. Both would require that the deck be replaced after the construction of the new parallel bridge, and both options assume that the new deck would be a reinforced concrete deck with a monolithic wearing course. Steel repairs at the roadway median and the expansion joints are included. It is also assumed that the approach roadway width would be increased (above-referenced Replacement Study, Scheme # 3). The two options are as follows:

- **Option 1 –** All four lanes of traffic would be shifted to the new parallel bridge structure. The deck construction on the existing bridge would occur during normal work days and the entire deck would be replaced without any traffic on the bridge. This option is similar to the Replacement Study's Traffic Staging Plan 2A for Scheme 3 which was priced at $142 million in 2001 dollars. This assessment assumes that the maintenance and protection of traffic (MPT) costs would be similar as it would be necessary to provide temporary striping and barriers on the new span while it is configured for two-way traffic. The seismic retrofit allowance is a separate line item in this study and has been deducted to avoid double-counting. The floorbeam and stringer repairs have been increased by 25 percent, assuming continued deterioration of the deck and steel framing. The resulting price for the repairs is approximately $116 million in 2001 dollars, or $139 million in 2005 dollars. (The substructure costs are discussed in Section 5.4, below.)
- **Option 2 -** The existing eastbound traffic would be shifted to the new bridge while the existing bridge would carry only two lanes of westbound traffic. The existing bridge's deck would be replaced in three stages during normal work hours. This option would require extensive MPT due to the limited width of the main bridge deck. This option is similar to the Traffic Staging Plan 2 for Scheme 3 in the Replacement Study, which was priced at $150 million in 2001 dollars. This assessment increases (doubles) the MPT requirement, removes the seismic retrofit allowance as it is a separate line item in this study, and increases the floorbeam and stringer repairs by 25 percent, assuming continued deterioration of the deck and steel framing. The resulting repairs are estimated at $130 million in 2001 dollars, or $155 million in 2005 dollars.

It has been assumed that a future deck replacement would be required approximately 50 years after the 2010 re-decking. However, depending upon the details of the 2010 re-decking, it may be possible that the deck could be maintained for 100 years and that deck repairs would be limited to resurfacing. Determining factors would include the possible use of stainless steel

[11] The comparable project was the redecking of the Brooklyn Queens Expressway in Brooklyn, which was bid in December 2005. The average bid price (there were six bidders) was $88 per square foot. The area to be replaced was approximately 520,000 square feet, which is on the same order of magnitude as the Goethals deck replacement of 330,000 square feet. Thus, the costs used for this assessment are reasonable and conservative.

reinforcing bars, high performance concrete, a high quality waterproofing membrane, the amount of chlorides applied to the deck, the level of maintenance of the overlay, and other maintenance programs, such as annual deck washing. At the time of a second re-decking, the traffic volumes will have significantly increased and closing the entire existing bridge to traffic would likely be impracticable. It is assumed that the re-decking would have to take place at night with two to three construction phases while taking one or two lanes out of service similar to Traffic Staging Plans 1 and 1A of the Port Authority's Replacement Study. The cost of this future second re-decking project is estimated at $233 million in 2005 dollars. If the construction is performed in 2060, the cost of the construction is estimated at $2.6 billion (2,618 million) in 2060 dollars with a 2005 net present value of $161million.

Periodic maintenance of the bridge deck is assumed to be necessary every 10 years. These repairs are for the patching of top of deck and bottom of deck spall repairs. The amount of repairs required is anticipated to increase by 15 percent of the deck area every 10 years. Costs for the deck repairs are estimated at $140 per square foot (sf) in 2005 dollars. The total deck area of the main bridge, both approaches, and the deck of the hollow abutment is 330,000 sf.

5.2 Seismic Retrofitting

Current policy of the U.S. Department of Transportation (USDOT)/Federal Highway Administration (FHWA) requires that existing structures be studied for seismic vulnerability and retrofitted, if necessary during major rehabilitation projects such as a deck replacement. Two seismic studies have been conducted to determine the seismic vulnerability of the Goethals Bridge and both approaches and to develop seismic retrofit details:

- *Seismic Evaluation for the Goethals Bridge Corridor*, prepared by Imbsen Consulting Engineer, PC for the Port Authority, March 1998;
- *Goethals Bridge Truss Span Seismic Assessment Structural Investigation Final Report (Volume I of IV)*, prepared by Lichtenstein Consulting Engineers for the Port Authority, December 18, 2003.

Both studies recommended seismic retrofits. For the purposes of this rehabilitation assessment, the recommendations of the December 18, 2003, Seismic Assessment have been used to determine the costs for the main bridge, as it includes a more detailed analysis of the main bridge and was based upon current seismic criteria of the New York State Department of Transportation Seismic Design (Blue Pages), Division 1-A.

The cost for the retrofitting of the approach spans is based on the estimates provided in the 1998 *Seismic Evaluation for the Goethals Bridge Corridor*.

The reports recommend the following retrofits:

- **Main Bridge** – The 2003 seismic assessment report recommended strengthening of the main bridge superstructure and substructure. Superstructure retrofitting would include replacement of sway bracing and bottom lateral bracing, strengthening of eight truss verticals, and installation of redundant tension links and bearing anchor bolts. The majority of the retrofitting costs would be for the bridge piers. The proposed substructure retrofitting

would include construction of reinforced concrete buttresses on a reinforced concrete cap supported by drilled shafts on Piers A, C, and D, the end piers and east main pier. The estimated cost of the main bridge work, per the 2003 seismic assessment report, was $8 million in 2003 dollars. Based upon a review of the pricing for the main truss superstructure replacement and the difficulty of constructing the pier buttresses, the 2003 estimate has been increased to $8.5 million in 2003 dollars, or $9 million in 2005 dollars.

- **Approach Spans** – Strengthening of the approach spans would include pier strengthening, bearing replacement, installation of lock-up devices and brackets/restrainers. The 1998 seismic evaluation report pointed out that the approach spans on the New York side are supported on timber piles and the approach spans on the New Jersey side are supported on concrete caissons. While the concrete caissons were not found to be vulnerable, the timber piles penetrate a layer of organic clay and loose sand. As the loose sands are susceptible to liquefaction and spreading, their behavior during a seismic event could affect the integrity of the timber piles and the stability of the New York approach span piers. The report recommended that, in this area, both stone columns and jet grouting be investigated to mitigate the potential for liquefaction, although the report added that jet grouting is the preferred solution. The report pointed out that the installation would be disruptive to the wetlands in the area as temporary access trestles would need to be constructed for the equipment used for this type of condition. The estimate for the approach span work was $35million in 1998 dollars and has been escalated to 2005 prices in this assessment, to $48 million.

The total cost of the seismic retrofit, including both the main bridge and approaches, is $57 million in 2005 dollars.

5.3 Security Upgrades

The existing bridge was not designed to mitigate threats from terrorist attacks, a concern that is more recent, arising largely within the past decade. The bridge is a non-redundant through truss that may have vulnerabilities. While determination of the actual vulnerabilities of the structure is beyond the scope of this investigation, an assumed cost of $1,000,000 (2005 dollars) has been included to strengthen or otherwise protect portions of the bridge structure to mitigate such threats. This includes an allowance for strengthening or protecting some of the truss members, such as the suspended span hangers and other critical primary members.

Items such as fencing, lighting, or surveillance measures that would be part of a physical security system would be implemented for either the existing bridge or a proposed replacement. As such, the cost of these measures has not been included in this study.

In addition, costs associated with reducing the bridge's vulnerability due to ship collision could add $20 to $30 million to the cost of the security upgrade. These costs would be associated with the cost of installing additional fender cells to improve the protection of the main piers. For purposes of this study, a value of $25 million has been used for the cost of additional ship collision protection provisions and possible strengthening of Pier B, similar to the strengthening proposal for Pier C as part of the seismic retrofit.

5.4 Concrete Pier and Abutment Repairs

Within the last 18 years, several contracts have been awarded to perform repairs to the existing concrete piers and abutments of the main bridge and both approaches. The work averages out to be approximately $190,000 per year in 2005 dollars.

For this study, it has been assumed that, in addition to the seismic retrofitting, some major rehabilitation of the substructure would be required in the 2010 rehabilitation contract. The magnitude of the work is equivalent to $4 million (2005 dollars).

Subsequent to the 2010 contract, it is anticipated that the substructures would need periodic repairs every 20 years. The estimated amount of work for each repair contract is $4 million (2005 dollars) escalated to the year of performance of the work. Each subsequent contract, which will cumulatively extend the substructure's life span for an additional 100 years, is also increased by 30 percent to take into account an increase in the rate of deterioration as the substructure ages.

The 2005 net present value of the pier and abutment repairs for 100 years, 2010 to 2110, is $16 million.

5.5 Fatigue Life

The existing main bridge and approach structures are constructed of riveted built-up members. Based on review of 1996 load ratings, the current inventory live load ratings are in excess of HS-20, and the bridge is not overstressed for normal design live loads.

Although the bridge may not be overstressed at this time, normal highway traffic is contributing to the cumulative fatigue damage of the primary tension members and the tension portions of the bridge floor framing. The large numbers of heavy vehicles that use the bridge also contribute to the damage and the reduction in the structure's remaining fatigue life.

Based on review of the Port Authority's 2002 Biennial Inspection report, there are no signs of fatigue damage or cracking of the main bridge or its approaches. In addition, there is no mention of fatigue sensitive details, tack welding or welded repairs that have been made to the primary members of the bridge.

Based on discussion with the Port Authority's Engineering staff, no remaining fatigue life studies have been performed for the main span or the approaches.

If the existing structure is to be rehabilitated and reused, it would be advisable to perform a fatigue study and determine the remaining fatigue service life of the bridge. The study should include a review of the existing bridge drawings and inspection reports for fatigue sensitive details, and an in-situ determination of the wheel loads for the actual vehicles using the bridge. It is the present understanding that agencies in the New York Metropolitan area have found that overweight vehicles, with weights equivalent to an AASHTO HS-33 (118,000 lbs), have been using their structures. The loads from these overweight vehicles, which are 33 percent heavier than the HS-25-44 trucks, have a significant adverse effect on the fatigue life of a structure.

It is recognized that adding a new deck will allow the stringers to be composite members, increasing their live load capacity and reducing their live load stress range and hence increasing their fatigue life. Possible future repairs or retrofits could include strengthening, as discussed in Section 3, above, removing tack welds, strengthening the section of the member, eliminating fatigue sensitive details, or replacing loose rivets. For purposes of this assessment $1 million (2005 dollars) has been added to the estimated rehabilitation costs of the structure for strengthening, tack weld removal, and other fatigue related repairs. However, detailed capacity and fatigue studies would be required to more accurately estimate the necessary repairs or retrofits and the associated costs.

5.6 Painting Bridge Superstructure

The main bridge was cleaned and painted for $18,425,000 in 2001 and the approaches were cleaned and painted for $12,291,000 in 1999. The scope of work for these contracts included removal of all prior paint coatings and to repaint the steel. Since the previous paint systems were lead-based, containment procedures were used to perform the paint removal.

In order to extend the life of the structure for an additional 100 years, the main bridge and the approach framing steel will need to be cleaned and painted on a periodic basis. Based on current experience with the Newport Suspension Bridge in Rhode Island, it is estimated that the paint system will provide a 25-year life with maintenance painting/touch-up anticipated after 15 years. Estimated pricing for each painting contract is $28 million (2005 dollars) and $5 million (2005 dollars) for each touch-up contract, escalated to the year in which the work would be performed.

The cost is based upon the two previous contracts but has been reduced by 35 percent since the lead paint has been removed and only a portion of the paint would need to be removed. While it is anticipated that paint containment systems will be required, the disposal costs and level of containment would be less than previously.

The total 2005 net present value for painting the bridge steel through 2110 is $87 million.

5.7 Expansion Joint Repairs/Replacement & Misc. Steel Repairs

Periodic resealing and repair/replacement of the bridge joints is important to maintaining the bridge and extending the life of the structure. Failed seals lead to deterioration of the steel floor framing, bearings, and piers below the joints.

The cost of resealing all of the bridge joints and repairing/replacing a portion of the joints every 10 years has been included in this assessment. Based upon the Port Authority's "Goethals Bridge – Deck Condition Assessment" (March 1997), there are 9,000 linear feet of bridge deck joints along the entire structure. Repair costs, in 2005 dollars, are estimated at $1,000 per linear foot to replace an expansion joint and $200 per linear foot to reseal the joints. The first contract would be in 2020 and would include the resealing of 90 percent of the joints and replacement of 10 percent of the joints. It is assumed that the amount of bridge joints to be replaced would increase by 10 percent for each subsequent contract.

In addition, a lump sum allowance of $250,000 (2005 dollars), escalated to the year in which the work would be performed, is included every 10 years for repairs to the steel below the joints.

The total cost of expansion joint and miscellaneous steel repairs to extend the life of the structure to 2110 is estimated at $24 million (2005 net present value).

5.8 Bearing Repair/Replacement

The initial rehabilitation assumed in this assessment would include rehabilitation and retrofitting of the main bridge bearings during the seismic retrofit. The approach span bearings would also have been replaced under that initial contract.

Periodic repair of the bearings will be required. Repairs are anticipated to be required every 33 years (i.e., twice of the 100-year life of the bridge structure) and are anticipated to increase in cost by 5 percent for each subsequent contract. A lump sum cost of $8 million (2005 dollars), escalated to the year in which the work would be performed is included in the cost estimate. The cost was based on an estimate of $7 million for replacement of the approach span bearings listed in Note 6, page 44, of the 2001 Deck Replacement Study, and assuming an additional $500,000 to replace the main span bearings. Work totaling $20 million (2005 net present value) would be required to maintain the bridge bearings through 2110.

5.9 Fender System Repairs

Two pier protection cells are currently located adjacent to Main Bridge Pier C. The pier protection cells are constructed of sheet piling driven in a circular pattern with a diameter of approximately 40 feet. The interior of the cell is filled with a rock or soil fill and is topped with a reinforced concrete deck. The exterior of the cell is covered with waterproofing and has heavy timber bumpers mounted to the sheet piling.

A repair/rehabilitation allowance of $1,000,000 (2005 dollars) is included in the 2010 repair contract. A periodic maintenance cost of $500,000 (2005 dollars), escalated to the year in which the work would be performed, is included to perform repairs to the waterproofing and timber bumpers every subsequent 10 years. The total cost of maintaining the fender system for 100 years, from 2010 to 2110, is estimated at $3million (2005 net present value).

As discussed in Section 5.3 Security Upgrades, above, $25 million has been included in the cost estimate for strengthening of the ship collision protection system.

CONCLUSIONS

The existing bridge is 78 years old. With the exception of the deck and some of the steel floor members, the structure is in good condition for its age. However, the structure is experiencing an increase in the rate of deterioration of both the superstructure and substructure, and it is expected that the rate of deterioration will continue to increase as the structure ages further. Significant retrofitting would be required to convert the structure to three lanes of traffic operating in a single direction and to bring the structure up to current standards.

Since the bridge was constructed in 1928, there has been a large increase in the traffic volumes and average annual daily traffic (AADT) traveling over the bridge. In addition, there has been an increase in the size of vehicles. Both of these factors contribute to the cumulative fatigue damage that the bridge has experienced. An analysis of the capacity of the bridge to carry

current design loads and to determine the remaining fatigue life and associated modifications of the bridge would need to be performed to accurately determine the effects of an additional 100 years of traffic traveling over the bridge structure.

Due to security concerns, a substantial investment would be required to upgrade the bridge to meet current standards. Even if all of the rehabilitation work considered in this assessment were accomplished, the three traffic lanes on a reconfigured existing Goethals Bridge would have substandard shoulders, at least on the main span and possibly throughout, depending upon the extent of widening that may be done on the approach spans. The New Jersey approach would still have a relatively sharp curve.[12]

A cost summary of the required repairs and retrofits for rehabilitation and maintenance activities to extend the Goethals Bridge's life span an additional 100 years is attached. Both the cost at the time of construction and the Net Present Value in 2005 is shown. An escalation rate of 4.5 percent[13] is used to project costs and a discount rate of 5.2 percent[14] is used to bring the costs back to 2005.

This analysis considered a major rehabilitation that would be performed in 2010, which would include reconfiguration and full replacement of the bridge deck, seismic retrofitting, security upgrades, pier and abutment repairs, strengthening of fatigue sensitive members and pier protection system repairs. The cost of this rehabilitation and retrofit contract is estimated at $228 million in 2005 dollars. The cost does not include the cost of a parallel three-lane bridge and costs associated with toll plaza modifications. The cost also does not include travelers' inconvenience and delay costs during the period of retrofitting and redecking of the existing bridge while a new parallel bridge is temporarily used for two-way traffic (per Option 1 for deck replacement; see Section 5.1, above).

In addition to the bridge rehabilitation, future maintenance repairs to extend the service life of the structure until 2110 are estimated at $432 million in 2005 dollars (net present value). The total estimated cost of repairs to the bridge to extend the life until 2110 is $660 million (2005 net present value).

[12] In addition, the rehabilitated and reconfigured Goethals Bridge could not accommodate a mass transit corridor, walkway/bikeway, nor incorporation of Intelligent Traffic System (ITS) technologies, all of which are included in the design of the proposed replacement bridge(s) in the Goethals Bridge corridor.

[13] Based on *Engineering News Record* reporting of construction cost indices from 1995 to 2005.

[14] Office of Management and Budget, The Executive Office of the President, Circular No. A-94, Appendix C (Revised January 2005): *Discount Rates for Cost-Effectiveness, Lease Purchase, and Related Analyses.*

Attachment A
Rehabilitation and Maintenance Costs

PANYNJ GOETHALS BRIDGE MODERNIZATION PROGRAM

ANTICIPATED CONSTRUCTION / RETROFITS AND MAINTENANCE

REPAIRS TO EXISTING BRIDGE TO EXTEND LIFE 100 YEARS (To 2110)
Revised April 5, 2006

Assumed Yearly construction cost escalation rate = 4.50%
Assumed Discount Rate = 5.20%

Year of Construction	Description of Work	Date of Last Repair	One Time or Recurring Expense	Life Expectancy of Repair / Retrofit (Years)	Cost at Time of Construction	2005 Cost Dollars (Net Present Value)	Notes
	INITIAL MAJOR REHABILITATION OF MAIN BRIDGE AND APPROACHES 2010						
2010	Replace Bridge Deck, Stringers, replace joints, repair floorbeams, trusses, and brackets & Reconfigure for 3 lanes one way (Main Bridge)	2010	One Time for Configuration, every 45 years for deck	50	$ 145,055,578	$ 138,809,165	Based upon PANYNJ Goethals Bridge - Replacement Study for Roadway and Sidewalk Decks dated March 2001 the cost was estimated at $116,400,000
2010	Seismic Retrofit (Main Bridge & Approach Spans)	2010	One Time	100	$ 70,923,176	$ 56,912,377	Per Lichtenstein Seismic Report dated December 18, 2003 the 2003 price for the seismic Retrofit work is estimated at $7,910,000 and was increased to $9,282,213 (2005 dollars), Approach Span Retrofit cost (including Jet Grouting) is estimated at $47,630,16
2010	Security Upgrades to Structure (Hardening and Strengthening for Blast Resistance)	N/A	One Time	100	$ 32,400,730	$ 26,000,000	Estimated at $26,000,000 in 2005 dollars
2010	Pier and Abutment Repairs to Main Bridge and Approaches	N/A		20	$ 4,735,491	$ 3,800,000	Estimated at $3,800,000 in 2005 dollars
2010	Strengthening of Steel Members to Increase Fatigue Strength	N/A	One Time	50	$ 1,246,182	$ 1,000,000	Estimated at $1,000,000 in 2005 dollars
2010	Fender System Rehabilitation	N/A	Recurring	10	$ 1,246,182	$ 1,000,000	Estimated at $1,000,000 in 2005 dollars
	Cost for Initial Rehabilitation Scheduled for 2010			**Subtotal**	**$ 255,607,339**	**$ 227,521,542**	
	COST OF SUBSEQUENT MAINTENANCE AND REHABILITATION WORK (2011 TO 2150) TO EXTEND LIFE OF SUPERSTRUCTURE 100 YEARS AND OF SUBSTRUCTURE 150 YEARS						
2060	**Replace Concrete Deck (Main Bridge & Approaches)**	**2010**	**Recurring**	**50**	**$ 2,617,553,159**	**$ 161,075,623**	Based upon a contract value of $232,541,000 in 2005 dollars
2026	Paint Bridge Superstructure (Main Bridge & Approaches)	2001	Recurring	25	$ 70,566,752	$ 24,337,143	Both Approaches and Main bridge have had lead paint removed and have been repainted (Approaches in 1999 for $12,291,000 and Main Bridge in 2001 for $18,425,000). Future painting is calculated based upon these contracts assuming the work is 35% cheaper as
2041	Touch Up Bridge Superstructure (Main Bridge & Approaches)	2016	Recurring	15	$ 24,386,892	$ 3,931,786	
2051	Paint Bridge Superstructure (Main Bridge & Approaches)	2026	Recurring	25	$ 212,083,749	$ 20,596,023	
2066	Touch Up Bridge Superstructure (Main Bridge & Approaches)	2041	Recurring	15	$ 73,293,206	$ 3,327,389	
2076	Paint Bridge Superstructure (Main Bridge & Approaches)	2051	Recurring	25	$ 637,403,807	$ 17,429,990	
2091	Touch Up Bridge Superstructure (Main Bridge & Approaches)	2066	Recurring	15	$ 220,277,928	$ 2,815,901	
2101	Paint Bridge Superstructure (Main Bridge & Approaches)	2076	Recurring	25	$ 1,915,675,364	$ 14,750,641	
		Subtotal Bridge Painting			**$ 3,153,687,700**	**$ 87,188,872**	
2020	Expansion Joint Repairs / Replacement & Steel Repairs	2010	Recurring	10	$ 5,360,732	$ 2,506,040	90% Joints Resealed & 10% of Joints Replaced
2030	Expansion Joint Repairs / Replacement & Steel Repairs	2020	Recurring	10	$ 10,488,966	$ 2,953,515	80% Joints Resealed & 20% of Joints Replaced
2040	Expansion Joint Repairs / Replacement & Steel Repairs	2030	Recurring	10	$ 19,649,534	$ 3,332,739	70% Joints Resealed & 30% of Joints Replaced
2050	Expansion Joint Repairs / Replacement & Steel Repairs	2040	Recurring	10	$ 35,733,865	$ 3,650,663	60% Joints Resealed & 40% of Joints Replaced
	BRIDGE REDECKING OCCURS IN 2060						
2070	Expansion Joint Repairs / Replacement & Steel Repairs	2060	Recurring	10	$ 48,421,546	$ 1,794,798	90% Joints Resealed & 10% of Joints Replaced
2080	Expansion Joint Repairs / Replacement & Steel Repairs	2070	Recurring	10	$ 94,743,017	$ 2,115,274	80% Joints Resealed & 20% of Joints Replaced
2090	Expansion Joint Repairs / Replacement & Steel Repairs	2080	Recurring	10	$ 177,487,096	$ 2,386,871	70% Joints Resealed & 30% of Joints Replaced
2100	Expansion Joint Repairs / Replacement & Steel Repairs	2090	Recurring	10	$ 322,771,003	$ 2,614,564	60% Joints Resealed & 40% of Joints Replaced
2110	Expansion Joint Repairs / Replacement & Steel Repairs	2100	Recurring	10	$ 574,458,877	$ 2,802,891	50% Joints Resealed & 50% of Joints Replaced
		Subtotal Expansion Joint Repairs / Replacement			**$ 1,289,114,636**	**$ 24,157,356**	
2043	Bearing Repair / Replacement	2010	Recurring	33	$ 42,609,754	$ 6,207,417	
2076	Bearing Repair / Replacement	2043	Recurring	33	$ 191,221,142	$ 5,228,997	5% of increase in Bearings Replaced
2109	Bearing Repair / Replacement	2076	Recurring	33	$ 856,203,263	$ 4,394,808	5% of increase in Bearings Replaced
2142	Bearing Repair / Replacement	2109	Recurring	33	$ 3,825,776,706	$ 3,686,067	5% of increase in Bearings Replaced
		Subtotal Bearing Repair / Replacement			**$ 4,915,810,865**	**$ 19,517,289**	
2020	Concrete Overlay Repair (Main Bridge & Approaches) Assumes new deck has a monolithic concrete wearing course	2010	Recurring	10	$ 13,411,507	$ 8,078,304	15% of Deck Area
2030	Concrete Overlay Repair (Main Bridge & Approaches)	2020	Recurring	10	$ 41,655,322	$ 15,113,174	30% of Deck Area
2040	Concrete Overlay Repair (Main Bridge & Approaches)	2030	Recurring	10	$ 97,034,161	$ 21,205,693	45% of Deck Area
2050	Concrete Overlay Repair (Main Bridge & Approaches)	2040	Recurring	10	$ 200,921,446	$ 26,448,236	60% of Deck Area
	BRIDGE REDECKING OCCURS IN 2060						
2070	Concrete Overlay Repair (Main Bridge & Approaches)	2050	Recurring	10	$ 121,141,268	$ 5,785,591	15% of Deck Area
2080	Concrete Overlay Repair (Main Bridge & Approaches)	2070	Recurring	10	$ 376,257,369	$ 10,823,886	30% of Deck Area
2090	Concrete Overlay Repair (Main Bridge & Approaches)	2080	Recurring	10	$ 876,474,282	$ 15,137,280	45% of Deck Area
2100	Concrete Overlay Repair (Main Bridge & Approaches)	2090	Recurring	10	$ 1,814,850,345	$ 18,941,930	60% of Deck Area
		Subtotal Concrete Overlay Repairs			**$ 3,541,745,700**	**$ 121,584,094**	
2030	Concrete Pier and Abutment Repairs (Main Bridge & Approaches)	2010	Recurring	20	$ 11,420,651	$ 3,215,862	Initial Cost determined by taking the total pier rehab costs from 1987 to 2005 adjusted to 2005 dollars ($3,800,000) and assuming repairs are similar but increase by 30% every 20 years
2050	Concrete Pier and Abutment Repairs (Main Bridge & Approaches)	2030	Recurring	20	$ 35,806,347	$ 3,658,068	
2070	Concrete Pier and Abutment Repairs (Main Bridge & Approaches)	2050	Recurring	20	$ 112,261,071	$ 4,161,080	
2090	Concrete Pier and Abutment Repairs (Main Bridge & Approaches)	2070	Recurring	20	$ 351,964,078	$ 4,733,261	
		Subtotal Concrete Pier and Abutment Repairs			**$ 511,452,147**	**$ 15,768,271**	
2020	Fender System Repairs	2010	Recurring	10	$ 967,641	$ 452,354	Replace Timber Bumpers, clean and waterproof sheet piling and top of cell concrete. Construction cost assumed at $500,000 (2005 dollars) escalated to the year in which the work is performed.
2030	Fender System Repairs	2020	Recurring	10	$ 1,502,717	$ 423,140	
2040	Fender System Repairs	2030	Recurring	10	$ 2,333,674	$ 395,812	
2050	Fender System Repairs	2040	Recurring	10	$ 3,624,124	$ 370,250	
2060	Fender System Repairs	2050	Recurring	10	$ 5,628,154	$ 346,338	
2070	Fender System Repairs	2060	Recurring	10	$ 8,740,351	$ 323,971	
2080	Fender System Repairs	2070	Recurring	10	$ 13,573,498	$ 303,048	
2090	Fender System Repairs	2080	Recurring	10	$ 21,079,228	$ 283,476	
2100	Fender System Repairs	2090	Recurring	10	$ 32,735,396	$ 265,169	
		Subtotal Fender System Repairs			**$ 90,184,783**	**$ 3,163,557**	
	Total Repairs				**$ 16,119,548,991**	**$ 432,455,062**	

NET PRESENT COST (2005) OF 2010 CONTRACT TO REHABILITATE THE BRIDGE	**$**	**227,521,542**
NET PRESENT COST (2005) OF REHABILITATION CONTRACTS AND MAINTENANCE REPAIRS FROM 2010 TO 2110	**$**	**432,455,062**
TOTAL NET PRESENT COST (2005) TO EXTEND THE SERVICE LIFE OF THE GOETHALS BRIDGE TO 2110	**$**	**659,976,604**

Appendix A.3
Goethals Transportation Model (GTM) – Model Development and Travel Demand Forecast Report

TASK T.2 FORECASTS OF FUTURE TRAFFIC CONDITIONS AND ASSESSMENT OF ALTERNATIVE IMPROVEMENT STRATEGIES

GOETHALS TRANSPORTATION MODEL (GTM):

MODEL DEVELOPMENT AND TRAVEL DEMAND FORECAST

January 2008

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Goethals Transportation Model (GTM): Model Development and Travel Demand Forecasts

1.0 INTRODUCTION

The Port Authority of New York and New Jersey (Port Authority) has proposed to construct a new bridge to replace the Goethals Bridge, which crosses the Arthur Kill between Staten Island, New York, and Elizabeth, New Jersey. A United States Coast Guard (USCG) Bridge Permit, pursuant to the General Bridge Act of 1946, is required before construction can begin, since the proposed replacement bridge would cross navigable waters of the United Sates. The USCG, the federal lead agency, with cooperation of the Port Authority, the project sponsor, has undertaken preparation of an Environmental Impact Statement (EIS), pursuant to the National Environmental Policy Act (NEPA) of 1969. The EIS examines the potential social, economic, and environmental impacts of reasonable and feasible alternatives for replacement of the Goethals Bridge. The principal elements of the Goethals Bridge Replacement (GBR) EIS process include definition and analysis of alternatives, environmental documentation, and public outreach and interagency coordination.

In support of the GBR EIS studies, a travel demand forecasting model, the Goethals Transportation Model (GTM), has been developed to analyze existing and forecast future traffic and transportation conditions within the Goethals Bridge corridor and a broader New York/New Jersey regional study area. The GTM was developed specifically to provide the corridor-level detail required for the GBR EIS to analyze future conditions with and without the proposed project, as part of the environmental documentation related to No-Build and project alternatives.

The GTM was developed from the New York Best Practice Model (NYBPM or BPM), the travel demand model developed in recent years by the New York Metropolitan Transportation Council (NYMTC), which is the Metropolitan Planning Organization for the five counties comprising the City of New York and for Nassau, Suffolk, Westchester, Putnam and Orange counties. As a regional model for the downstate New York metropolitan area, the BPM encompasses 28 counties in New York, New Jersey, and Connecticut. Figure 1 depicts the 12 New York, 14 northern New Jersey, and 2 Connecticut counties that collectively comprise the region covered by the BPM.

Consistent with recent research and advancement in the field of travel demand modeling and forecasting, the BPM is considered a state-of-the-practice “activity-based” multi-modal travel demand model. Its highway and transit networks reflect the realistic topology of the transportation network (e.g., “map-like” highway links), employing full use of Geographic Information System (GIS) technology. Its use of “tour-based” journey production, combined with household synthesis and auto-ownership models, is a clear departure from and improvement over the traditional “un-linked trip-based” travel demand modeling approaches. The BPM’s travelers destination/travel mode/stop choice models are based on a fully nested logit model of discrete choice, estimated statistically based on the detailed survey of daily activity and travel conducted by 11,000 households in the region. Both the highway assignments and transit trip assignments employ capacity-constrained equilibrium assignment approaches.

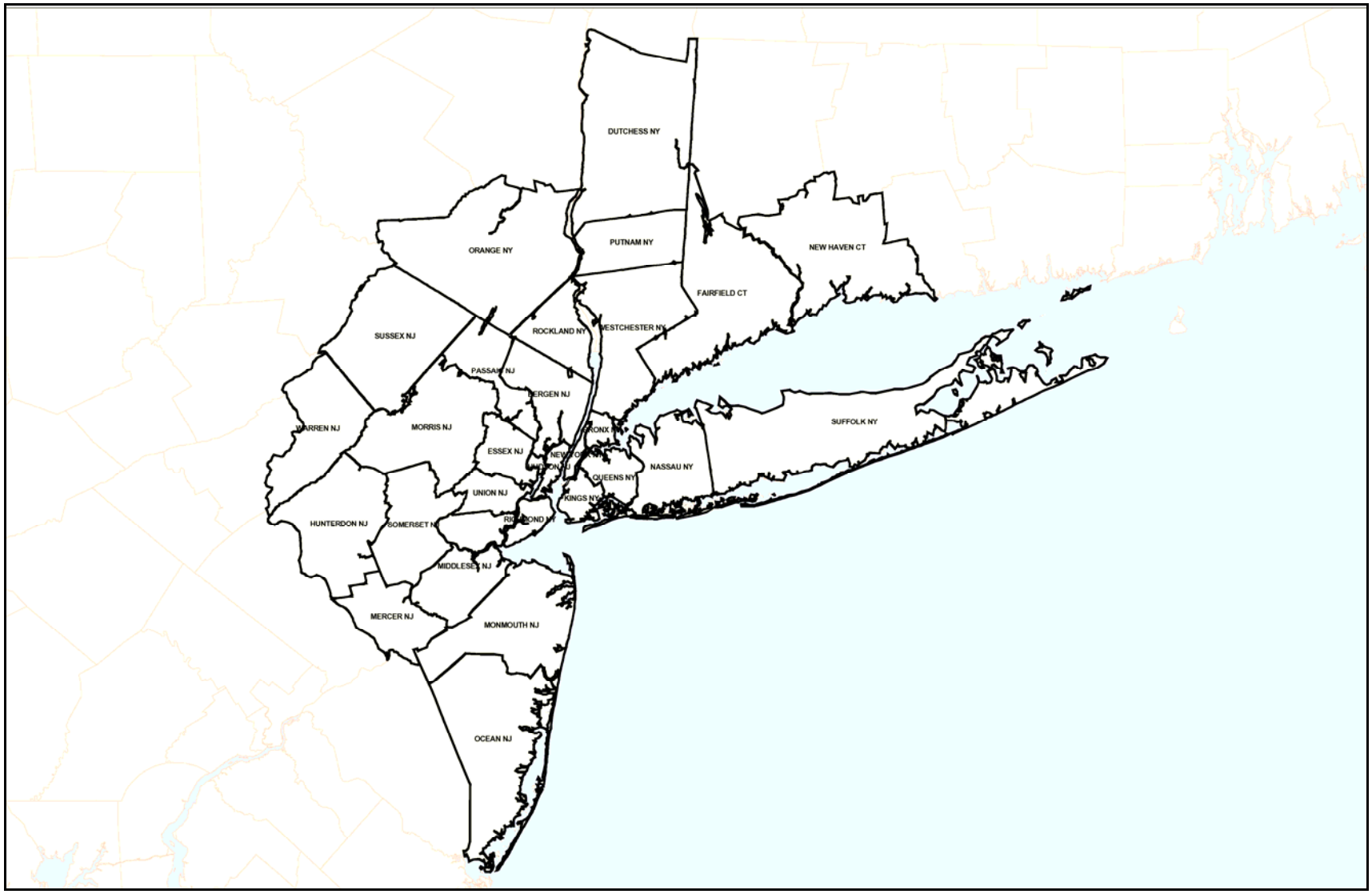
Originally developed by NYMTC in the late 1990s, the BPM was further updated by NYMTC to year 2002 conditions to reflect the prevailing socioeconomic characteristics of the region surveyed in 2000 U.S. Census data, as well as the observed impact on the region of the aftermath of the September 11, 2001, World Trade Center disaster [Ref. 1]. Since its creation, the BPM has served critical roles in NYMTC's regional travel demand analysis, including for conformity analysis and for Long Range Transportation Plan (LRTP) and Congestion Management System (CMS) development.

The GTM, the travel demand modeling system deployed for the forecasting and analysis needs of the GBR EIS, was developed based on the foundation of the BPM (i.e., 2002 Update version). The GTM incorporates additional enhancements and calibration measures in order to forecast future-year transportation needs and the performance of various transportation alternatives considered in the study. To support sub-regional and corridor-level resolution for purposes of travel analysis for the GBR EIS, the BPM was refined and further enhanced to more accurately represent travel characteristics for the corridor-level study area, particularly for trips involving interstate crossings of the downstate Hudson River and via the Staten Island bridges (i.e., Goethals Bridge, Outerbridge Crossing, Bayonne Bridge).

Chapter 2 of this report describes the model refinements and enhancements incorporated to create the GTM. The travel demand forecasts produced with the GTM for the GBR EIS analyses of future No-Build and project alternatives are presented in Chapters 3 and 4, respectively.

As the regional travel demand model developed for NYMTC, the BPM continues to be updated and enhanced as part of NYMTC's ongoing model improvement efforts. Currently (as of December 2007), NYMTC is undertaking "2005 Model Updates," which are scheduled to be released for general project applications by early 2008. The GTM, which was developed and deployed for the GBR EIS based on BPM 2002 updates (the most current BPM version available at the time of GTM development and application), does not reflect the additional model updates that will be part of the upcoming BPM 2005 Updates version. However, the GBR EIS study team tested certain previewed features of the 2005 BPM Updates (e.g., sensitivity of route selection to tolls in the highway trip assignment step) that may be pertinent to the GTM. On that basis, it has been concluded that the GTM, as developed and used for the GBR EIS, is an appropriate and adequate model for the purposes of this study. Appendix D describes the preview testing performed to reach this conclusion.

FIGURE 1:
COUNTIES INCLUDED IN NYMTC BPM REGION



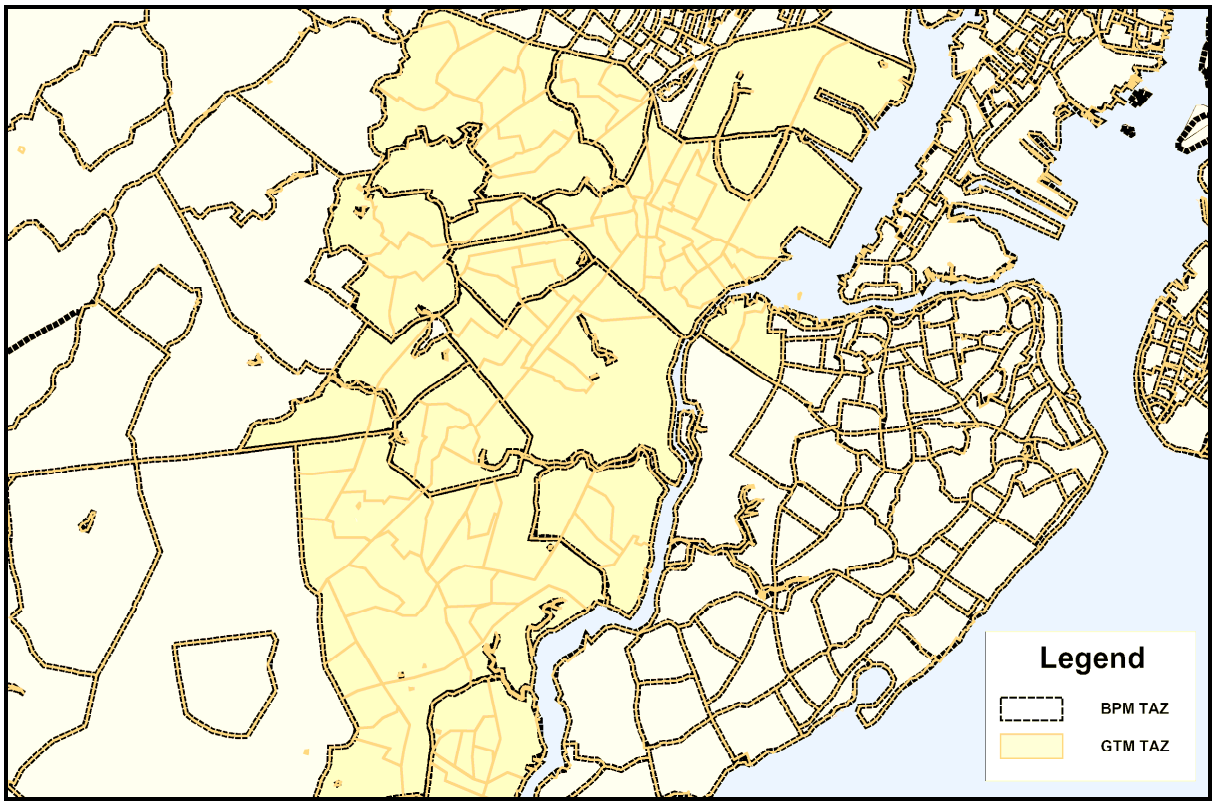
2.0 BASE YEAR MODEL DEVELOPMENT

The GTM was developed from the BPM to create a state-of-the-practice travel demand model appropriate for the interstate crossing analysis for the proposed Goethals Bridge Replacement project. The initial step in the GTM development process comprised a detailed review of the BPM and assessment of the feasibility of forecasting future travel demand for Port Authority crossing facilities using the BPM. Based on this review, refinements of the BPM were undertaken to create a model suitable for purposes of the detailed forecasting and evaluations required for the GBR EIS. Initial efforts produced a more refined transportation analysis zone structure for selected New Jersey counties, as well as significantly more detailed representation of the crossing facilities and the highways in New Jersey [Refs. 2 and 3]. Further GTM development efforts included various model improvements, such as more refined zonal socio-economic input data; explicit representation of New York and New Jersey seaport-related truck traffic (Howland Hook Marine Terminal, operated as the New York Container Terminal, Port Newark, Port Elizabeth) and of passenger traffic at Newark Liberty International Airport; and time-of-day toll modeling with differential tolls for various vehicle types and passenger occupancy. The refinements and enhancements embodied in the GTM are described in the following sections.

2.1 Transportation Analysis Zones

In general, the BPM employs U.S. census tracts as geographical boundaries for its transportation analysis zones (TAZ) for the boroughs of New York City. For the GBR EIS's primary analysis areas situated in New Jersey, Minor Civil Divisions (MCD) were used to define TAZ boundaries. As the MCD-based zonal geography was deemed insufficiently detailed for representation of the Goethals Bridge primary study area, the TAZ system for primary subareas in New Jersey's Union, Middlesex, and Essex counties was subsequently disaggregated and refined. Within the sub-region shown in Figure 2, which is bounded roughly by the Raritan River to the south, the Garden State Parkway to the west, and Route 22/ I-78 in New Jersey to the north, the North Jersey Transportation Planning Authority's (NJTPA) North Jersey Regional Travel Model (NJRTM) zone system was adopted and incorporated into the GTM system, with two exceptions. In the new GTM system, four zones were created (instead of two as in the NJRTM), for the Newark Airport and Port Elizabeth complex, separating areas along the Union/Essex county line (East-West), and by the New Jersey Turnpike (North-South). For the rest of this study's sub-area within New Jersey, 15 BPM zones were subdivided, and 113 new zones were created. In addition, a new zone was created on Staten Island to isolate the Howland Hook Marine Terminal. As a result of these changes, there was a net addition of 99 zones to the GTM version of the regional modeling system, creating a composite system with 3,685 zones, rather than the 3,586 zones used in the standard regional BPM.

FIGURE 2
DISAGGREGATED GTM TRANSPORTATION ANALYSIS ZONES (TAZ)
FOR PRIMARY SUBAREA IN NEW JERSEY



2.2 Highway Network

Within the same primary sub-area in New Jersey, several significant refinements in the simple "stick-network" coding of the BPM highway network were made to bring it to a similar level of GIS-based, uni-directional representation as in the New York part of the regional model's network. Network enhancements were also made for the three Staten Island bridges (Goethals Bridge, Outerbridge Crossing, Bayonne Bridge). Some examples of these enhancements are shown on Figures 3A, 3B, 4A and 4B.

The network refinement work to create the GTM from the BPM included the following:

- Obtained the latest NJRTM network through NJTPA;
- Obtained the latest TAZ layer information through NJTPA;
- Extended GIS conflation/dualization and added names for the New Jersey part of study area; detailed line-editing of the highway network for the major roads and interchanges in New Jersey in the sub-area -- the Garden State Parkway, New Jersey Turnpike, Route 440, Route 1/9, etc. -- was completed, with these facilities "dualized" and with ramps and interchanges more realistically represented;
- Revised "centroid connection" coding consistent with the revised, more detailed zone system discussed above;
- Created more detailed representation of the Port Authority's crossing toll policy, such as differential tolls for autos, trucks, and 3-person high-occupancy-vehicle (HOV3) vehicles, existing congestion pricing (e.g., peak period vs. off-peak periods), E-Z Pass discounts, and Staten Island resident discounts; and
- Included BPM link attributes in the primary study area.

In addition, reviews and rectification of the network, specifically for the key links relative to the GBR EIS studies, were performed. The highway network attributes considered for this purpose included: network connectivity and continuity, link travel directionality, number of lanes, capacity, speed, functional class, tolls, and usage restrictions (e.g., truck prohibitions, bus/HOV3+ requirement, etc).

2.3 Zonal Socioeconomic Data

While the NYMTC BPM includes zonal socioeconomic data for the 14 North Jersey counties located in its study area, more detailed and updated socioeconomic forecasts for these New Jersey counties are developed and maintained by the NJTPA, the Metropolitan Planning Organization for northern New Jersey. To further improve the travel modeling accuracy of the GTM for trips between New Jersey and New York, NJTPA's socioeconomic data for the zones located in New Jersey were adopted for the GTM. The latest NJTPA socioeconomic data, including both base (existing) and future-year forecasts, were obtained and incorporated into zonal data inputs for the GTM for the purpose of the GBR EIS studies. For the New York and Connecticut counties, the BPM socioeconomic data were retained for the GTM.

FIGURE 3A
REGIONAL BPM NETWORK CODING:
GOETHALS BRIDGE, NEW JERSEY TURNPIKE, AND RAMPS

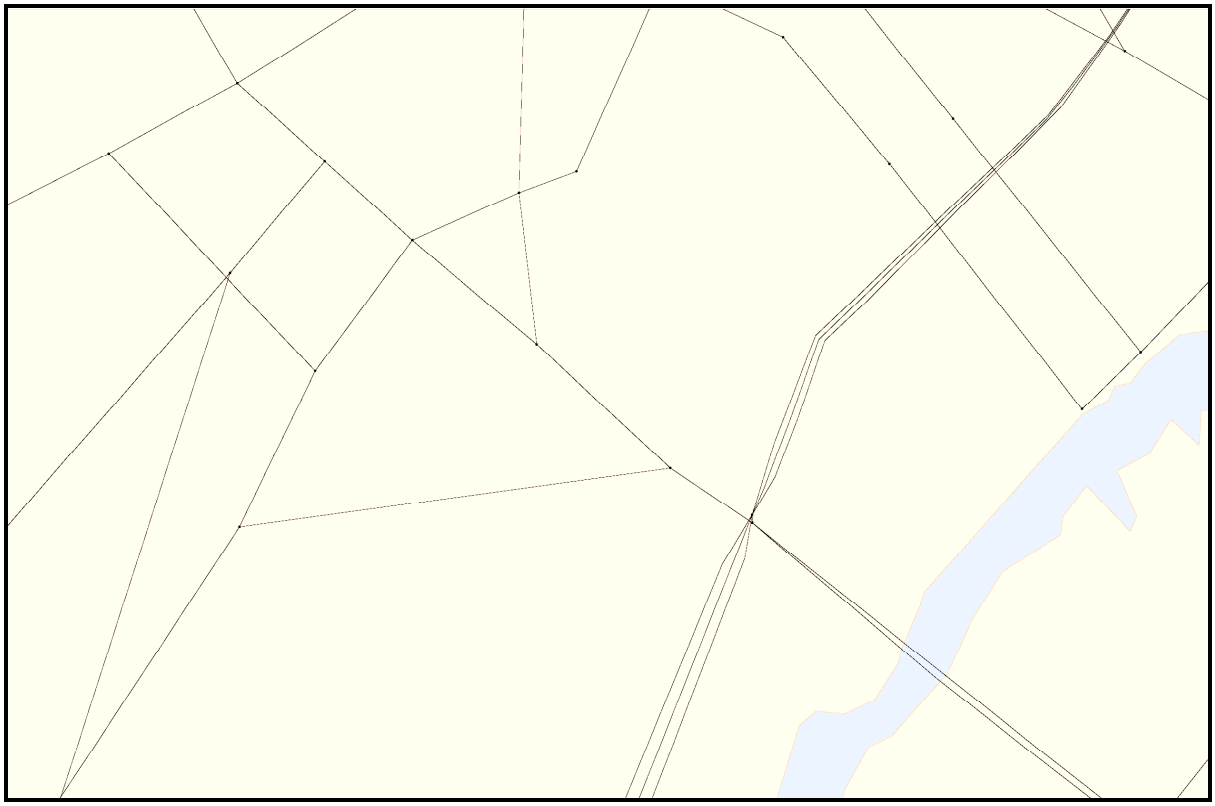


FIGURE 3B
ENHANCED GTM NETWORK:
DUALIZED GOETHALS BRIDGE, NEW JERSEY TURNPIKE, AND RAMPS

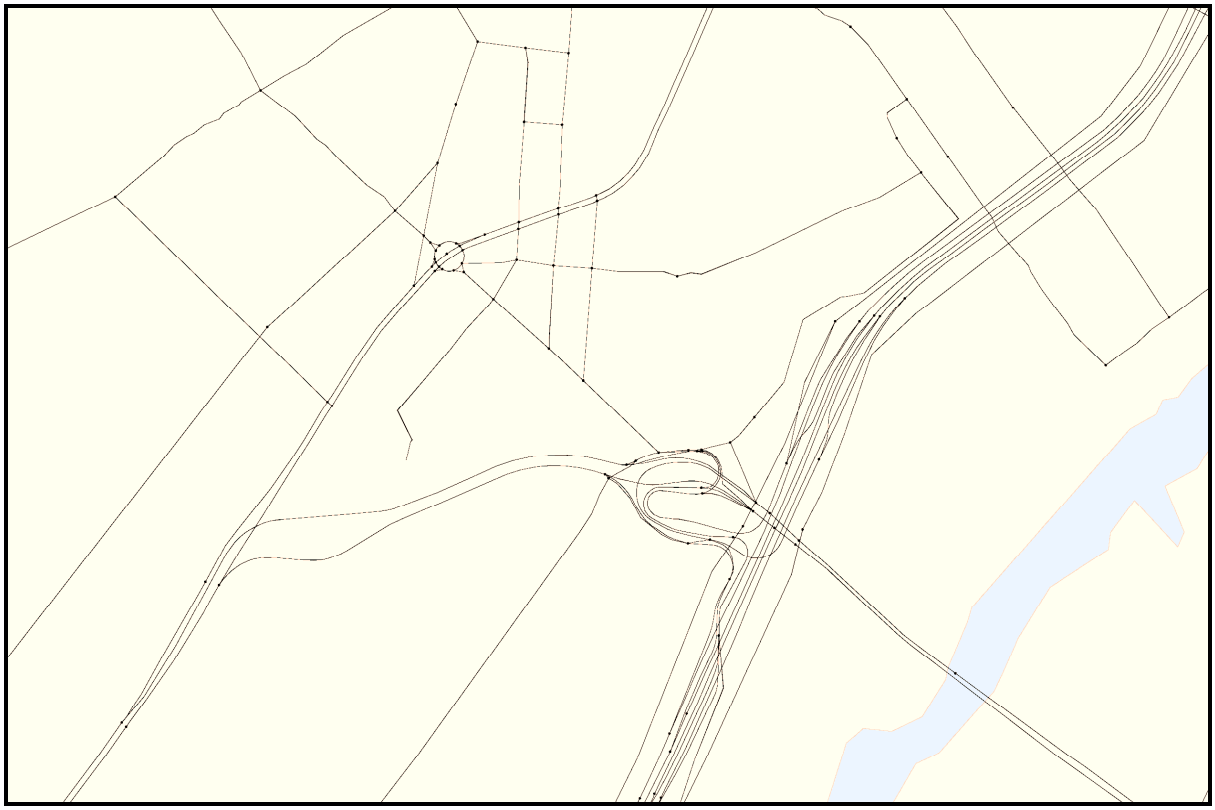


FIGURE 4A
REGIONAL BPM NETWORK CODING:
NEW JERSEY TURNPIKE/ROUTE 660 IN UNION COUNTY

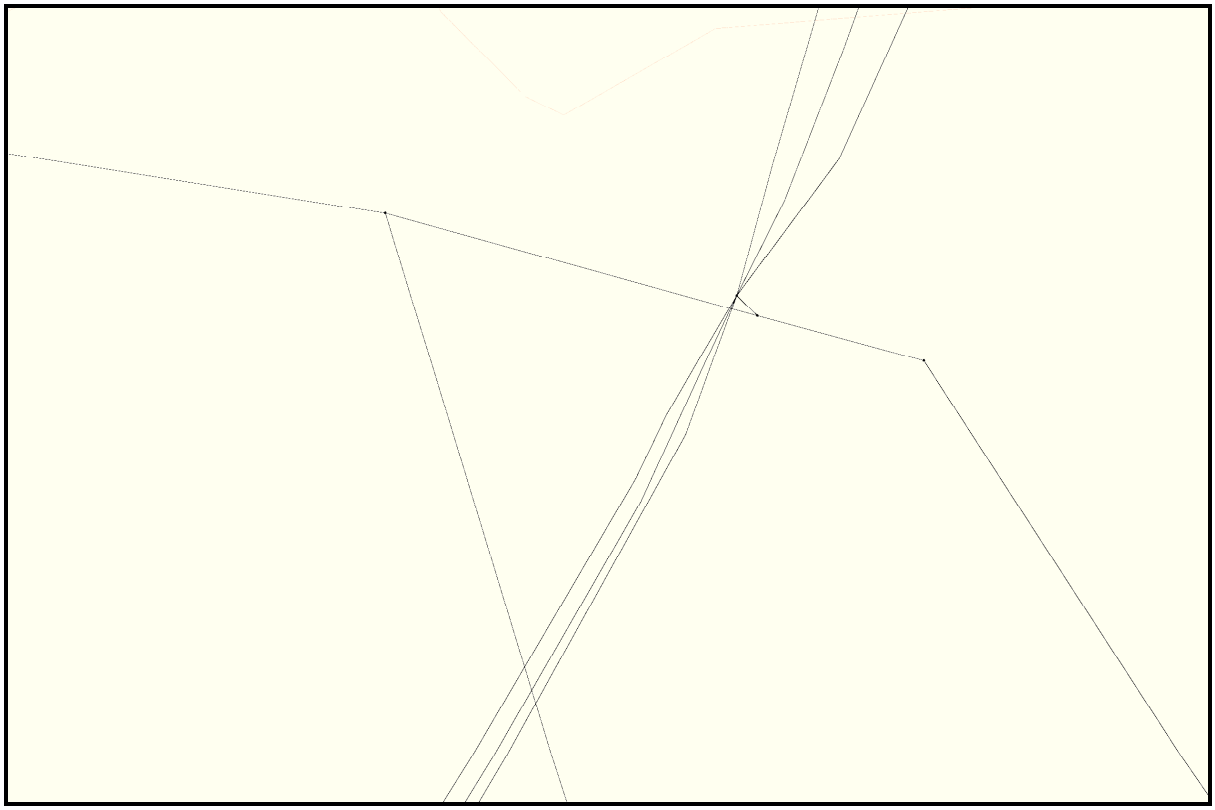
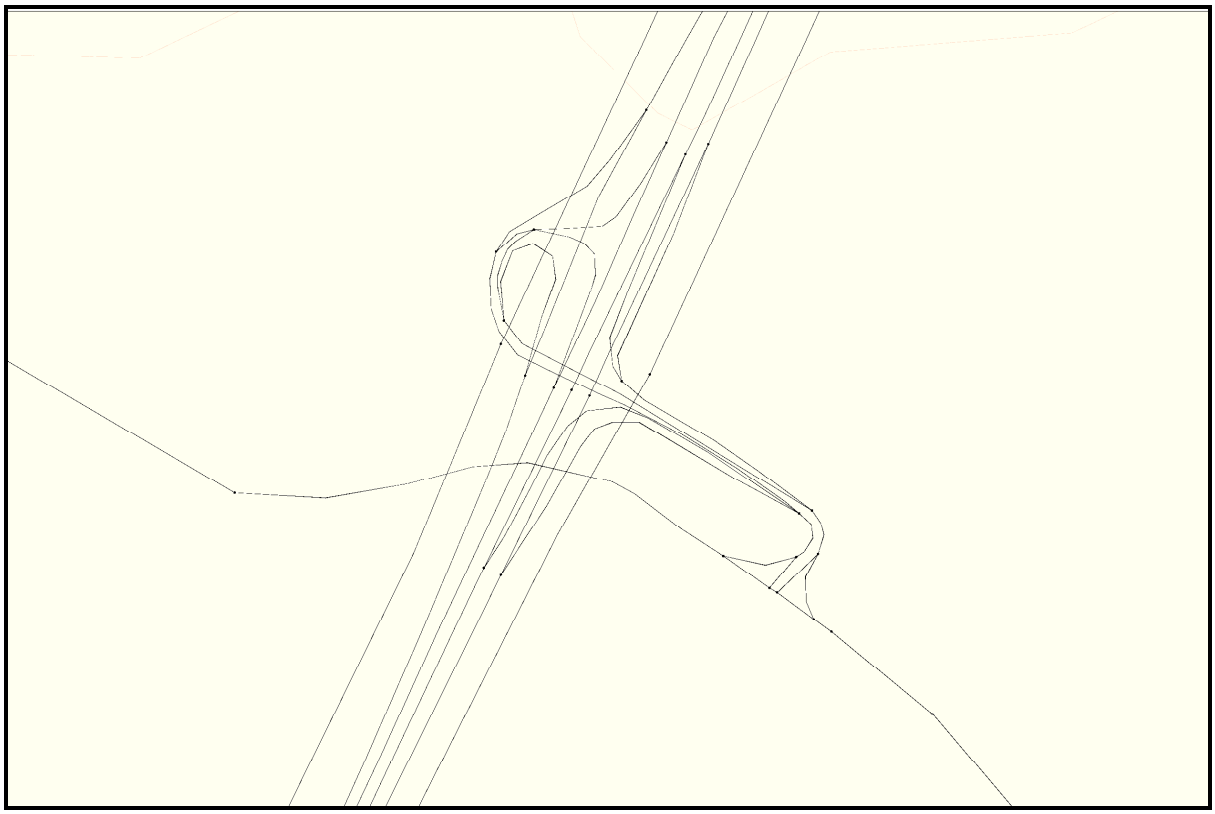


FIGURE 4B
ENHANCED GTM NETWORK:
NEW JERSEY TURNPIKE/ROUTE 660 IN UNION COUNTY



2.4 Special Trip Generators for New York and New Jersey Ports

The primary analysis area for the GBR EIS studies is home to major New York and New Jersey port terminals, including Howland Hook Marine Terminal (operated as New York Container Terminal), Port Newark, Port Elizabeth, Global/NEAT/BMW, and North Brooklyn/Red Hook/South Brooklyn. To provide more detailed and accurate reflection of the truck trips generated by these ports, a special trip generator model was developed and incorporated in the GTM [Ref. 4: Appendix A]. This port trip model was based on data from the Port Authority's Port Commerce Department, as well as on information developed for the Comprehensive Port Improvement Plan (CPIP) for the Port of New York and New Jersey, a multi-agency-sponsored planning study completed in 2006 that is intended to serve as a framework for planning and implementation of future port and associated transportation investments to support forecasted cargo volume growth in the Port.

2.5 Special Trip Generator for Newark Liberty International Airport

Another important and unique major trip generator found in the study area is Newark Liberty International Airport. A special trip generation model was developed and incorporated in the GTM to properly represent ground access travel for air passenger trips to/from Newark Airport. The model's initial air travel demand estimates were created based on a 1998 Newark Airport survey of departing passengers and were subsequently expanded and updated to represent base-year and projected future-year airport trip generation [Ref. 4: Appendix A].

2.6 Modeling of Response to Time-of-Day Differential Tolls

The Port Authority's toll program and policy for its crossings have become an increasingly advanced and sophisticated system since its inception. The current program features cash or EZ Pass payment, discounts for HOV3+ and for Staten Island residents, higher tolls for trucks, and congestion pricing (peak period vs. off-peak period). To represent this toll policy in the travel demand model, GTM was updated to accommodate differential time-of-day tolls. This expanded capability allows levying of differential tolls on single-occupant vehicles (SOV). HOV2, HOV3+, and trucks, as well as varying tolls for different time-of-day periods [Ref. 5: Appendix B].

The technical memorandum provided in Appendix B to this report describes the data, assumptions and methods used to add a sensitivity of travel demand with respect to time-of-day (TOD) tolls to the GTM. This was done to enable evaluation of congestion pricing as a potential Transportation Demand Management (TDM) alternative to the proposed Goethals Bridge replacement. The new TOD component of the GTM was specifically designed for use in the testing of potential time-of-day toll policies at all Port Authority interstate crossings, as part of TDM alternatives considered during the GBR EIS studies.

Prior to implementation of this GTM model enhancement, the forecasting of travel responses to changes in tolls recognized only average daily tolls for autos and trucks, which resulted in shifts

in destination/mode choice and route (or assignment) choice[1]. With the TOD component added to the GTM, a shift in demand between the four time periods of the day can also be forecast as a response to changes in travel costs, including variable tolls, as well as to travel times and level-of-service conditions during each time period.

The main method used to incorporate this capability in the GTM was the development and validation of a TOD procedure that adjusts the otherwise fixed set of diurnal distributions (percent of daily travel by 1/2 hour) of trips produced by the model, stratified by travel purpose, mode and general origin-destination categories. Incremental changes to these "time-maps," originally derived from the NY-NJ Regional Travel – Household Interview Survey (RT-HIS), are made with the TOD model based on time and cost network inputs and simulation by time period, and the estimated time-of-day switching for behavioral sensitivities incorporated in the model. In the current implementation of the GTM TOD model, the coefficients for time and cost for TOD shifting were adopted from the previously estimated GTM mode and destination choice models. As part of the model testing and validation stage, several additional scaling factors were explored and are reported here.

The validation of the new TOD choice model component with respect to estimation of the impact of congestion pricing was done by comparison of its estimates with observed sensitivities, as reported by the Port Authority, that occurred with the introduction of peak-period surcharges as part of the agency's March 2001 toll increase. While a complete and direct validation of the sensitivity of the new TOD model implemented for the GTM is not possible with the available data, the general comparison does confirm that the model forecasts a reasonable and correct magnitude of time-of-day response to variable road pricing.

2.7 Base-Year Model Calibration

With the refinements and enhancements made to its various components, the GTM was further calibrated to represent the current travel patterns of the study area within a reasonable degree of accuracy. Initially, the GTM modeling was applied to produce the full travel characteristics of the traveler's choice behavior within the study area. The chain of travel demand modeling steps includes a full representation of area households, with their detailed household composition, socioeconomic attributes, and auto ownership profiles; the production of daily tours (with an option of stops) undertaken by each household member; travelers' trip destination and mode choice decisions; the diurnal distribution of the trips; and travelers' route choices made over the highway and transit system networks with capacity constraints. The initial modeling results were carefully compared with the empirical traffic and travel data compiled to represent the study area's base-year travel conditions.

Based on the comparison of model outputs with observed data, model calibration was performed to more accurately represent the prevailing travel characteristics of the study area for weekday AM and PM peak periods (6:00 - 10:00 AM and 4:00 - 8:00 PM, respectively). This calibration effort was structured in a hierarchical way to produce logical, incremental, and cumulative

[1] The GTM includes a sensitivity to tolls in the mode, destination, and time-of-day components of the model. As noted in Section 1.0 Introduction, sensitivity to tolls in the assignment step will be enabled as part of NYMTC's BPM 2005 Updates version, using TransCAD 4.8.

improvement throughout the calibration process. The first stage of calibration was focused on the development of reasonably accurate person-trip interchanges between the counties pertinent to the interstate crossing trips. The effort was guided by the use of Port Authority interstate crossing traffic volumes, as well as the U.S. Census journey-to-work data of estimated flows between counties. The county-to-county factors of the model were reviewed and appropriate refinements were made iteratively to improve accuracy of the model's inter-county person trips.

The second stage examined the travel mode-share characteristics of the model's inter-county trips compared with current travel conditions. The mode-choice factors of the GTM were reviewed and limited refinements were incorporated to further improve the comparison between the model's travel-mode forecasts and the empirical travel data.

The third stage of the calibration involved a very detailed review of the GTM highway trip-assignment results and iterative rectification, refinements, and enhancements of the network system and its attributes. This effort was focused on the Port Authority's interstate crossings and their highway interchange systems, highway roadway components pertinent to this study (e.g., Bay Way Circle), and other critical local roadway locations, such as air quality analysis sites. Throughout the calibration efforts, caution was exercised to limit these calibration adjustments to moderate levels so that the model would retain appropriate levels of travel-choice sensitivity to various changes in the model's demand and supply inputs.

Table 1 presents summary statistics of the GTM base-year calibration results. The comparison of total crossing volumes between observed traffic counts and the model-assigned demand volumes, shown in the two bottom rows of the table, indicates the latter are similar to the former. The difference between them ranges from 3 to 8 percent. Such differences, i.e., of less than 10 percent, are generally considered successful calibration results for these types of facilities.

An important validation consideration is how the prevailing travel peaking characteristics are represented by the model. In the AM peak period, the eastbound direction represents the peak travel direction for most Port Authority crossings, with the exception of the Goethals Bridge, where the AM peak direction is westbound towards New Jersey, and of the Bayonne Bridge, where the AM peak direction is northbound. An examination of the model-assigned crossing volumes for the AM peak period indicates that the GTM generally replicates current peak directionalities. The difference between the observed traffic counts and the assigned demand volumes for the AM peak direction at the Goethals Bridge is about 3 percent. Other Port Authority crossings exhibit differences of generally less than 10 percent for the AM peak direction, except for the Holland Tunnel and the Bayonne Bridge. For the PM peak period, the westbound direction represents the peak travel direction for most Port Authority crossings, except for the Goethals Bridge, where the peak direction is towards Staten Island, and the Bayonne Bridge, where the PM peak direction is southbound. A review of the model-assigned crossing volumes for this peak period shows that the GTM generally replicates current PM peak directionality. The difference between the observed and the assigned volumes for the PM peak direction at the Goethals Bridge (i.e., eastbound) is about 1 percent. Other Port Authority crossings exhibit a difference of generally less than 10 percent, except for the Bayonne Bridge, which carries very low volumes; such small volume differences translate to larger percentage differences than at the other crossings.

TABLE 1:
GOETHALS TRANSPORTATION MODEL (GTM) - BASE YEAR (2002) CALIBRATION OBSERVED TRAFFIC VOLUME COUNTS VS. ASSIGNED DEMAND VOLUMES

Crossing Facilities	Travel Direction	Traffic Volume Counts Peak Period AM (6 to 10)	Traffic Volume Counts Peak Period PM (4 to 8)	Assigned Demand Volume Peak Period AM (6 to 10)	Assigned Demand Volume Peak Period PM (4 to 8)	Differenc (2) Peak Period AM (6 to 10)	Differenc (2) Peak Period PM (4 to 8)	% Difference (3) Peak Period AM (6 to 10)	% Difference (3) Peak Period PM (4 to 8)
Outerbridge Crossing	EB	10,415	10,723	10,225	7,332	-190	-3,391	-2%	-32%
	WB	8,488	9,777	8,343	11,079	-145	1,302	-2%	13%
Goethals Bridge	EB	7,184	11,104	9,535	10,989	2,351	-115	33%	-1%
	WB	9,954	8,433	10,232	10,335	278	1,902	3%	23%
Bayonne Bridge	SB	1,873	4,477	1,726	5,268	-147	791	-8%	18%
	NB	3,054	1,628	4,266	1,879	1,212	251	40%	15%
Holland Tunnel	EB	10,917	10,936	12,922	9,294	2,005	-1,642	18%	-15%
	WB	10,029	12,630	8,609	14,277	-1,420	1,647	-14%	13%
Lincoln Tunnel	EB	19,414	9,924	20,146	10,582	732	658	4%	7%
	WB	8,609	22,685	9,317	22,671	708	-14	8%	0%
George Washington Bridge	EB	40,283	35,605	40,313	32,849	30	-2,756	0%	-8%
	WB	34,361	42,081	33,506	41,167	-855	-914	-2%	-2%
Verrazano Narrows Bridge	EB	32,269	24,507	35,653	18,091	3,384	-6,416	10%	-26%
	WB	16,840	29,743	14,479	35,819	-2,361	6,076	-14%	20%
Tappan Zee Bridge	EB	23,210	15,129	22,979	15,459	-231	330	-1%	2%
	WB	17,947	16,764	15,692	21,918	-2,255	5,154	-13%	31%
TOTAL (1)	EB	113,296	97,898	117,844	91,773	4,548	-6,125	4%	-6%
	WB	92,442	113,998	89,965	123,326	-2,477	9,328	-3%	8%

Notes: (1) Represents the Hudson River Crossing & Staten Island Bridge Traffic Volume, excluding Verrazano Narrows Bridge traffic.

(2) Difference between the observed traffic volume counts and the GTM assigned demand volumes (= Assigned Demand - Observed volume).

(3) Percentage difference between the observed traffic volume counts and the GTM assigned demand volumes.

The differences between the observed counts and the model-assigned volumes are somewhat larger for off-peak directions of crossings than those for the peak directions. These differences range from 3 to 33 percent[2]. This deviation exhibited in the off-peak directional crossing trips, which are larger than those of the peak period, are not unexpected as the off-peak-period direction generally represents lower traffic volumes than those of the peak direction. In general across all of the Hudson River crossings, the assignment differences are less than 10 percent in both the peak and off-peak directions. The peak direction has a better fit between observed counts and model-assigned volumes for each facility, while the off-peak direction has a good fit overall but the trips are distributed differently across the various crossings. These off-peak differences between observed counts and modeled volumes by bridge are reduced in the future forecasts through the use of incremental differences in the assignments (see discussion in Section 3.3 of this report).

Overall, the comparison of the base-year modeling results with the observed counts indicates that the GTM generally replicates the prevailing travel conditions of the study area, particularly the interstate crossing trips that are critical to the GBR EIS studies, with a reasonable degree of accuracy.

[2] The 40 percent difference shown for the Bayonne Bridge in the AM peak period reflects the bridge's overall lower volumes. While the magnitude of the absolute volume difference on the Bayonne is in line with differences on several other bridges, it computes as a higher percentage due to the Bayonne Bridge's low overall volumes, compared to the other bridges.

3.0 FUTURE TRAVEL DEMAND FORECAST – NO BUILD ALTERNATIVE

The GTM for future-year (2030[3]) travel demand forecasting was developed by updating the base-year calibrated GTM to reflect changes anticipated in the region in terms of zonal and areawide socioeconomic characteristics, transportation (both highway and transit) system networks and services, and transportation policy. As the downstate regional travel demand model, the future-year (2030 No-Build) BPM already identified and incorporated expected future changes pertinent to future year travel demand modeling. While the future-year GTM adopted most of these anticipated changes from the 2030 BPM, further updating in selected areas of the model was performed for the purposes of GBR EIS studies. The following section briefly describes these additional updates applied to the GTM in order to develop future-year travel demand forecasts.

3.1 Future Zonal Socioeconomic Forecast Data

Similar to the base-year model development, the future-year GTM zonal socioeconomic data for the counties in New Jersey are based on the socioeconomic forecasts obtained from the NJTPA. The NJTPA forecast data were geographically transformed to be consistent with the zonal structure employed in the GTM.

For the rest of the GTM area, the 2030 socioeconomic forecast data embedded in the BPM were retained for the future-year GTM, with one exception. A detailed review of the employment growth forecast used for Staten Island in the BPM indicated that this employment forecast may embody overly optimistic growth projections. Based on discussions with NYMTC, the New York City Economic Development Corporation, and the Port Authority, a more realistic "moderate" forecast of employment growth projections were developed for Staten Island. This moderate forecast of employment growth was further processed to produce zonal employment growth, considering the following information for Staten Island: the latest alternate county-level employment forecast, known and planned development activity, sub-area and zone-level development potential, as-of-right development potential for the former GATX property, as defined by the developers of the then-proposed NASCAR complex, and existing land use patterns [Refs. 6 and 7: Appendix C].

3.2 Future Transportation System Networks and Services

The future transportation network and services for the GTM were initially developed by updating the model's base-year network, based on the future network changes incorporated into the BPM 2030 No-Build transportation network. This initial network was further updated to include additional planned (or already implemented, after 2002) transportation improvements for the study area, as identified during the GBR EIS studies. These additional future highway and transit system improvements reflected in the future No-Build GTM include:

[3] For purposes of the GBR EIS, the future analysis year is the estimated time of completion (ETC) + 20 years, i.e., 2010 + 20 = 2030. During preparation of the GBR EIS, the ETC was revised to 2014; therefore, the future analysis year for which the potential impacts of alternatives are being analyzed in the GBR EIS is 2034. Consequently, GTM output for year 2030 was adjusted through post-processing to reflect forecasts for 2034.

- West Shore Expressway Service Road from Staten Island Expressway interchange to Victory Boulevard;
- New Jersey Turnpike Exit 12 reconstruction project;
- High Speed EZPASS at the Outerbridge Crossing;
- Staten Island (North Shore) Railroad reactivation for freight rail, providing freight rail service and intermodal capability to the Howland Hook Marine Terminal;
- Staten Island Expressway (SIE) median Bus Lane between the Verrazano-Narrows Bridge and Slosson Avenue;
- Newark City subway extension to Newark Broad Street station;
- Elizabeth Ferry Terminal and service;
- Ferry service between The Peninsula at Bayonne Harbor (formerly the Marine Ocean Terminal Bayonne) to Pier 11 in Lower Manhattan;
- Ferry service between South Amboy and Lower Manhattan;
- Howland Hook Marine Terminal build-out, including Parcel "C," represented in the GTM by most-recent truck forecasts provided by the Port Authority-Port Commerce for use in the GTM truck trip table;
- Detailed toll structure for the Staten Island Bridges (SIB) embedded in the GTM, as follows:
    - Cash Auto - $6.00
    - Peak EZPASS - $5.00
    - Off-Peak EZPASS - $4.00
    - HOV - $1.00
    - SIB - $2.50
- Detailed toll structure for SIB also included for trucks.

3.3 Forecast Travel Demand – 2030 No-Build

The future No-Build travel characteristics of the study area were developed by applying the GTM with zonal socioeconomic data and transportation networks updated for future-year 2030, as described above in Sections 3.2 and 3.3. To improve the overall accuracy of the future travel demand forecast for sub-regional analysis (e.g., with focus on facility-level travel demand forecasting), "incremental" post-processing procedures were employed to develop future travel demand for the crossing facilities, as well as for the traffic impact analysis sites of the GBR EIS' traffic studies. In essence, this approach forecasts future total demand by first forecasting the incremental changes in travel demand from base year to future year (based on GTM model assignment outputs) and then superimposing these changes on the actual traffic volume counts established for the project's base-year traffic condition. By having the model focus on forecasting the expected change in travel demand, rather than the total demand, the incremental forecasting approach significantly improves the accuracy of all the scenarios considered studying the GBR EIS studies. In general, the consistent incremental post-processing performed for all scenarios (base year, no-build, build, build with mitigation) tends to minimize the margin of error that may be associated (either inherently or inadvertently) with very complex regional travel demand models, such as the GTM. The incremental post-processing procedures were employed for the development of travel demand for peak periods, as well as for peak hours.

Table 2 presents the forecast future No-Build travel demand, post-processed and summarized for the Port Authority interstate crossings for the AM and PM peak periods. (More detailed forecasts of peak-hour travel demand volumes were also developed and are reported in Chapter 5.0 of the GBR EIS.) As shown in Table 2, the travel demand for the Goethals Bridge by year 2030 is expected to grow by 37 to 46 percent for travel originating in counties west of the Hudson River, and by 14 to 18 percent for travel originating in Staten Island and further east. The other two of the Port Authority's Staten Island Bridges (i.e., Outerbridge Crossing and Bayonne Bridge) are also expected to experience similar, albeit somewhat lesser, levels and patterns of travel demand growth in the future. The overall level of travel demand growth forecast for the three Staten Island Bridges is expected to be higher than that forecast for other Port Authority Hudson River Crossings (i.e., Holland Tunnel, Lincoln Tunnel, and George Washington Bridge). This uneven growth forecast for these Port Authority crossings is deemed to be consistent with the level of future socioeconomic (e.g., households, employment, etc.) growth expected for Staten Island, which is forecast to be substantially higher than for the other NYC boroughs and western New Jersey counties in the study area. Peak-hour post-processed forecasts were prepared for 2034, for use in the traffic impact studies for the GBR EIS, using a smaller continued growth, which amounted to less than 1 percent per year from 2030 to 2034.

TABLE 2:
FORECAST FUTURE NO-BUILD (2030) TRAVEL DEMAND COMPARED TO BASE-YEAR OBSERVED TRAFFIC VOLUMES

Crossing Facilities	Travel Direction	Base Year (2002) Traffic Volume Counts Peak Period		Future No Build (2030) Forecast Demand Volume Peak Period		Change (2) No Build - Base Year Peak Period		% Change (3) No Build - Base Year Peak Period	
		AM (6 to 10)	PM (4 to 8)	AM (6 to 10)	PM (4 to 8)	AM (6 to 10)	PM (4 to 8)	AM (6 to 10)	PM (4 to 8)
Outerbridge Crossing	EB	10,415	10,723	14,120	13,088	3,705	2,365	36%	22%
	WB	8,488	9,777	10,830	13,136	2,342	3,359	28%	34%
Goethals Bridge	EB	7,184	11,104	10,490	12,704	3,306	1,600	46%	14%
	WB	9,954	8,433	11,746	11,541	1,792	3,108	18%	37%
Bayonne Bridge	SB	1,873	4,477	2,794	6,050	921	1,573	49%	35%
	NB	3,054	1,628	3,947	2,368	893	740	29%	45%
Holland Tunnel	EB	10,917	10,936	12,427	12,024	1,510	1,088	14%	10%
	WB	10,029	12,630	11,186	13,938	1,157	1,308	12%	10%
Lincoln Tunnel	EB	19,414	9,924	21,831	10,744	2,417	820	12%	8%
	WB	8,609	22,685	9,697	24,783	1,088	2,098	13%	9%
George Washington Bridge	EB	40,283	35,605	49,250	37,551	8,967	1,946	22%	5%
	WB	34,361	42,081	38,486	50,176	4,125	8,095	12%	19%
Verrazano Narrows Bridge	EB	32,269	24,507	39,590	26,963	7,321	2,456	23%	10%
	WB	16,840	29,743	19,046	36,271	2,206	6,528	13%	22%
Tappan Zee Bridge	EB	23,210	15,129	27,037	17,009	3,827	1,880	16%	12%
	WB	17,947	16,764	19,454	21,464	1,507	4,700	8%	28%
TOTAL (1)	EB	113,296	97,898	137,949	109,172	24,653	11,274	22%	12%
	WB	92,442	113,998	105,346	137,406	12,904	23,407	14%	21%

Notes: (1) Represents the Hudson River Crossing & Staten Island Bridge Traffic Volume, excluding Verrazano Narrows Bridge traffic.

(2) Represents the change in travel demand from Base Year (2002) to future No Build (2030)

(3) Represents the percentage change in travel demand from Base Year (2002) to future No Build (2030).

4.0 FUTURE TRAVEL DEMAND FORECAST – BUILD ALTERNATIVE

During the alternatives screening phase of the GBR EIS studies, preliminary project alternatives were identified and assessed, employing an early version of the GTM, which was available at that time. Based on the alternatives screening process, four 6-lane bridge-replacement alternatives were advanced for detailed evaluation in the GBR EIS. The refined GTM, as described in Chapter 2.0 of this report, was used to model the four project alternatives. While representing different alignments[4], the four project alternatives are the same in terms of capacity, as each comprises three general-use lanes in each direction of travel, and connect to the same termini, i.e., New Jersey Turnpike Interchange 13 to the west and the Staten Island Expressway to the east. Consequently, the future travel demand forecast and resultant future traffic conditions projected with each of the four project alternatives are the same This chapter presents the future travel demand forecast for the 6-lane bridge-replacement alternatives, and also presents the travel demand forecast results for the 6-lane bridge-replacement alternatives supplemented with a managed lane as a potential mitigation measure for the project alternatives' impacts.

The future travel demand for the build alternatives was developed by:

- updating the future No-Build GTM transportation networks to represent the additional capacity of the bridge-replacement build alternatives;
- developing multi-modal, time period-specific trip tables, employing core submodels of journey frequency and destination/mode/stop choice; and
- conducting capacity constraint equilibrium trip assignments.

Similar to those of the No-Build alternative, the finalized travel demand forecasts for the project alternatives were developed based on "incremental" post-processing of the future travel demand, briefly described in Chapter 3.0.

4.1 Forecast Travel Demand - 6-Lane Bridge-Replacement Alternatives

The four bridge-replacement alternatives are designed to provide a total of six general-use travel lanes (three in each direction) on the Goethals Bridge. While their alignments vary, they are the same for the purpose of travel demand modeling. To fully reflect this "Build" alternative in the demand analysis, the number of lanes of the Goethals Bridge links in the GTM highway network was updated to represent a total of six lanes, and their capacity was also increased (by about 100 vehicles per lane per hour). The lane capacity increase was incorporated to reflect the standard design features of the proposed new Goethals Bridge (e.g., full lane width of 12 feet, full-width shoulders, etc.) based on review of the Highway Capacity Manual (HCM) published by the Transportation Research Board [Ref. 8]. Using the updated transportation network, the GTM

[4] Each of the four bridge-replacement alternative's alignment is either within and extending north or south of the existing Goethals Bridge alignment or located entirely north or south of the existing bridge's alignment. These four project alternatives are named as follows in the GBR EIS: Existing Alignment – South; New Alignment-South; Existing Alignment – North; and New Alignment – North.

modeling was conducted, employing full chain of GTM submodels, including travel destination/mode/stop choice, time-of-day distribution, and equilibrium trip assignments, and incremental post-processing. The post-processing included development of 2034 AM and PM peak-hour volumes for use in the traffic impact analyses for the GBR EIS.

Table 3 presents the forecast future travel demand for the 6-lane bridge-replacement alternatives, as post-processed and summarized for the Port Authority interstate crossings for the AM and PM peak periods. (More detailed forecasts of peak-hour travel demand volumes were also developed and are reported in Chapter 5.0 of the GBR EIS.) As shown in Table 3, the travel demand for the 6-lane Goethals Bridge is expected to be higher than in the future No-Build condition (i.e., with four lanes, two in each direction, as currently exists on the Goethals Bridge) by 28 to 37 percent. As the 6-lane bridge-replacement alternative would accommodate a higher share of the crossing travel demand, due to the additional capacity provided by the proposed new bridge, travel demand at the parallel Outerbridge Crossing is forecast to be moderately reduced, by 3 to 9 percent. A mixed effect is expected at the Bayonne Bridge, with a 1 to 6 percent reduction in travelers originating from north of the bridge and a 4 to 7 percent increase in travelers originating south of the bridge. The effects of the proposed 6-lane Goethals Bridge at other PANYNY crossings are expected to be relatively small reductions in travel demand, ranging from 0 to 2 percent (see Table 3).

4.2 Forecast Travel Demand - 6-Lane Bridge-Replacement Alternatives with Managed Lane (ML) Option

A Managed Lane option was defined and evaluated to determine its potential utility to mitigate significant traffic impacts that would result with the 6-Lane Bridge-Replacement alternatives evaluated in the GBR EIS. While the ML option is also configured to provide a total of six travel lanes (three in each direction) on the Goethals Bridge, it has some key differences with the proposed bridge-replacement alternatives, as follows:

- Managed Lanes on Goethals Bridge --- Of the six travel lanes, two lanes (one in each direction) would be designated as managed lanes, which would be available only to public transit (e.g., Bus Rapid Transit, or BRT) and HOVs with three or more vehicle occupants. The remaining four lanes (two in each direction) would be available to general traffic without use restriction;

- Managed Lane on the Staten Island Expressway (SIE) – For the purpose of analyzing the Managed Lane option, it was assumed that two managed lanes (one new lane constructed in each direction) would also be in place on the entire length of the Staten Island Expressway in the future. Moreover, it was assumed that the managed lanes on the Goethals Bridge would be coordinated with and connected to the SIE managed lanes to form a continuous managed lane corridor with an approximate total length of 8 miles from the western end of the Goethals Bridge to the western beginning of the Verrazano Narrows Bridge[5];

[5] The New York State Department of Transportation is undertaking two studies of the SIE bus lanes' operations and traffic performance to determine whether to extend the facility and/or modify its use. The initial study will go evaluate the SIE as far west as Richmond Avenue and is scheduled to be completed in January 2009. A second study will examine the SIE section to the Goethals Bridge and is not expected to start before Spring 2009, with possible construction in 2017/2018.

- Deployment of new Express Bus Service – For the Managed Lane option, it was assumed that new Express Bus service would be provided for travelers in the study area. The transit system assumed as part of the ML option is similar to that modeled for the BRT System during the alternatives screening process to select project alternatives for detailed analysis in the GBR EIS. The bus system routes were designed to serve trips primarily between Staten Island/Brooklyn and western New Jersey counties. Appendix E of this report provides a detailed description of the BRT system assumed with the ML option.

To fully reflect this Managed Lane option in the demand analysis, the number of lanes of the Goethals Bridge links in the GTM highway network was updated to represent a total of four general-use travel lanes and two managed lanes (one in each direction), with the managed lanes open only to public transit and HOVs with three or more vehicle occupants. Similar to the 6-Lane Bridge-Replacement alternatives, the per-lane capacity was also increased (by about 100 vehicles per lane per hour) to reflect full lane width of 12 feet and other standard design features. Using the updated transportation network, the GTM modeling was conducted, employing full chain of GTM submodels, including travel destination/mode/stop choice, time-of-day distribution, and equilibrium trip assignments and incremental post-processing. The post-processing included development of 2034 AM and PM peak-hour volumes for use in the traffic impact studies for the GBR EIS.

Table 4 presents the forecast future travel demand for the 6-Lane Bridge-Replacement alternative with implementation of the Managed Lane option as a mitigation measure, post-processed and summarized for the Port Authority interstate crossings for the AM and PM peak periods. (A more detailed forecast of peak-hour travel demand volumes was also developed and is reported in Chapter 5.0 of the GBR EIS.) As shown in Table 4, the total travel demand for the Managed Lane option is expected to be moderately higher than in the No-Build condition (i.e., with four general-use lanes on the existing Goethals Bridge), by 6 to 19 percent. However, the percent increase in managed lane-eligible travel demand is expected to be markedly higher (i.e., from 35 to 169 percent) than for general-use lanes (i.e., from 5 to 16 percent). The high percentage increase for the managed lane demand is associated with a relatively moderate level of change in actual vehicular travel demand. That is, as the 6-Lane Bridge-Replacement alternative with the Managed Lane option undertakes a moderately higher share of the crossing travel demand, moderate yet mixed effects on the travel demand for the other two PANYNJ Staten Island Bridges are expected, with the change in travel demand at the other crossings ranging from reductions of 0 to 3 percent to increases of 0 to 8 percent, depending on travel direction and time period. Other PANYNJ crossings are expected to see very small to negligible changes in travel demand, ranging from -2 to +1 percent, with the 6-Lane Bridge-Replacement alternative with Managed Lane option.

TABLE 3:
FORECAST FUTURE TRAVEL DEMAND: 6-LANE BRIDGE-REPLACEMENT ALTERNATIVE (2030) COMPARED TO FUTURE NO-BUILD CONDITION

Crossing Facilities	Travel Direction	No-Build (2030) Forecast Demand Volume Peak Period		6-Lane Build (2030) Forecast Demand Volume Peak Period		Change (2) 6-Lane Build - No Build Peak Period		% Change (3) 6-Lane Build - No Build Peak Period	
		AM (6 to 10)	PM (4 to 8)	AM (6 to 10)	PM (4 to 8)	AM (6 to 10)	PM (4 to 8)	AM (6 to 10)	PM (4 to 8)
Outerbridge Crossing	**EB**	14,120	13,088	13,755	11,983	-365	-1,105	-3%	-8%
	WB	10,830	13,136	9,803	12,239	-1,026	-897	-9%	-7%
Goethals Bridge	**EB**	10,490	12,704	14,083	16,255	3,594	3,551	34%	28%
	WB	11,746	11,541	15,247	15,809	3,501	4,268	30%	37%
Bayonne Bridge	**SB**	2,794	6,050	2,615	6,320	-178	270	-6%	4%
	NB	3,947	2,368	4,215	2,334	268	-34	7%	-1%
Holland Tunnel	**EB**	12,427	12,024	12,381	11,835	-46	-189	0%	-2%
	WB	11,186	13,938	11,006	13,700	-180	-238	-2%	-2%
Lincoln Tunnel	**EB**	21,831	10,744	21,692	10,692	-138	-52	-1%	0%
	WB	9,697	24,783	9,677	24,583	-20	-199	0%	-1%
George Washington Bridge	**EB**	49,250	37,551	49,446	37,442	196	-110	0%	0%
	WB	38,486	50,176	38,455	50,160	-31	-16	0%	0%
Verrazano Narrows Bridge	**EB**	39,590	26,963	40,372	26,842	781	-120	2%	0%
	WB	19,046	36,271	19,563	36,832	518	561	3%	2%
Tappan Zee Bridge	**EB**	27,037	17,009	27,132	17,012	95	3	0%	0%
	WB	19,454	21,464	19,605	21,746	151	282	1%	1%
TOTAL (1)	**EB**	137,949	109,172	141,105	111,540	3,156	2,368	2%	2%
	WB	105,346	137,406	108,009	140,571	2,663	3,165	3%	2%

Notes: (1) Represents the Hudson River Crossing & Staten Island Bridge Traffic Volume, excluding Verrazano Narrows Bridge traffic.

(2) Represents the change in travel demand from future No Build (2030) to future 6-Lane Bridge-Replacement Alternatives with all general-use lanes (2030).

(3) Represents the percentage change in travel demand from future No Build (2030) to future 6-Lane Bridge-Replacement alternatives with all general-use lanes (2030)

TABLE 4:
FORECAST FUTURE TRAVEL DEMAND: 6-LANE BRIDGE-REPLACEMENT ALTERNATIVE WITH MANAGED LANE OPTION COMPARED TO 2030 NO-BUILD CONDITION

Crossing Facilities	Travel Direction	No Build (2030) Forecast Demand Volume Peak Period		Build with ML (2030) Forecast Demand Volume Peak Period		Change (2) Build with ML - No Build Peak Period		% Change (3) Build with ML - No Build Peak Period	
		AM (6 to 10)	PM (4 to 8)	AM (6 to 10)	PM (4 to 8)	AM (6 to 10)	PM (4 to 8)	AM (6 to 10)	PM (4 to 8)
Outerbridge Crossing	**EB**	14,120	13,088	14,847	12,683	727	-405	5%	-3%
	WB	10,830	13,136	10,544	13,493	-286	357	-3%	3%
Goethals Bridge	**EB - GUL (4)**	10,191	12,318	11,696	12,950	1,505	632	15%	5%
	EB - ML (5)	299	386	805	520	506	134	169%	35%
	EB - Total	10,490	12,704	12,501	13,470	2,011	766	19%	6%
	WB - GUL	11,378	11,184	11,956	12,930	578	1,746	5%	16%
	WB - ML	368	358	607	850	239	492	65%	138%
	WB Total	11,746	11,541	12,563	13,780	817	2,239	7%	19%
Bayonne Bridge	**SB**	2,794	6,050	3,017	5,927	223	-123	8%	-2%
	NB	3,947	2,368	3,947	2,365	0	-3	0%	0%
Holland Tunnel	**EB**	12,427	12,024	12,609	11,825	182	-200	1%	-2%
	WB	11,186	13,938	10,881	13,988	-305	50	-3%	0%
Lincoln Tunnel	**EB**	21,831	10,744	22,086	10,652	255	-92	1%	-1%
	WB	9,697	24,783	9,591	24,812	-106	30	-1%	0%
George Washington Bridge	**EB**	49,250	37,551	50,026	37,452	776	-99	2%	0%
	WB	38,486	50,176	38,432	50,662	-54	486	0%	1%
Verrazano Narrows Bridge	**EB**	39,590	26,963	41,381	26,408	1,790	-555	5%	-2%
	WB	19,046	36,271	19,164	37,921	119	1,650	1%	5%
Tappan Zee Bridge	**EB**	27,037	17,009	27,395	16,949	358	-60	1%	0%
	WB	19,454	21,464	19,486	21,967	32	502	0%	2%
TOTAL (1)	**EB**	137,949	109,172	142,481	108,959	4,532	-213	3%	0%
	WB	105,346	137,406	105,444	141,067	98	3,661	0%	3%

Notes: (1) Represents the Hudson River Crossing & Staten Island Bridge Traffic Volume, excluding Verrazano Narrows Bridge traffic.

(2) Represents the change in travel demand from future No Build (2030) to Build with Managed Lane (2030)

(3) Represents the percentage change in travel demand from future No Build (2030) to Build with Managed Lane (2030).

(4) Represents the forecast travel demand volume for the general use lane.

(5) Represents the forecast travel demand volume for the Managed Lane, including buses and HOV3 vehicles.

5.0 REFERENCES

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APPENDIX A:

Memorandum on Special Generator Development Methodology

pbConsult

Memorandum

To: Bob Donnelly, PB Consult

From: Joe Castiglione, PB Consult

Date: March 24, 2005

Subject: Special Generator Development Methodology for the GTM

The purpose of this memo is to document the creation and integration of estimates of travel demand associated with "special generators" such as Port of New York & New Jersey terminals and the Newark airport. For the Port terminals of Howland Hook, Newark, Elizabeth, Global/NEAT/BMW and North Brooklyn/Red Hook/South Brooklyn, previously prepared estimates of base year and forecast year truck trip demand prepared by the Port Authority as well as information derived from the Comprehensive Port Improvement Plan (CPIP), were adapted to the NYMTC BPMPA model system. For the Newark airport, new estimates of travel demand were created based on summaries of surveys of Newark airport departing passengers. The following sections describe the creation of these datasets, and contain summaries of outputs.

Port of New York & New Jersey Terminals

Estimates of base year and forecast year truck trips were derived from Port Authority data as well as from the Comprehensive Port Improvement Plan (CPIP) for the Port of New York & New Jersey. The Port Authority data provided estimates of base year and forecast year truck volumes to and from the Newark, Elizabeth, and Howland Hook terminals. The CPIP provided estimates of the distribution of these trips in the base and forecast years. For the Howland Hook terminal, the CPIP-based distribution was adjusted to reflect observed origin-destination information for this facility.

The CPIP forecasts generally followed a "4-step" modeling procedure, in which total truck trip generation was first estimated. A mode was then assigned based on assumptions associated with different commodities. Perhaps most critically, estimates of expected truck volumes produced by the previous steps were distributed to the New Jersey Truck Model zone system based on zip code origin and destination concentrations for cargo from the port, as identified from Port Inland Distribution Network figures. Finally, the resulting truck trip table was assigned to the New Jersey Truck Model highway network.

In order to integrate the New Jersey Truck Model-based estimates of Port truck trips into the NYMTC BPM-PA Model, it was necessary to create a correspondence between the two difference geographic areas represented in these two different models. The New Jersey Truck Model incorporates the entire state of New Jersey at a relatively detailed geographic scale. It also encompasses portions of the New York metropolitan area in New York State, as well as metropolitan areas of Philadelphia and Wilmington, Delaware. In contrast, the NYMTC BPM-PA Model incorporates the New York metropolitan area and northern and central New Jersey counties at a relatively detailed geographic scale (in most cases finer than the New Jersey Truck Model), and also includes southern Connecticut counties. However, it does not include southern New Jersey counties, nor does it include any portions of Pennsylvania or Delaware. To address these three levels of geographic consistency, it was necessary to set up a 3-tier system of correspondence.

For areas where there was geographic overlap in New Jersey between the BPMPA and New Jersey Truck Model, a simple correspondence was established to aggregate NJ Truck Model TAZs to BPMPA zones. In these areas there was at least one, and typically many, New Jersey Truck Model zones for each BPMPA zone, which makes "collapsing" the New Jersey Truck Model to the BPMPA zones relatively straightforward.

For areas in southern New Jersey, Pennsylvania, and Delaware, the New Jersey Truck Model contained significantly more zones than the BPMPA. Approximately 1200 zones are used in the New Jersey Truck Model, while the same area is represented in the BPMPA Model by a few dozen external stations. In order to bridge the gap between the spatial details of the two models, the New Jersey Truck Model zones were first collapsed to 3 broad zone groups based on geography. The three zone groups were then disaggregated to BPMPA external stations based on heavy truck volumes derived from the NJ Truck Model. Not all BPMPA external stations received truck volumes. The key links included in the analyses were the New Jersey Turnpike, the Garden State Parkway, I-95, I-295, I-84, I-80, and I-78, as well as a handful of other links.

In contrast to the New Jersey Truck Model, which contained significantly more spatial detail than the BPMPA in southern New Jersey and Pennsylvania, the BPMPA contained significantly more spatial detail in New York and Connecticut. For areas within New York City, trips were disaggregated from the larger New Jersey Truck Model zones to the smaller BPMPA zones using the share of total employment for each BPMPA zone within the group of zones that nest within each given New Jersey Truck zone. This effort was complicated by the fact there does not exist an electronic (GIS) version of the NJ Truck model zones. Therefore, in order to identify the groups of BPMPA zones that nest within each New Jersey Truck Model zone, the truck model zone centroids from the highway network were used to build and manually adjust a layer of Thiessen polygons, which were then used to associate NJ Truck zones to BPMPA zones.

For Long Island counties and Connecticut counties, where the BPMPA model also contained significantly more spatial detail than the New Jersey Truck Model, the truck model zones were aggregated to 5 new zone groups based on geography, and then disaggregated to BPMPA using the share of BPMPA zone total employment within each group of BPMPA zones that nest within each given group.

The truck demand forecasts prepared for the Comprehensive Port Improvement Plan were prepared for the years 2000, 2020, and 2060. The Goethals Bridge Improvement Project analysis considers the years 2004 and 2030. As a result, it was necessary to interpolate the CPIP demand to the forecast years required for the Goethals analysis. This interpolation was performed using the following formula, applied to each cell in the truck demand matrix:

$$InterimYearVolume = Vol_{base} + \left(\left[\frac{(Volume_{future} - Volume_{base})}{(Year_{future} - Year_{base})} \right] \times (Year_{\text{int}\,erim} - Year_{base} \right)$$

The transformation of the New Jersey Truck Model demand to the BPMPA zone system was performed using the TP+ MATRIX module. Once the transformation was performed, the estimates of truck trips to and from Howland Hook, Newark and Elizabeth were compared to other estimates of base year (2004) and forecast year (2030) truck volumes developed by the Port Authority. For the Howland Hook facility an analysis of origins and destinations was prepared, based on O/D survey information gathered for this specific terminal.

The CPIP-based estimates of truck volumes associated with Howland Hook were significantly different in both the base year and forecast year than other Port Authority data sources. In addition, the analysis of the distribution of Howland Hook truck trips also showed significant differences between the CPIP trip tables and the observed origin-destination pattern. In order to address these differences, Howland Hook truck trips were factored to better match other Port Authority estimates. For the base year, the Howland Hook truck trips were factored to better match gate counts from Sept 2004. For the forecast year, the Howland Hook truck trips were factored to match the expected 2030 volumes, which were themselves estimated by applying 2004-2030 growth rates to the 2004 gate counts. In addition, the distribution of Howland Hook trips in both the base and forecast year were also adjusted to better match the observed distribution.

For the Newark and Elizabeth facilities, an analysis of base year truck volumes indicated that the CPIP-based estimates of truck volumes were less than 5 percent different than base year data provided by the Port Authority. However, the CPIP-based truck volumes for the forecast year were approximately 25 percent lower than other forecast year data provided by the Port Authority, so these trips were factored to better match the expected Port Authority 2030 volumes.

As a final step, the resulting matrices were exported to a text format for integration into the BPMPA.

The exported matrix contains estimate of daily truck demand. In order to fully integrate this demand it is necessary to provide temporal information about truck trip demand to the BPMPA model. The Port authority provided two difference sources for information on truck trips by time of day. One source addressed the Newark and Elizabeth facilities, while the second source addressed the Howland Hook facility. The BPMPA model uses half-hour increments to allocate demand. The Newark/Elizabeth and Howland Hook datasets were processed into the half-hour format based on this observed data. The Newark/Elizabeth time-of-day distribution was also applied to the North Brooklyn/South Brooklyn/Red Hook and the Global/NEAT facilities, which also were represented in the CPIP trip tables.

Step 1. Run NJTruck_to_BPMPA.job (TP+ jobfile)

This TP+ script converts the TRANPLAN-based CPIP trip tables into the BPMPA zone system for the desired based and forecast years. It requires five additional files: njtruck_aggregate.csv and njtruck_disaggregate.csv are used in the zone correspondence process, while TASKEFINALPORT00.TAB, TASKEFINALPORT20.TAB, and TASKEFINALPORT60.TAB are the original NJ Truck Model-based CPIP trip tables.

Step 2. Run cleanCPIPtrucks2bpm.awk (GNU AWK script)

This reformats the text files output by TP+ into the format desired by PAP.

Step 3. Convert BPMPA to BPM

This collapses the BPMPA-based trip table to a BPM-base trip table.

Newark Airport

Unlike the Port Terminals, for which previously prepared travel model estimates of truck demand could be adapted to the BPMPA model system, no travel model estimates of air traveler demand had been prepared for Newark airport. Therefore, it was necessary to create these estimates of Newark air traveler demand based on existing survey data and BPMPA model inputs. The 1998 Air Passenger Survey for

Newark Airport was used as the primary source for information on air traveler behavior. However, only the summary tables from the survey, and not the disaggregate survey records, were available for use. In addition, the survey contained information only on departing and transferring air passengers. These survey limitations imposed some significant constraints on the level of detail that could be incorporated into the air passenger demand estimates.

In general, the process for developing Newark Airport air passenger demand estimates for incorporation into the BPMPA model system involves a process of temporal and spatial disaggregation from exogenous forecasts of annual revenue passengers. The estimate of annual revenue passengers is first converted to an estimate of average weekday departing passengers, using annual to week to weekday factors based on Port Authority data.

The estimate of total daily departing air passengers is then disaggregated to BPMPA model system counties and external stations using information about the share of passenger origins from the air passenger survey summaries. For those counties reported in the survey but beyond the BPMPA model system boundaries, external stations that best corresponded to the counties were identified. Multiple counties were often assigned to the same external station due to the lack of information about the particular routes used by residents of individual counties.

Total air passenger origins associated with counties and external stations were then further disaggregated to individual BPMPA travel analysis zones (TAZs), and individual external stations. The allocation of trip origins to TAZs considered both home-based and work-based patterns derived from the survey summaries and informed by TAZ totals of population and employment. The allocation of trip origins to external stations incorporated information on total volumes associated with external stations derived from the BPMPA model system.

Once the distribution of trip origins was established, modes were assigned to the trips. The modes reported in the air passenger survey were not fully consistent with the modes used in the BPMPA model system. It was therefore necessary to establish a set of rule for allocating trips to the BPMPA modes based on the often limited information in the survey summaries. Table X illustrates the mode correspondence scheme. Note that Walk to Rail is not represented in this correspondence table, due to the fact that rail service to Newark airport did not exist at the time of the survey.

Table: BPMPA-Air Passenger Survey Mode Correspondence Table

BPMPA Mode	Air Passenger Survey Modes
Drive Alone	Parked on Airport (0.598)
	Parked off Airport (0.598)
	Rental Car (0.598)
HOV2 + Taxi	Parked on Airport (0.263)
	Parked off Airport (0.263)
	Rental Car (0.263)
	Taxi
	Private Limo
	Shared Limo
HOV 3+	Parked on Airport (0.139)
	Parked off Airport (0.139)
	Rental Car (0.139)
Other Commercial	Charter Bus
	Scheduled Airport Bus
	Hotel Courtesy Van
	Other
Walk to Transit	Ferry
	Helicopter
	Local Bus

As with the Port demand, in order to fully integrate into the BPMPA model system the estimates of air passenger trips to Newark airport by mode and origin, it is necessary to provide temporal information about air passenger demand. The air passenger survey contained information on the starting time of trips to the airport by mode. This information was used to create the temporal distribution of trips by mode in the half-hour increments required by the BPMPA model system.

As stated previously, only information about passengers departing Newark airport was available in the survey summaries. In the absence of information about the travel behavior of passengers arriving at Newark airport, the departing air passenger demand matrix was simply transposed to create an arriving air passenger demand matrix. This is a significantly simplifying assumption, in that there are likely differences in the temporal distribution of departing and arriving flights and passengers.

Step 1. Update EWR Process BPMPA.xls, “Annual Trips” worksheet, “Total Commercial Passenger Traffic” cell.

Step 2. Create 2 .CSV files (one of EWR departures and one of EWR arrives), from the “Export EWR” worksheet.

Step 3. Create CSV to PAP input using “convertEWRarrivalCsv2bpm.awk” and “convertEWRdepartureCsv2bpm.awk”

APPENDIX B:

Memorandum on Time-of-Day Model with Sensitivity to Travel Time and Costs

DATE: 10-16-06

TO: Judith Versenyi, Peter Sucher

FROM: Bob Donnelly

SUBJECT: Time-of-Day Model with Sensitivity to Travel Time and Costs

CC: James Kahng, Peter Vovsha, Surabhi Gupta

OVERVIEW and SUMMARY

This technical memorandum describes the data, assumptions and methods used to add a sensitivity of travel demand with respect to time-of-day (TOD) tolls to the Goethals Transportation Model (GTM), in order to evaluate "congestion pricing" as a possible Transportation Demand Management (TDM) measure as part of the Goethals Bridge Replacement DEIS. The new TOD component of the GTM has been specifically designed for use in the testing of the impacts of time-of-day toll policies that could be implemented at all the Port Authority interstate crossings as part of a Transportation Demand Management analysis of Goethals Bridge alternatives.

Prior to the implementation of this model enhancement to the GTM, the forecasting of travel responses to changes in tolls recognized only average daily tolls for autos and trucks, and would result in shifts in mode choice and route (or assignment) choice. With the TOD model added to the GTM, a shift in demand between the four time periods of the day can also be forecasted as a response to changes in travel costs, including variable tolls, as well as to travel times and level-of-service conditions during each time period.

The main method used to incorporate this capability in the GTM has been the development and validation of a TOD procedure that adjusts the otherwise fixed set of diurnal distributions (percent of daily travel by 1/2 hour) of trips produced by the model, stratified by travel purpose, mode and general origin-destination categories. Incremental changes to these "time-maps," originally derived from the NY-NJ Regional Travel – Household Interview Survey (RT-HIS), are made with the TOD model based on time and cost network inputs and simulation by time period, and the estimated time-of-day switching for behavioral sensitivities incorporated in the model. In the current implementation of the GTM TOD model, the coefficients for time and cost for TOD shifting were adopted from the previously estimated GTM mode and destination choice models. As part of the model testing and validation stage, several additional scaling factors were explored and are reported here.

The validation of the new TOD choice model with respect to estimation of the impact of congestion pricing has been done by comparison of its estimates with observed sensitivities reported by that PANYNJ that occurred with the introduction of peak-period surcharges as part of the March 2001 toll increase. While a complete and direct validation of the sensitivity of the new TOD model implemented for the GTM is not possible with the available data, the general comparison does confirm that the model forecasts a reasonable and correct magnitude of time-of-day response to variable road pricing.

INTRODUCTION

The current Pre-Assignment Processor (PAP) and Time-of-Day (TODP component of NYMTC's Best Practice Model (BPM) distributes trips across time periods based on pre-determined diurnal distributions ("time maps") for specific modes and trip purposes. Based on observed travel patterns from the

1997/1998 Household Interview Survey, this model works well for current conditions; however, for the analysis of pricing policies it cannot estimate shifts in departure times. This is due to a lack of sensitivity to change in travel time and travel costs between origin-destination groups.

In order to build this sensitivity into the GTM for use in evaluating possible congestion-pricing scenarios as part of the GBR DEIS, a new PAP has been developed using an incremental logit model to allow for the effect of change in travel time and cost on departure-time decisions. Currently, a few assumptions have been made specifically so that the new model is appropriate for the GTM evaluation of congestion pricing for this study. However, these assumptions could be relaxed in the future to make the revised PAP/TOD available for other applications, as well.

The new PAP/TOD procedures for the GTM are documented in the following subsections:

1. Updated PAP.exe and revised PAP.ctl file - different time maps are defined for all segment groups across trip purpose, mode, origin, and destination;
2. New classification of origin and destination zones is defined for this study;
3. Time Map Adjustment Factors – these factors are calculated based on change in travel times and tolls between origin-destination group pairs. The factors are used to change the arrival and duration time maps to incorporate sensitivity to travel times and tolls in the time-of-day model;
4. Time Map Correspondence File;
5. Algorithm for Transformation of TOD Distributions – FoxPro Procedure are used to create new time maps based on adjustment factors;
6. Setting Model Coefficients; and
7. Testing and Validation.

1. UPDATED PAP.EXE AND CONTROL FILE

The source code for PAP was edited to allow different origin and destination classifications for the map and recompiled into PAP5.exe. A new field was added in the zone equivalent (zone_equiv.asc) file corresponding to the origin zone group. The existing first zone equiv field is used to define destination zone group.

2. DEFINITION OF ORIGIN AND DESTINATION ZONE GROUPS FOR INTERSTATE ANALYSIS

For the purpose of modeling time-of-day choice for travel under different time-of-day tolling policies for interstate travel, origin zones are categorized in the following two groups (as shown in Figure 1):

1. West of Hudson River (WHR)
2. Not West of Hudson River

For the purpose of modeling time-of-day choice for travel under different time-of-day tolling policies for interstate travel, destinations are categorized in the following three groups (as shown in Figure 2):

1. Manhattan
2. East of Hudson River (EHR)
3. Other

3. CALCULATING TIME MAP ADJUSTMENT FACTORS

First, for all zone pairs and time periods, the change in inter-zonal travel time and toll skims (t_{ij}^{n}) from the base skims (t_{ij}^{b}) is calculated and weighted by number of trips (T_{ij}).

$$f_{ij} = T_{ij} \times (t_{ij}^{n} - t_{ij}^{b})$$

Then, the factors F_{od} for the six origin-destination group pair are calculated by aggregating the weighted travel time and toll skim differences and weighting by total trips for origin (o) and destination (d) group.

$$F_{od} = \frac{\sum f_{ij}}{\sum T_{ij}}$$

4. TIME MAPS CORRESPONDENCE

This look-up table is located in C:\0_BPM1\0_SetUp\2_LUT\3_PAP\ and it defines the correspondence between time maps and adjustment factors based on travel time and tolls.

There are six fields

1. ID
2. Arrival Map as defined in TOD_Factors371
3. Duration Map as defined in TOD_Factors371
4. Trip Purpose (1-8)
5. Mode (Drive Alone or HOV)
6. Segment (1-6)

The segment number is defined based on the origin and destination zone group for the time maps.

Origins \ Destinations	Manhattan	East of Hudson	Other
West of Hudson	1	2	3
Not West of Hudson	4	5	6

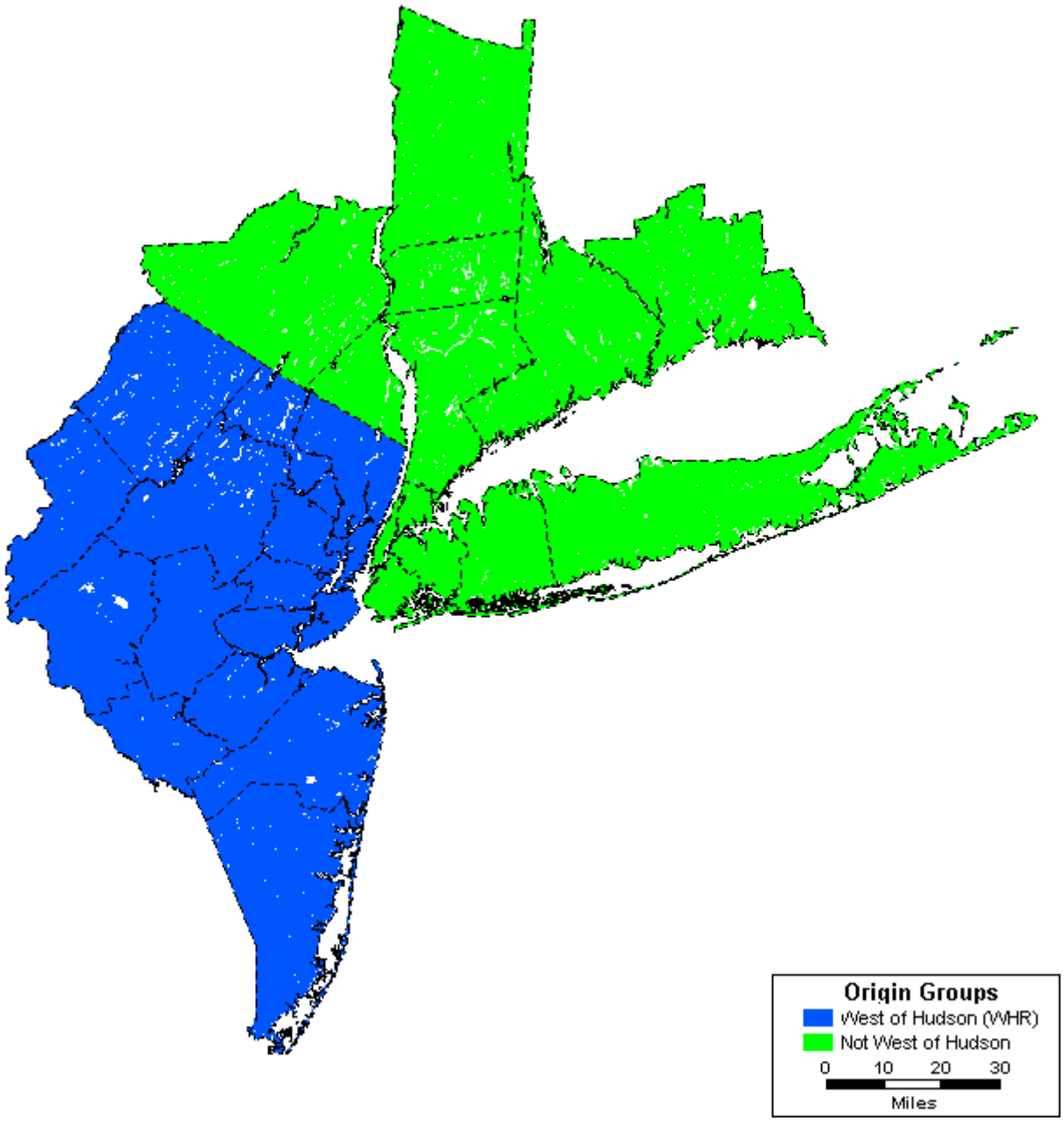

Figure 1: Origin zone groups time-of-day arrival and duration maps

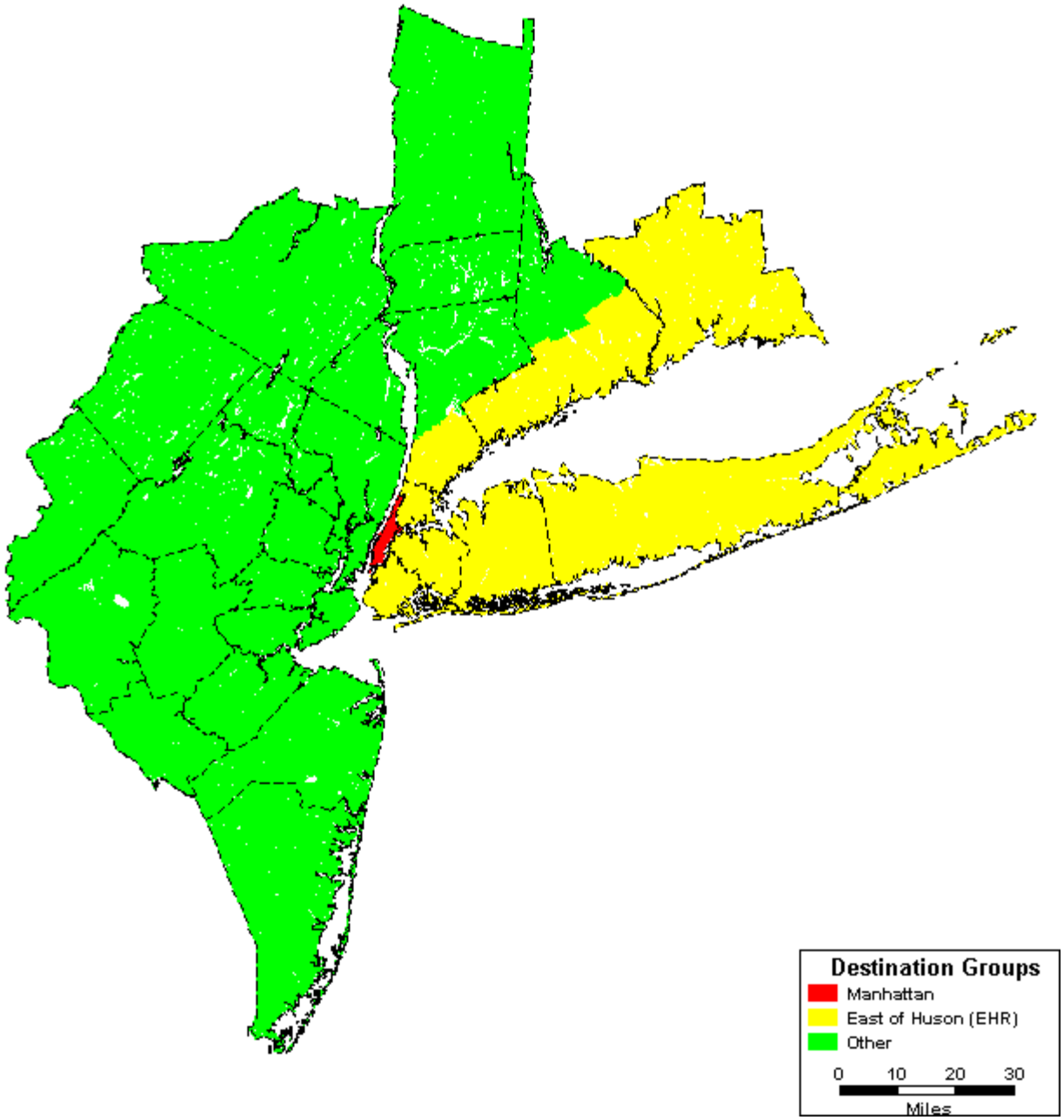

Figure 2: Destination zone groups time-of-day arrival and duration maps

5. ALGORITHM FOR TRANSFORMATION OF TOD DISTRIBUTIONS OF THE NYMTC BPM MODEL AS A RESULT OF PRICING POLICIES

The current version of the NYMTC BPM model system uses a predetermined set of time-of-day (TOD) diurnal distributions to calculate period-specific trip tables from the daily set of tours. The basic TOD distributions for travel tours are segmented by 63 travel segments ($s \in S$) that are organized by travel purpose, mode, and aggregate destination (Manhattan versus the rest) since these are important factors that have a strong impact on the TOD distribution of trips. For each segment, the following two distributions were prepared based on the observed timing patterns from the household survey:

$0 \le D_{si} \le 1$ = departure-from-home time distribution

$0 \le U_{sk} \le 1$ = tour duration (from the departure from home to arrival back home) distribution

where:

$i, k = 1,2,...,48$ = half-hour intervals covering the whole day period (from midnight to midnight)

$\sum_{i=1}^{48} D_{si} = 1$ = necessary condition for completeness of departure time distribution

$\sum_{k=1}^{48} U_{sk} = 1$ = necessary condition for completeness of duration distribution.

The developed algorithm is applied to transform the original distributions $\{D_{si}\},\{U_{sk}\}$ into updated distributions $\{\tilde{D}_{si}\},\{\tilde{U}_{sk}\}$ that correspond to the traveler responses to time and cost changes. We currently apply this algorithm only for highway modes (SOV, HOV) and the associated travel cost with tolls. In order to account for differential time and cost changes, an additional segmentation by six aggregate origin-destination areas was applied that was combined with the original segments $s \in S$ in a Cartesian way (for simplicity of notation, we will use the same index s for the resulted segmentation).

The time and cost changes were calculated for each segment as weighted averages across multiple origin-destination pairs. This is an aggregate version of the TOD choice model that can be replaced with a fully disaggregate TOD choice model in the future, i.e., one that would not require any aggregation across individual records with the individual origins and destinations. The time and cost changes are summarized by the four network assignment periods τ used for skimming in the following way:

$$\Delta T_{s\tau} = \tilde{T}_{s\tau} - T_{s\tau},$$

$$\Delta C_{s\tau} = \tilde{C}_{s\tau} - C_{s\tau},$$

where:

$T_{s\tau}, \tilde{T}_{s\tau}$ = weighted average travel time before and after pricing, respectively

$C_{s\tau}, \tilde{C}_{s\tau}$ = weighted average travel cost (toll) before and after pricing, respectively.

The developed algorithm includes three successive steps:

1. Calculation of two-dimensional departure-arrival time distributions from one-dimensional departure and duration distributions;
2. Application of incremental logit model for two-dimensional redistribution of departure and arrival times; and
3. Update of one-dimensional departure time and duration distributions.

Each step is described below.

1. Calculation of two-dimensional departure-arrival time distributions from one-dimensional departure and duration distributions: In the model application, each tour record is processed in a micro-simulation fashion for choice of the departure time from home and then choice of the tour duration. The total of departure time and tour duration yields the arrival time back home. Departure time from home is associated with the outbound half-tour (with the intermediate stops, if made) while the arrival time is associated with the inbound half-tours (with the intermediate stops, if made). It means that the resultant entire-tour TOD choice is driven by an underlying two-dimensional departure-arrival distribution that can be calculated for the baseline case for each segment from the one-dimensional distributions for departure time and duration in the following way:

$$P_{si(j=i+k)} = D_{si} \times U_{sk} \,, \qquad \textbf{(1)}$$

where:

P_{sij} = two-dimensional departure-arrival time distribution

$j = i + k$ = arrival time that ranges from 2 to 96

2. Application of incremental logit model for two-dimensional redistribution of departure and arrival time: The incremental logit technique is perfectly suitable for the restructuring of TOD distribution as the result of road pricing impacts since it does not require a calibration of the entire utility function but rather operates with utility increments associated with time and cost changes. The incremental logit model for TOD distribution can be written in the following form:

$$\tilde{P}_{sij} = \frac{P_{sij} \times \exp(\Delta V_{sij})}{\sum_{i'=1}^{48} \sum_{j'=i'+1}^{i'+48} P_{si'j'} \times \exp(\Delta V_{si'j'})} \,, \qquad \textbf{(2)}$$

where:

$\tilde{P}_{sij}$ = redistributed departure arrival distribution as the result of pricing

ΔV_{sij} = utility increment associated with time and cost (toll) change

The utility increment is calculated as the relevant part of the underlying TOD choice utility function:

$$\Delta V_{sij} = \alpha \times \lfloor \Delta T_{s\tau(i)} + \Delta T'_{s\tau(j)} \rfloor + \beta \lfloor \Delta C_{s\tau(i)} + \Delta C'_{s\tau(j)} \rfloor, \qquad \textbf{(3)}$$

where:

α, β = (negative) coefficients estimated for time and cost, respectively
$\tau(i)$ = outbound TOD period corresponding to the departure time from home
$\tau(j)$ = inbound TOD period corresponding to the arrival time back home
$\Delta T_{s\tau}$ = outbound travel time change from weighted skims
$\Delta T'_{s\tau}$ = inbound (transposed) travel time change from weighted skims
$\Delta C_{s\tau}$ = outbound travel cost (toll) change from weighted skims
$\Delta C'_{s\tau}$ = inbound (transposed) travel cost (toll) change from weighted skims

3. Update of one-dimensional departure time and duration distributions: After restructuring the core two-dimensional distribution, calculation of the updated one-dimensional departure and duration distributions is straightforward and based on the reversed application of formula (1) in the following way:

$$\tilde{D}_{si} = \sum_{j=i+1}^{i+48} \tilde{P}_{sij} \,, \qquad \textbf{(4)}$$

$$\tilde{U}_{sk} = \sum_{i=1}^{48} \tilde{P}_{si(j=i+k)} \,. \qquad \textbf{(5)}$$

6. SETTING MODEL COEFFICIENTS

At the current stage, the model coefficients for time and cost were adopted from the previously estimated GTM mode and destination choice models. As part of the model testing and validation stage, several additional scaling factors were explored. The adoption of the mode and destination choice model coefficients for time and cost variables can be substantiated by the fact that all three related travel choices (destination, TOD, and mode) are closely intertwined. The most frequently used order of choices for activity-based models corresponds to the following (assuming a nested structure):

1. Destination choice (upper level)
2. Time-of-day choice (intermediate level)
3. Mode choice (lower level)

In a fully disaggregate model implementation, all three models would share the same time and cost coefficients, estimated at the lower level and then carried up to the upper level choices through logsums. This means that the ratio between time and cost coefficients (that can expressed as the value of time) would be the same for all three models, while the absolute value of the coefficients for the intermediate and upper level models would be scaled down by the nesting parameters that lie in the unit interval.

In the current version of the NYMTC BPM model, only the 1st (destination) and the 3rd (mode) choice levels were estimated in a disaggregate fashion. It should be noted that the mode choice logsum coefficients for all travel purposes proved to be close or equal to 1.0, indicating a limited need for scaling. Thus, one can reasonably expect that inclusion of an intermediate level for TOD choice would fit only with a nested scale close to 1.0 since it cannot be stronger than the scaling between the extreme levels.

The basic values of the time and cost coefficients, from the estimated mode and destination choice model are presented in Table 1, below, along with their associated value of time (VOT) in dollars per hour. In

the current version of the NYMTC BPM, these coefficients are estimated generically, i.e., common to all motorized modes and income groups.

Table 1: Estimated Travel Time and Costs Coefficients – Mode/Destination Choice

Travel purpose	Base (estimated) values		
	Time coefficient	Cost coefficient	VOT, $/hour
1-Work	-0.02476	-0.00094	15.81
2-School	-0.01815	-0.00168	6.50
3-University	-0.06653	-0.00341	11.72
4-Maintenance	-0.01458	-0.00071	12.38
5-Discretionary	-0.02104	-0.00118	10.74
6-At work	-0.06834	-0.00103	40.00

VOT – value of time

Additionally, the cost coefficient for HOV is divided by 2 to take into account reduced sensitivity to travel cost at the entire-vehicle-unit level. The base TOD maps are distinguished between SOV and HOV only (with HOV2, HOV3, and HOV4+ collapsed all together). Taxi trips are also pooled with either SOV or HOV.

7. TESTING AND VALIDATION

The method that has been used for the testing and validation of the new TOD choice model is presented in the Figure 3, below, in a simplified way. It corresponds to a single iteration of the mode and destination choice model with a subsequent single iteration of the TOD choice model (TOD map restructuring for highway modes: SOV, HOV, and taxi) without updating level-of-service skims.

Three sets of runs were implemented and compared for each scaling strategy:

1. Baseline run without additional tolls;
2. Run with additional tolls that affected mode and destination choice (MDSC) but with the baseline TOD maps; and
3. Run with additional tolls that affected mode and destination choice (MDSC) and restructures TOD maps. This run corresponds to the model application algorithm.

Synthetic households, auto ownership, and journey generation components (HAJ) were kept constant through all runs. This way the change of final TOD-specific trip tables for highway and transit modes that occurs between runs 1 and 2 reflects only the sensitivity due mode and destination changes. The change observed between runs 2 and 3 corresponds only to the TOD response. The total change between runs 1 and 3 is the combined effect of mode, destination, and TOD choices.

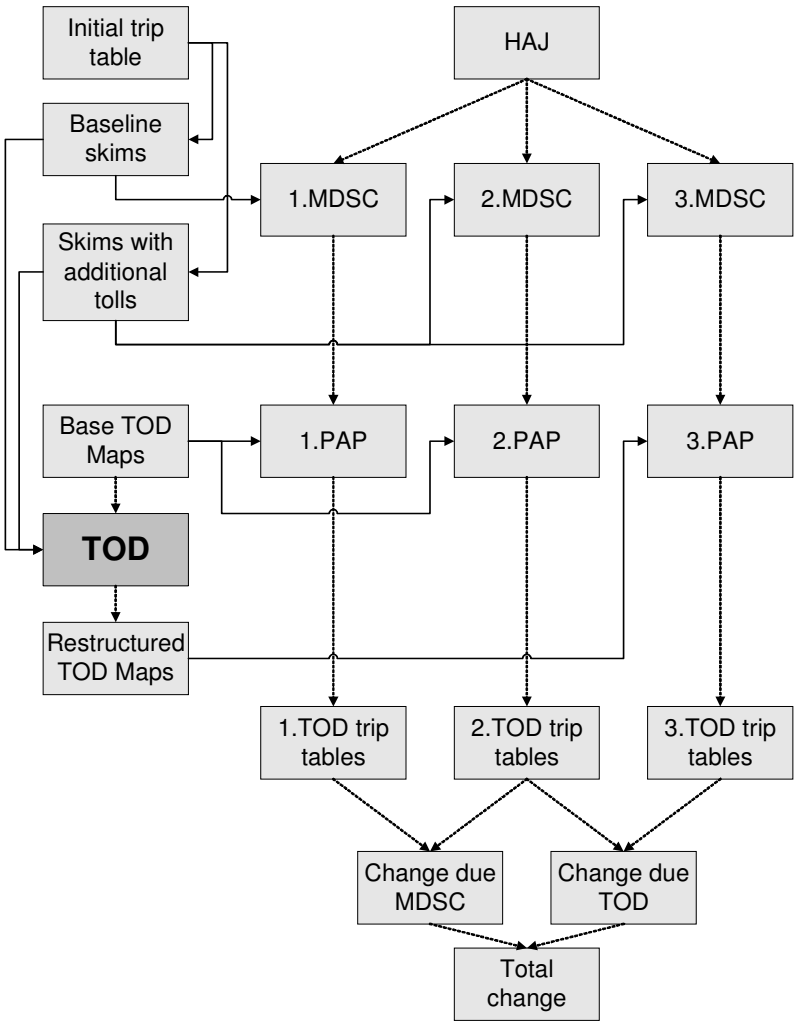

Figure 3: Structure for Application and Testing of the GTM with TOD Choice Model

The model testing results for the basic pricing scenario (TDM2) for the GBR DEIS, with approximately $2.00 of additional toll for the peak period for each of the crossings, are presented for the base year 2002 in Table 2, below (in absolute numbers). They correspond to the strategy where the originally estimated coefficients were directly used in the incremental TOD choice model, with no scaling.

Table 2 presents the expected pricing impact on absolute number of highway vehicle trips, highway person trips, and transit person trips. The impacts are tabulated for the different spatial markets, including the whole region, trips to the Central Business District (CBD) area, and trips from the area West-to-the-Hudson River (WHR) to the area East-to-the-Hudson River (EHR).

Table 2: Summary of Results – Test Pricing Strategy (TDM2)

Highway Vehicle Trips		Daily	AM	MD	PM	NT
Regional	MDSC	-10,899	-5,192	2,702	-6,927	-1,482
	TOD Pricing	0	-2,242	869	-1,028	2,401
	Total	-10,899	-7,434	3,571	-7,955	919
CBD	MDSC	-5,516	-1,476	-1,232	-1,800	-1,008
	TOD Pricing	0	-715	214	12	489
	Total	-5,516	-2,191	-1,018	-1,788	-519
W.H.R to E.H.R	MDSC	-6,412	-2,504	-1,964	-897	-1,047
	TOD Pricing	0	-1,185	358	213	614
	Total	-6,412	-3,689	-1,606	-684	-433

Highway Person Trips		Daily	AM	MD	PM	NT
Regional	MDSC	-22,162	-7,458	6,073	-14,605	-6,172
	TOD Pricing	0	-2,472	937	-1,114	2,650
	Total	-22,162	-9,930	7,010	-15,719	-3,523
CBD	MDSC	-8,171	-1,528	-2,418	-2,862	-1,363
	TOD Pricing	0	-771	224	26	521
	Total	-8,171	-2,299	-2,194	-2,836	-842
W.H.R to E.H.R	MDSC	-9,100	-3,277	-3,200	-1,437	-1,187
	TOD Pricing	0	-1,264	379	223	662
	Total	-9,100	-4,541	-2,821	-1,214	-524

Transit Person Trips		Daily	AM	MD	PM	NT
Regional	MDSC	18,021	2,946	7,712	4,956	2,407
	TOD Pricing	0	0	0	0	0
	Total	18,021	2,946	7,712	4,956	2,407
CBD	MDSC	3,517	542	1,272	1,405	298
	TOD Pricing	0	0	0	0	0
	Total	3,517	542	1,272	1,405	298
W.H.R to E.H.R	MDSC	8,737	2,722	4,193	1,035	787
	TOD Pricing	0	0	0	0	0
	Total	8,737	2,722	4,193	1,035	787

MD – mid-day NT – night time

There are several important aspects of these results that can be noted:

- The MDSC component includes destination, stop frequency, and stop location choices. Because of different rates of stop-making on highway and transit tours, the total daily trip table is not fixed across runs 1, 2, and 3, despite the fact that the set of journey records is the same (HAJ is not re-run). For this reason, the number of diverted highway person trips is not exactly offset by additional transit person trips.
- The TOD choice model does not affect the total daily number of trips in each spatial segment. It only affects trip distribution across TOD periods. In general, there is a logical pattern of shifting trips from the peak periods (AM, PM) to off-peak periods (MD,NT).
- The TOD choice model is not applied for transit trips since they are not affected by road pricing. This means that the modeled growth in transit trips is due to the effect of a change in tolls on mode and destination choices only.
- The differential effects of pricing on highway vehicle and person trips are due to differential TOD maps for SOV and HOV/taxi modes. In particular, HOV/taxi has a large share in the MD/PM/NT periods compared to the AM period. Thus, tolling of the same amount of vehicles in the MD period would result in more person-trip switches compared to the AM period.
- In general, the relevant spatial markets (trips to CBD and trips from WHR to EHR trips) are logically the most affected in relative terms.
- The (seemingly illogical) positive impact of pricing on the number of highway trips in the MD period is due to the shift from SOV to HOV/taxi that have a different base TOD map with a large share of MD.
- In general, for the test pricing strategy, TOD sensitivity accounts for 10-30 percent of the highway congestion relief in the peak periods (AM, PM) while mode shift accounts for 70-90 percent. It is also differential by spatial markets, with the highest relative peak-spreading in the AM period for trips to the CBD and trips from WHR to EHR. This proportion between mode choice shift and peak spreading is considered appropriate and typical for urban areas with strong transit. It also shows that there is no need for additional scaling of the TOD choice coefficients, which would reduce the relative TOD impact even more, as was confirmed in multiple sensitivity tests that were implemented as part of the testing and validation.

An important additional aspect of the validation of the new TOD choice model relates to the relative impact of congestion pricing that can be compared to the observed sensitivities reported by the PANYNJ as the result of its introduction of peak-period surcharges as part of the March 2001 toll increase. The observed sensitivity to this road-pricing event is based on traffic that reflects the combined effects of all possible traveler responses including mode switching, destination changes, and peak spreading. Thus, it can only be compared to the total modeled effect when both mode and destination and TOD choice models are applied.

To provide for an approximate comparison of the adopted TOD model sensitivity for the test pricing strategy (TDM2) with the observed impacts of the 2001 toll changes, Table 3, below, shows the percentage change for regional vehicle trips to those to the CBD.

Table 3: TOD Sensitivity – Highway Volumes - Test Pricing Strategy (TDM2)

		Highway Vehicle				
		Daily	**AM**	**MD**	**PM**	**NT**
Base	**Regional**	43,711,751	8,608,870	15,877,721	12,011,225	7,213,934
	To CBD	1,078,263	253,390	415,779	227,050	182,045
Pricing TDM2	**Regional**	43,700,852	8,601,436	15,881,292	12,003,270	7,214,853
	To CBD	1,072,747	251,199	414,761	225,262	181,526
Difference	**Regional**	-10,899	-7,434	3,571	-7,955	919
	To CBD	-5,516	-2,191	-1,018	-1,788	-519
% Change	**Regional**	0.0%	-0.1%	0.0%	-0.1%	0.0%
	To CBD	-0.5%	-0.9%	-0.2%	-0.8%	-0.3%

The impact of pricing on regional totals is close to negligible because of the region's large size and the huge amount of trips that are not affected by pricing. The relative impact for trips to the CBD, however, is visible, but is generally under 1 percent in terms of AM and PM peak spreading.

While these numbers may appear to be quite conservative, they match the observed sensitivities that are summarized in Table 4, below (source: *Evaluation Study of Port Authority of New York and New Jersey's Time of Day Pricing Initiative: Final Report*. FHWA/NJ-2005-005). It should be mentioned that the PANYNJ initiative included a $2 difference between the peak and off-peak tolls, as well as special discounts for E-ZPass users. Thus, it is only approximately comparable to the GBR DEIS' congestion-pricing study. The following relative changes in the weekday traffic were observed on major facilities during the period January 2000 to August 2001, which spans the pricing change (and also allowed to capture unrelated seasonal effects and control for them).

Table 4: Observed Volume Changes – PANYNJ Toll Change March 2001

- Holland tunnel:
  - – 1.6% daily
  - - 0.7% AM peak hour
- Lincoln tunnel:
  - – 1.5% daily
  - – 0.3% AM peak hour
- Bayonne bridge:
  - -0.2% daily
  - -0.5% AM peak hour
- Goethals Bridge:
  - 4.0 % daily
  - 0.6% AM peak hour

While a complete and direct validation of the sensitivity of the new TOD model implemented for the GTM is not possible with the available data, the general comparison does confirm the model forecasts a reasonable and correct magnitude of time-of-day response to variable road pricing.

APPENDIX C:

Memorandum on Development of Moderate Employment Forecast for Staten Island and Associated Version of Goethals Transportation Model (GTM): Phase I for Nine Subarea Forecast

Memorandum on Development of Moderate Employment Forecast for Staten Island and Associated Version of Goethals Transportation Model (GTM): Phase II Allocation from Subarea to Traffic Analysis Zones

Goethals Bridge Replacement EIS

Development of Moderate Employment Forecast for Staten Island and Associated Version of Goethals Transportation Model (GTM)

INTRODUCTION

Due to concerns initially identified by the Port Authority of New York and New Jersey (PANYNJ) regarding unanticipated traffic growth and patterns, which were predicted using the Goethals Transportation Model (GTM), it was determined that such results were likely due to the high uniform employment growth across Staten Island that was predicted by the New York Metropolitan Transportation Council (NYMTC) and which was used as input to the GTM. The PANYNJ's concerns about the unanticipated traffic growth and patterns predicted by the GTM were then presented to the U.S. Coast Guard (USCG), the federal lead agency for the Goethals Bridge Replacement Environmental Impact Statement (GBR EIS). The USCG agreed that it is important that the results be credible for the EIS and for presentation to the Technical Advisory Committee (TAC) and the Environmental Task Force (ETF), as well as the general public. As a result, a meeting was held between the PANYNJ and NYMTC on January 4, 2006, where it was agreed that a second set of travel forecasts would be developed as part of the GBR EIS, based on a modified and more moderate employment forecast for 2030 on Staten Island and with non-uniform distribution.

This effort involved two separate and distinct elements: 1) the preparation of the modified 2030 employment forecast for Staten Island; and 2) creation of a second version of the GTM using the modified employment forecast inputs and re-running of the screening-level forecasts for the 2030 No-Build and 6-Lane Replacement Bridge alternatives with the moderate growth version of the GTM.

The approach and scope of work presented below for development of the modified employment forecast was designed with the principal consideration being the defensibility of the resultant Staten Island employment growth forecast, and for potential use in the GBR EIS. The following scope of work was completed by the Louis Berger Group, Inc./Parsons Brinckerhoff, Inc. Joint Venture (Berger/PB), environmental consultant to the USCG for preparation of the GBR EIS. Necessary reviews were conducted at key decision points during this work scope.

DEVELOPMENT OF MODERATE 2030 EMPLOYMENT GROWTH FORECAST

Berger/PB will develop a moderate 2030 employment growth forecast for Staten Island in the employment categories required as inputs to the GTM through a series of four tasks in order to: 1) identify a moderate-growth control total for Richmond County; 2) estimate development potential by sub-area within Staten Island; 3) inventory pipeline projects and proposed zoning changes; and 4) perform an allocation of 2030 forecast employment by sub-area.

Task 1 – Establish Richmond County Control Total

The first step in a re-evaluation of the employment forecast for Staten Island is an examination of the third-party forecasts available through PANYNJ or other sources. Berger/PB will coordinate with the PANYNJ Chief Economist and Office of Policy and Planning to obtain the latest county-level employment forecasts from their vendors (e.g., Economy.com and Global Insight) with disaggregation by major industry group (NAICS 2-digit level). Based on an initial review of forecast sources by the PANYNJ Chief Economist, it is anticipated that the county-level Economy.com forecast will provide the most appropriate base for the Richmond County control total. Berger/PB will work with PANYNJ to

review other available forecasts for Staten Island (including but not necessarily limited to the New York State Department of Labor occupational projections, the New York Statistical Information System (NYSIS) maintained by Cornell University, and ESRI Business Information System industry projections) so that the available information and recommendation are clearly documented. Once the relevant forecast has been identified, Berger/PB will coordinate with the forecast vendor and project team members, as appropriate, to identify the basis for the forecasts (definition of employment and industry groupings) and make any necessary adjustments to match the input requirements for the GTM. Berger/PB will prepare a memo for review by the project team outlining the following:

- Employment forecasts by year by industry for Richmond and surrounding counties for years 2000 through 2030, as available through PANYNJ subscriptions or other readily available sources (if extrapolation of forecasts from 2020 or 2025 to 2030 is necessary, Berger/PB will document the method and results for the extrapolation);
- Basis for each of the forecasts reviewed and compatibility with estimates required for use in the GTM;
- Benchmark of each of the forecasts reviewed to previous rates of employment growth for Staten Island and surrounding areas; and
- Recommendation on employment control total to be selected for distribution among GTM Traffic Analysis Zones (TAZs).

Task 2 – Develop Zoning Capacity Estimates for Staten Island Sub-Areas

The location and magnitude of future employment on Staten Island will be based, in part, on the capacity for future commercial development in each of the TAZs. Berger/PB will use the MapPLUTO database from the New York City Department of City Planning to identify key zoning and land use parameters for each Sub-Area. This will involve the following sub-tasks.

Task 2.1 – Identification of Sub-Areas
For the purpose of evaluating the potential for employment growth in localized portions of Staten Island, Berger/PB will develop six to eight Sub-Areas. The boundaries of these Sub-Areas will initially be based on the three Community Districts for the borough (Community Boards 1 through 3), with further divisions into Sub-Areas to account for key neighborhoods and/or predominant land uses, and existing or potential future commercial districts/employment centers. The boundaries for the Sub-Areas will be drawn to take into account major roadways and GTM TAZ boundaries. Ultimately, the Sub-Areas that are developed will easily correlate with groups of TAZs during the modification of the GTM portion of this scope of work.

Task 2.2 – Aggregation of Data into Sub-Areas
To facilitate the calculation of land use parameters described in Task 2.4, Berger/PB will join the GTM's TAZ GIS boundary layers for Staten Island to the parcel-level data available in MapPLUTO. These geographies will then be aggregated into the Sub-Areas, as defined in Task 2.1. Each parcel will be assigned a TAZ and Sub-Area identifier. Berger/PB will fully document this process and decision-rules used in evaluating instances where parcel lines cross Sub-Area boundaries.

Task 2.3 – Estimation of allowable densities by Sub-Area
The MapPLUTO database contains information on land use, building type, zoning designation, exemption status, and ownership of each parcel along with the dimensions of the parcel and area of any structures. The database does not, however, indicate the allowable density to which parcels may be developed for commercial use. For each zoning district on Staten Island allowing employment-generating uses,

Berger/PB will develop estimates of non-residential development density based on current densities observed in the database and the density allowable for the given zoning designation in the New York City Zoning Ordinance. The purpose of this task is to develop a composite density (average factor) for each Sub-Area so that they can be ranked according to development potential (see Task 2.4 below).

Task 2.4 – Development of land use parameters

Once allowable densities have been identified, Berger/PB will enter the information into the database and relate it to the parcel files. This will allow for the development of a generalized estimate of development potential based on gross lot area and current floor area on the parcel. A factor of 20 percent will be applied to reduce floor area potential to account for net leasable areas, parking/circulation, and irregular lot dimensions. This development potential parameter will allow for the ranking of Sub-Areas based on their potential to accommodate future commercial development.

Berger/PB will develop queries to the database to develop the following parameters for each Sub-Area in Richmond County:

- Parkland and undeveloped municipal land (e.g., landfills) and other land types unlikely to be developable for commercial uses will be identified and removed from the inventory of developable land for each TAZ.
- Berger/PB will query the CoStar[6] real estate database to establish the 2005 inventory of commercial office space and benchmark recent vacancy rates to determine areas of slack capacity that will be occupied as demand for space grows.
- The baseline employment in each zone will be identified and compared to Zip-Code business patterns (U.S. Census Bureau) to establish areas that have experienced employment growth since 2000.
- The year-built, year-renovated fields in the MapPluto database will be reviewed to account for commercial development taking place after the baseline year and identify areas of recent growth. This will allow the ability to account for any growth that has already taken place since 2000 and may indicate attractiveness for future development.
- Acreage of vacant, developable land in each Sub-Area will be identified along with its development potential expressed in square-footage of floorspace.
- The sum of floorspace in parcels that are improved but to a density less than 50 percent of the allowable density will be identified.

The parameters will be estimated for each Sub-Area and utilized in the allocation process in Task 4.

Task 3 – Identify Pipeline Development Projects and Rezoning Initiatives

To capture known planned or proposed commercial developments and the potential for changes in the zoning ordinance that would affect the location or capacity for future commercial development, Berger/PB will undertake the following activities:

- Berger/PB will obtain access to and consult the CityLand database[7] to identify "pipeline" projects on Staten Island, including rezonings/special permits, and other ULURP activities that would add substantial employment-generating uses to Sub-Areas.

[6] CoStar Group (www.costar.com) provides information on existing and proposed commercial space and current vacancies that will help in identifying the location and supply of space for future employment. Berger/PB has access to recent datafiles for Richmond County.

- Berger/PB will supplement the database search with inquiries to the Staten Island Office of the NYC Department of City Planning, the NYC Economic Development Corporation, and the Staten Island Borough President's office to ensure that all pipeline projects are identified and gain any further information on potential major employment generating uses in the Sub-Areas. Berger/PB will fully document these discussions and any assumptions based upon them for review by PANYNJ / USCG.

Task 4 – Allocate County Control Totals to Sub-Areas

After completion of the land use parameter database and the inventory of pipeline projects/rezonings, Berger/PB will use the data to develop an allocation of the county control total for employment to the Sub-Areas. This allocation will be consistent with the requirements for input to the GTM (industry groupings, interim forecast years). The allocation will be based on the parameter indicators developed in Task 2. Examples include:

- Current proportion of employment and recent levels of employment growth/development activity
- The available commercial capacity of a Sub-Area
- Redevelopment potential (underutilized capacity)
- Proximity to major roadways or commercial streets/districts
- Known projects or increases in development capacity

The potential for commercial development (vacant, developable parcels/substantial redevelopment potential) will be used as both a measure of development potential, as noted above, and a constraint on development. Employment will only be allocated to a Sub-Area up to its estimated potential.

As a final step to test the reasonableness of the "top-down" county forecast total identified in Step 1, results of the "bottom-up" estimates of development capacity will be reviewed to note the feasibility of growth rates identified for the county in reference to previous levels of employment growth, the total estimated development capacity for the county, and the development capacity consumed in key commercial areas during the allocation process. As necessary, Berger/PB will recommend modification of the control total should the control total substantially exceed the estimated development capacity.

Meeting/Review: Berger/PB will present findings and recommendations for Tasks 1 - 4, including Sub-Area allocations, at a meeting with the PANYNJ / USCG and key agencies in the region with specific interest and expertise in employment forecasting (i.e., the New York Metropolitan Transportation Council [NYMTC], the New York City Department of City Planning [NYCDCP] and the New York City Economic Development Corporation [NYCEDC]). The purpose of this meeting is to receive buy-in on the findings and recommendations regarding the moderate employment forecasts to be included in the GTM from the other agencies before proceeding with the actual incorporation of those forecasts into the GTM.

Schedule: This task cannot proceed until the PANYNJ / USCG have approved the findings and recommendations developed in Task 1. Based on the schedule assumptions presented in Task 1, this task would begin at the completion of the third week, with the draft memorandum produced in one week, or four (4) weeks from notice to proceed. While the PANYNJ / USCG are conducting their review and approval of the draft memorandum during the fifth week, an informal working meeting with the PANYNJ, USCG, NYMTC, NYCDCP and NYCEDC to present results of Tasks 1 – 4 before proceeding to the modification of the GTM will also occur. The GTM revision with updated employment forecast

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[7] Center for New York City Law, New York Law School

inputs can then begin immediately following the meeting, assuming that buy-in is obtained from the attending agencies. Therefore, the GTM revision can begin approximately five (5) weeks from notice to proceed.

MODIFICATION OF GTM AND RELATED TRAFFIC ASSIGNMENTS

Following review and approval of the moderate employment growth forecast for Staten Island and its distribution among the set of geographic sub-areas (each comprising some number of traffic analysis zones (TAZs)), the employment forecast data will be incorporated in the GTM, after which a series of updates and revisions of GTM elements will be required to enable forecasting of future travel demand with the moderate employment growth forecast. The necessary steps to create a revised GTM with the moderate growth forecast, i.e., steps 1 through 6, below, are similar to those that were necessary in the previous activity to incorporate the North Jersey Transportation Planning Authority's (NJTPA) new employment forecasts in the GTM. Steps 7 through 9, below, constitute the actual running of the revised GTM (GTM-Moderate Growth) with the No-Build and 6-Lane Replacement alternatives, and development of the AM and PM peak-hour volumes to be used to compare these results with the previous results completed for the No-Build and 6-Lane Replacement Bridge alternatives.

The new employment forecast data will be used to "disaggregate" the trips using the parameters of several mathematical models. These parameters include the estimated coefficients of the "utility" expressions that comprise destination and mode choice, and the stop-making behavior components of the *core GTM model*. This is the key to understanding the tasks required for the proposed GTM revision using a new employment forecast for Staten Island. Each time the base data for the model are changed (in this case, the employment portion of the socioeconomic data), the core model has to be modified. This does not relate to any given alternative. The socioeconomic characteristics are embedded in the base model and require updates to several files that are the basic foundation of the model. For this revision, the new employment data for Staten Island will result in a new mode-choice percentage for work trips to Staten Island, as well as a new distribution of work trips. Fewer trips will go to workplaces in Staten Island (as a result of the lower employment forecast) and more will go to work places in New Jersey and the other boroughs of New York City.

There are several steps needed to modify the data files and procedures in the GTM after the basic data for the model are changed. The major step is to allocate the socioeconomic data (*zsed.prn* file) into the zone system. This takes the individual growth factors developed for the large areas and allocates specific numbers on the basis of geographic area or known features of the region. All variables needed in the model must be allocated into the zone system. The GTM also uses an area type file that must be modified based on this new allocation of employment for each zone. The household auto journey generation model, one element of the GTM, uses a file called *bpzdata.prn*. Although the majority of the values in the file come straight from the data input files, the highway and transit skims for the new zone data can only be run after the base data files have been updated. This can only occur after all the data have been created and inputted to the base model, and may require several iterations until all the data are in synch with the data already in the GTM for the other 27 counties.

About 25 percent of the files listed in Table 1 need to be modified and updated each time there are new socioeconomic data introduced, such as the moderate growth employment forecasts data for Staten Island. These modifications and updates were done as part of the modeling work for incorporation of NYMTC's and NJTPA's new socioeconomic base and forecast data. All of these modifications and updates must again be completed *before* the GTM can be used to forecast future results with any alternative.

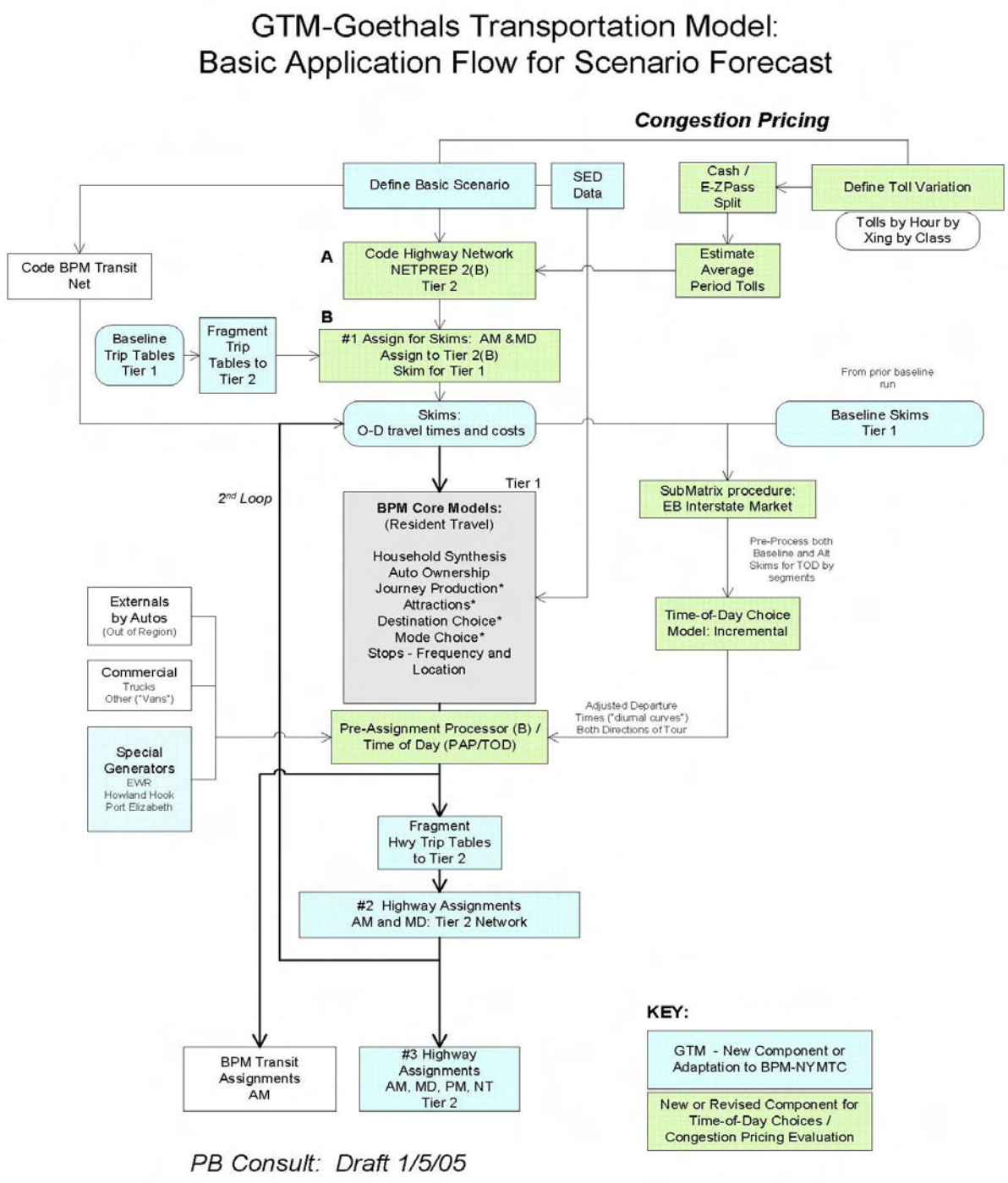
The figure included after Table 1 outlines the procedures required to run the GTM. The socioeconomic data (SED – small, blue box in top row of boxes) are outside the Core Model process (grey box in figure). Each time anything changes in this part of the model, the base model has to change and all alternatives have to be re-run.

In terms of the actual alternatives, each step in the Core Model box is a separate computer run that requires about 12 to 24 hours of computer processing time. Each step must wait for the output of the previous step because the output file becomes the input file for the next step. Outlined in the figure are all of these basic steps required in the Core Model portion of the process (which were run most recently when the NJTPA data were imported) and the steps required to update the socioeconomic data that will need to be newly run for the change in the employment data for Staten Island.

Table 1:
GTM Files

File Name	File Location	File Description	Change
Control files			
haj.ctl	0_bpm1\0_SetUp\1_ctl\0_pre	Control File for HAJ	Twice uses the constant "3586" for the max zones. Lines 36 and 63
mdc.ctl	0_bpm1\0_SetUp\1_ctl\0_pre	Control file for MDC.	3686 is set eight times as the max zones.
netprep1.ctl	0_bpm1\0_SetUp\1_ctl\0_pre	Netprep transCAD macro.	The number of zones is set once, near the end of the program. Line 2066
netprep1_Sub.ctl	0_bpm1\0_SetUp\1_ctl\0_pre	Netprep sub regional transCAD macro	The number of zones is set once, near the end of the program. Line 2092
Coefficients			
co_dist.prn	0_BPM1\0_Setup\2_LUT\1_HAJ	HAJ	taz to district correspondence file
hhsize.prn	0_BPM1\0_Setup\2_LUT\1_HAJ	HAJ	Household size by zone
co_dist	0_BPM1\0_Setup\2_LUT\2_MDC	MDC	
dc_dist	0_BPM1\0_Setup\2_LUT\2_MDC	MDC	Zone to county equivalency
att_corr(1-8)	0_BPM1\0_Setup\2_LUT\2_MDC	MDC	Zone attractions
taz2schl	0_BPM1\0_Setup\2_LUT\2_MDC	MDC	Zone to school district correspondence
work_att_pcts	0_BPM1\0_Setup\2_LUT\2_MDC	MDC	% of work attractions for each zone
revzone2.dat	0_bpm1\0_SetUp\2_LUT\2_MDC	MDC (non-motorized)	Needs to be rebuilt using 3-mile buffer of new zone layer and new shortest path matrix
revzone3.dat	0_bpm1\0_SetUp\2_LUT\2_MDC	MDC (non-motorized)	Needs to be rebuilt using 3-mile buffer of new zone layer and new shortest path matrix
zone_equiv	0_BPM1\0_Setup\2_LUT\3_PAP	PAP	
co_dist	0_BPM1\0_Setup\2_LUT\3_PAP	PAP	
dc_dist	0_BPM1\0_Setup\2_LUT\3_PAP	PAP	zone to county equivalency
codist21	0_BPM1\0_Setup\2_LUT\4_Hnet	HNET	Update to include all 3865 zones
ZSEDBS.prn	0_bpm1\1_Prep\0_SED\+YEAR	SED file used throughout the BPM process.	Created using SPSS from Census Data
ZSEDBS.dbf	0_bpm1\1_Prep\0_SED\+YEAR	SED	Created using SPSS from Census Data
atype.dat	0_bpm1\1_Prep\0_SED\+YEAR	SED	Must be created and updated using the revised ZSEDBS.prn file
atype.dbf	0_bpm1\1_Prep\0_SED\+YEAR	SED	Must be created and updated using the revised ZSEDBS.prn file
gridrev.asc	0_bpm1\1_Prep\2_tnet\access	Transit Accessibilities	Must be revised to match new zone system
bpzdata.prn	0_bpm1\2_Alts\Scenario\0_Input\0_SED\	HAJ	Zone structure needs to be updated for PA zone system.
Transit files			
runtrnmodel.rsc	0_bpm1\6_pgms\5_Tnet\Utils	Woodford's code	Woodford sets up the zones for the specific counties.
zone.asc	0_bpm1\1_Prep\2_tnet\zones	Transit	
taz_area.dbf	0_bpm1\1_Prep\2_tnet\zones\taz	Transit	
taz_cnty.asc	0_bpm1\1_Prep\2_tnet\zones\taz	Transit	
taz_cent.dbd	0_bpm1\1_Prep\2_tnet\zones\taz\taz_cent	Transit	Centroid layer for new zone layer
taz_edge.asc	0_bpm1\1_Prep\2_tnet\zones\taz_edge	Transit	

In most cases, changing zone systems means that a new model has been developed.


GTM-Goethals Transportation Model:
Basic Application Flow for Scenario Forecast
Congestion Pricing
Define Basic Scenario
SED Data
Cash / E-ZPass Split
Define Toll Variation
Tolls by Hour by Xing by Class
Code BPM Transit Net
A
Code Highway Network NETPREP 2(B) Tier 2
Estimate Average Period Tolls
B
Baseline Trip Tables Tier 1
Fragment Trip Tables to Tier 2
#1 Assign for Skims: AM &MD Assign to Tier 2(B) Skim for Tier 1
From prior baseline run
Skims: O-D travel times and costs
Baseline Skims Tier 1
2nd Loop
Tier 1
BPM Core Models: (Resident Travel)
Household Synthesis
Auto Ownership
Journey Production*
Attractions*
Destination Choice*
Mode Choice*
Stops - Frequency and Location
SubMatrix procedure: EB Interstate Market
Pre-Process both Baseline and Alt Skims for TOD by segments
Time-of-Day Choice Model: Incremental
Externals by Autos (Out of Region)
Commercial Trucks Other ("Vans")
Special Generators EWR Howland Hook Port Elizabeth
Adjusted Departure Times ("diurnal curves") Both Directions of Tour
Pre-Assignment Processor (B) / Time of Day (PAP/TOD)
Fragment Hwy Trip Tables to Tier 2
#2 Highway Assignments AM and MD: Tier 2 Network
BPM Transit Assignments AM
#3 Highway Assignments AM, MD, PM, NT Tier 2
KEY:
GTM - New Component or Adaptation to BPM-NYMTC
New or Revised Component for Time-of-Day Choices / Congestion Pricing Evaluation
PB Consult: Draft 1/5/05

Tasks 1-3 - Modification of the GTM Using Moderate Employment Growth Forecast

1. For the GTM characteristics that deal with the employment data requirements, convert the 2030 forecast data:
   The GTM model requires that the employment forecasts be converted into Census-based employment forecasts, holding to the County-level total, and requires both total employment and sub-categories of retail and office employment as key indicators of travel.

2. Develop the 2030 data inputs for the 85 TAZs in Staten Island, which were created as part of the previous GTM development process:
   The employment forecasts for Staten Island will be developed for up to six Sub-Areas, as described in the first portion of this proposed scope of work. The GTM, however, requires that a separate forecast be developed for each of the 85 zones in Staten Island for each of the three employment categories (total, retail and office). Based on GIS data, this will have to be completed prior to any computer model runs.

   The moderate-growth employment forecasts developed for the Sub-Areas will be disaggregated among each Sub-Area's constituent TAZs based on each TAZ's existing (base-year) employment as a proportion of the Sub-Area total. This de-segregation will be refined to account for specific, pipeline development projects (as identified in Task 3 of the first portion of this proposed scope of work) located within any given TAZ. For example, if existing employment in a given TAZ in Sub-Area A constitutes 10 percent of the existing employment in Sub-Area A, 10 percent of the employment growth (i.e., 2030 employment minus existing employment) will be assigned to that TAZ. However, if any of the pipeline development projects are slated for parcels within that TAZ, the proportional employment increase assigned to it will be re-assessed and, if appropriate, increased, based on the details of the development project(s) and the parcel-level data compiled in Task 2. Any increase will be offset by any decrease in one or all of the remaining TAZs in the Sub-Area, depending on the land use characteristics of the remaining TAZs.

3. Update Area Type files used in the GTM, as necessary, based on the changes in employment densities:
   The GTM employs Area Type that affects the trip-generation portion of the model. This needs to be reviewed in light of the new disaggregation of employment, i.e., non-uniformly to each zone. The previously coded Type may no longer be valid.

Tasks 4-9 – Running of Revised GTM with the No-Build and 6-Lane Replacement Alternatives

4. Develop 2030 productions and attractions to be used in the No-Build and 6-Lane Replacement Bridge alternatives' assignments:
   This is the trip-generation portion of the model. The major change will occur at the destination end of the trip since Staten Island employment will be lower with the moderate growth forecast. It is likely that there will be fewer trips into Staten Island and more Staten Island workers will have to travel to off-Island job locations.

5. Develop new modal split characteristics for the 2030 GTM:
   The mode split characteristics are very heavily work-based. Since the employment numbers on Staten Island will change, the GTM will need to rerun the mode split to determine how the work-based trips would be affected on Staten Island, as well as how trips to Staten Island would be affected.

6. Prepare new highway and transit skim trees for the 2030 No-Build and 6-Lane Replacement Bridge alternatives:
   Since the number of trips attracted to Staten Island and the mode-split characteristics on Staten Island will change, new skim trees will need to be developed for the assignments. Skim trees measure the total travel time and cost (including tolls) between any two zones. This information is used to identify the best paths between any two zones and helps the GTM assign trips among multiple travel path options between zones. The best time and cost gets the most trips and then other possible paths get progressively fewer trips. This routine is run at least three times to balance flows among likely paths.

7. Run the revised GTM for the 2030 No-Build and 6-Lane Replacement Bridge alternatives:
   These runs will use the same networks as previously developed but will require the outputs of subtasks 2, 4, 5, and 6, above, for the new employment forecasts to develop the actual trip assignments.

8. From the GTM output, prepare new 2030 estimates of AM and PM peak-hour traffic, by direction, for the selected links[8] for comparison with the previous results:
   Once the 4-hour runs are completed by the GTM, the output is converted into directional peak-hour flows along each link that is being used for comparison purposes as part of the alternatives screening process.

9. From the GTM output, calculate results for the traffic/transportation-related evaluation measures associated with Screening Criteria 1 and 2:
   Results for several screening evaluation measures (including levels of service, speed, region-wide VMT and number of trips) need to be developed for the two alternatives (No-Build and 6-Lane replacement capacity) for comparison purposes against the previous results with the base GTM (i.e., using NYMTC's Staten Island 2030 employment forecast).

[8] Goethals Bridge, Outerbridge Crossing, Bayonne Bridge, Verrazano-Narrows Bridge, Holland Tunnel.

Goethals Bridge Replacement EIS

Development of Moderate Employment Forecast for Staten Island and Associated Version of Goethals Transportation Model (GTM)

Phase II – Tasks 1 and 2
Allocation from Sub-Areas to Traffic Analysis Zones

Introduction

In previous tasks, indicators of vacant land, previous employment growth, and known and planned development projects were compiled for nine Sub-Areas on Staten Island in order to develop a more refined distribution of employment growth. The GTM requires land use inputs for 84 traffic analysis zones (TAZs) in the borough. This memo describes the process of allocating Sub-Area employment forecasts for 2030 to TAZs.

Methods

Each of the Sub-Areas is composed of several TAZs. To allocate the increment of employment growth from the GTM base year (2002) to the forecast year (2030), the following steps were taken.

County Control Totals for Office and Retail – Control totals for total employment were developed in Task 4 and documented in the summary technical memorandum. County level totals for Office and Retail employment required for the GTM were derived by taking the share of these industries in the Economy.com forecast and applying it to the total employment forecast for 2030. Using this method, Office employment is 31 percent of the growth in total employment from 2002 to 2030, Retail represents 23 percent of the growth. Table 1 show the increment of growth and total employment by Sub-Area.

Table 1:
Sub-Area Control Totals

	Total		Office		Retail	
SubArea	Increment 2002-2030	Total 2030	Increment 2002-2030	Total 2030	Increment 2002-2030	Total 2030
1	9,030	25,722	2,720	6,140	1,334	4,637
2	3,106	19,191	969	4,384	338	2,681
3	6,497	25,632	2,447	7,352	548	2,708
4	14,046	28,174	4,048	6,818	4,213	9,891
5	1,108	12,189	290	2,266	123	1,776
6	4,302	24,062	1,136	4,688	743	5,314
7	10,729	19,134	3,058	4,688	4,109	8,422
8	3,392	12,279	1,331	3,703	380	1,713
9	2,390	8,571	751	2,073	498	2,223
	54,601	174,955	16,751	42,113	12,285	39,365

Allocation to TAZs – Sub-Area control totals for each of the three industry categories were allocated to TAZs based on each TAZ's share of existing employment in the Sub-Area, and each TAZ's share of

vacant land in the Sub-Area. Known development activity since the 2002 base year and planned development activities identified in Task 4 were also included in the TAZ allocation. The process for allocation is as follows.

- **Known Development Activity 2002-2004 –** Queries to the MapPLUTO database established commercial floor space added to the borough since 2002. These development locations were identified by TAZ. The new floor area was converted to employment potential by applying the average floor area per employee in each Sub-Area (see Task 4 memo). Employment estimates were listed by TAZ.

- **Planned Development Activity 2005 and Beyond –** The location of planned commercial, retail, and industrial development activity by Sub-Area and TAZ was identified in Task 4. Floor area was converted to employment potential using sub-area averages and listed by TAZ.

- **Allocation of Remaining Growth –** Once known and planned employment growth was allocated to TAZs, the remaining increment of growth from 2002 to 2030 was allocated based on share of existing employment and vacant land:

    - Share of existing employment in each of the three categories was summarized for each TAZ and Sub-Areas from the 2002 GTM SED database.
    - Share of vacant/underutilized floor space was derived from the inventory developed for each TAZ and Sub-Area in Task 4.
    - An allocation share was developed by taking a weighted average of the existing employment share and the vacant/underutilized share. This average ensures that a larger proportion of the increment of future growth goes to those TAZs with development capacity. To reflect the potential for employment growth in existing developments and areas with existing employment the average was weighted 70% for existing employment and 30% for vacant/underutilized capacity.

- **Summation –** Known, planned, and remaining growth were summed by TAZ to derive the total allocation for each industry category. Cross-checks with control totals were performed to ensure that the TAZ estimates match the control totals for the Sub-Areas and the county as a whole.

Findings

Allocations to TAZs match Sub-Area and regional control totals and correlate closely with vacant land capacity and existing development as intended. Table 2 displays the top ten largest allocations of the increment of growth from 2002 to 2030 by TAZ. Zones on the western shore in Sub-Areas 1, 4, and 7 show the largest levels of growth. These include the TAZs in the Charleston area, Howland Hook, and the former GATX tank farm. The TAZ with the Stapleton-Homeport proposed development is also represented among the top 10 TAZs in terms of growth.

Table 2: Allocation of Employment Growth by TAZ
10 TAZs with Largest Increment of Growth 2002-2030

TAZ	Increment of Employment Growth 2002-2030
5083	7,454
5040	5,945
5057	4,727
5041	3,374
5025	3,292
5036	2,597
5074	1,389
5080	1,079
5078	974
5067	963

Full TAZ allocations are presented in the spreadsheet table accompanying this memorandum.

APPENDIX D:

Memorandum on GTM Toll Sensitivity in Highway Trip Assignments

GTM Toll Sensitivity in Highway Trip Assignments

The GTM was developed based on NYMTC's regional travel demand model, i.e., Best Practice Model (BPM) "2002 Updates version," by refining and enhancing the latter to provide a level of travel analysis resolution appropriate for a subregional study, i.e., Goethals Bridge Replacement EIS. The standard practice of travel demand modeling applications is to keep the model unaltered (i.e., "frozen") once model development has been completed, the results of model runs have been determined to be reasonable, and the model has been adopted and used for a given study. PB generally prefers to follow this policy regarding model updates for a given study because it allows consistent and objective comparisons of travel conditions of the base year, no-build, and various build alternative scenarios. Altering this standard practice may be necessary under certain exceptional conditions, but it requires careful weighing of the trade-offs between the desire to use a "better" enhanced model, and an anticipation of to what extent the accuracy of the model results may be improved, and retaining the version already adopted and used in the given study. Such trade-offs may include consideration of the potential analytical improvements and/or additional project benefits that may be realized with further model refinement (e.g., material change in model results and conclusions regarding the proposed project), balanced against the additional study cost and schedule delay associated with further model refinements (e.g., first updating the model and then re-doing all model runs previously completed with the possibility that it may not materially change the results or conclusions).

Berger/PB exercised due diligence to keep the GTM unchanged once the PANYNJ and Berger/PB reached consensus that the existing conditions, No-Build and Build runs were completed. Nonetheless, a technical modeling situation arose during the course of this study that necessitated the consideration of GTM updates. Discussion of such a case, i.e., to toll sensitivity of the model's highway trip assignment procedure, is provided below.

Toll Sensitivity During Highway Trip Assignments – While the GTM model's development was completed and the GBR EIS model runs were performed, NYMTC's regional BPM continues to evolve through NYMTC's model-enhancement efforts and feedback from BPM applications on other studies and projects being conducted in the region. Berger/PB's modeling staff, which developed the GTM, is aware and keeps abreast of the ongoing revisions and changes made by NYMTC to the BPM.

As part of the initial Congestion-Pricing modeling that was conducted by PB for the City of New York and modeling conducted by PB for NYMTC's CATS II project, it was determined that the trip-assignment process needed to be more sensitive to tolls in the assignment process. More specifically, it was discovered that the selection of routes in the BPM was not sensitive to tolls during highway trip assignments, although the tolls were properly considered for in the prior core choice travel choice steps of the modeling, such as travel destination choice and mode choice. It was determined that this toll insensitivity in the highway assignment was an inherent problem in the TransCAD software version 4.5, which is currently the platform of the BPM (Version 2002), as it is also for the GTM. The history of this toll sensitivity rectification is as follows:

- In late October/early November 2006, both the CATS II and the early Congestion Pricing Studies found assignment issues with the East River Crossings.
- In Mid November 2006, this issue was brought to Caliper's attention (Caliper is the developer of TransCAD). Caliper determined that it was an issue with the toll sensitivity on the TransCAD 4.5 platform used for assignment routing. It was determined that the mode split and trip distribution routines were handling tolls correctly.
- In early December 2006, Caliper suggested switching to TransCAD 4.8 and created a fix in the route assignment process.

- In December 2006, PB began testing the TransCAD fix on the City's Congestion Pricing assignments.
- In February 2007, it was concluded, based on PB's testing of the fix, that the assignment-routing sensitivity was improved across the East River Crossings where free bridges compete with toll facilities. However, at toll facilities that compete solely with other toll facilities, the route assignment was not significantly affected.

This toll sensitivity patch that was developed in February 2007 has ***not been released by NYMTC for universal use by those using the BPM.*** It is expected to be made available to users in February/March 2008 as part of the BPM 2005 Update that will be implemented in TransCAD 4.8. However, it was available to be used by PB, if required, on projects by March/early April 2007. In fact, PB used it in April 2007 for a study being conducted for NYSDOT on the East side of Manhattan. However, by March 2007, all of the GBR EIS modeling runs, including the Managed Lane mitigation run, were complete but the post processing was not done until the fall. Correcting this issue for the GBR EIS model runs would require switching the TransCAD platform from version 4.5 to at least version 4.8 or later. In addition, it would also require modification of certain programs and TransCAD macro-program scripts that are used internally by the GTM.

Recent questions raised by PANYNJ staff about the toll sensitivity revision to the BPM were brought to Berger/PB's attention. As a consequence, Berger/PB undertook a review to determine whether the patch would materially affect the GTM and potentially warrant the updating of the GBR EIS alternatives modeling. The revised version of the route assignment routine was tested on the GTM to determine the net effects of this change on the GTM model results developed for this study. This included separate testing of the effect of changing TransCAD platforms, as well as testing of the effects of adding toll sensitivity to the route choice/trip assignment module in the model.

Based on our having developed the BPM and the GTM, on our understanding of the regional network, and on the modeling we have conducted for the other studies cited above, PB believed that the overall change from this revision would not be of a magnitude to warrant the time and resources required to update the GTM and re-do the GBR EIS modeling done to date. We expected that the traveler's route choice in the GTM could be affected somewhat due to the presence of the large one-way toll on the Verrazano Narrows Bridge (VNB). Some travelers may try to avoid the VNB tolls by opting to use the toll-free NYC East River Bridges even though the most direct route would use the VNB; in this case, some of the travel demand for the Goethals Bridge would be affected. The impact of tolls differentials on the NJ Turnpike for routes using either the Goethals or the Outerbridge was seen to be small, given the actual differences in tolls paid, and the average value of time applied in the GTM.

It also is essential to understand how the volumes for the GTM are post-processed for the GBR EIS traffic studies. The study does not use the "raw" assigned demand that comes directly out of the GTM, but employs "incrementally post-processed" demand forecasts compared to existing base-year counts. Therefore, any net change in Goethals Bridge demand from the toll sensitivity in route-selection revision would not be significant because any change in the pattern of trip assignments would be expected to be similar for Base Year, No-Build, and Build scenarios, since there are no facility-specific toll policies that vary among these scenarios.

The results of testing the GTM with this patch confirmed the above professional judgment. It was found that differences in forecast volumes with the GTM and the GTM-with-toll-sensitivity revision for the future Build (2034) at the Goethals Bridge ranged from -50 trips to -190 trips in the peak hours. This translates to the eastbound AM peak-hour volume being reduced by about 50 trips (a 1.2% reduction); the westbound AM being reduced by 60 trips (1.3% reduction); the eastbound PM being reduced by 95 trips (2.0% reduction); and the westbound PM being reduced by 190 trips (4.3% reduction). Similar volume

changes (but increases rather than decreases) were found on the parallel Outerbridge Crossing, representing the magnitude of traffic shifting between the two bridges with the Patch used in the assignment process. ***All of these changes fall well within the industry-wide standard of travel demand forecasting accuracy*** and are insignificant in the decision about which Bridge alignment to build or whether the Replacement Bridge alternative needs six lanes. These minimal traffic reductions also would have no effect on the overall areas for which traffic impacts have been identified for mitigation. The testing confirms what was observed from other studies -- that this revision is not needed for the Goethals Bridge traffic forecasts prepared for the EIS.

APPENDIX E:

Description of Express Bus System Assumed for 6-Lane Bridge-Replacement Alternative with Managed Lane Option

Description of Express Bus Transit System Assumed for 6-Lane Bridge-Replacement Alternative with Managed Lane Option

An express bus system was incorporated in the Managed Lane option, which was tested for its potential utility to mitigate significant traffic impacts that would result with the four 6-Lane Bridge-Replacement alternatives being evaluated in the GBR EIS. The bus system assumed to be in place with the Managed Lane option was originally developed and tested as a Bus Rapid Transit (BRT) alternative in the alternatives screening process conducted to select project alternatives for detailed evaluation in the GBR EIS. That original BRT system, which assumed dedicated rights-of-way, was re-defined as an express bus system, i.e., no dedicated rights-of-way for the buses, for purposes of the Managed Lane option. The initial route system was developed and subsequently refined based on review comments from the Port Authority, the Metropolitan Transportation Authority (MTA), and MTA-New York City Transit (NYCT). Figure E1 depicts the express bus route system considered in conjunction with the Managed Lane option. A detailed description of the preliminary system assumed in the alternatives screening process is provided below, followed by a description of refinements made to it for purposes of the Managed Lane option analysis.

Figure E1. Express Bus Transit System Assumed for 6-Lane Bridge-Replacement Alternatives with Managed Lane Option

Notes for Preliminary Bus Transit System Considered in Alternatives Screening Process

- The mode for all routes should be coded as bus.
- Capacity of mode should be assumed at 70 passengers (seated and standing) and a consist size of 1, based on the use of an articulated vehicle.
- Headway for new routes is detailed below in the description of bus routes. Headways for existing services should be assumed to remain the same as they are currently.
- Local bus route changes are detailed in the attached spreadsheets that indicate any modifications to the routing.
- Fare for all routes should be assumed to be the same as for current subway and local bus ($2.00).
- All express bus stops should be coded as having walk access, pick-up/drop-off access, and transfer access from any other transit mode located within a ¼ mile.
- Assume the following parking is available:

Station	Parking Available	Source	Daily Rate
St. George	902	NYC DOT	$6
Sailor's Snug Harbor	20	Assumed on-street parking	-
West Brighton	20	Assumed on-street parking	-
Port Richmond	20	Assumed on-street parking	-
Elm Park	20	Assumed on-street parking	-
Mariner's Harbor	20	Assumed on-street parking	-
Arlington	200	Assumed new lot adjacent to Arlington Yard	$3
Hylan	20	Assumed on-street parking	-
Targee	20	Assumed on-street parking	-
Clove	20	Assumed on-street parking	-
Bradley	20	Assumed on-street parking	-
Victory (SIE)	20	Assumed on-street parking	-
Richmond	20	Assumed on-street parking	-
Outerbridge	250	Expansion of existing lot	$3
Huguenot	100	Assumed new lot adjacent to West Shore Expressway	$3
Victory (WS)	100	Assumed new lot adjacent to West Shore Expressway	$3
Bloomfield	500	Assumed new lot available as part of NASCAR/ISC project	$3
Elizabeth train station	900	NJ Transit	$5
Union Township train station	500	NJ Transit	$3
Field Rd.	20	Assumed on-street parking	-
Stuyvesant Ave.	20	Assumed on-street parking	-
Rahway Ave.	20	Assumed on-street parking	-
SR 124	20	Assumed on-street parking	-
Millburn Ave.	20	Assumed on-street parking	-
Summit train station	925	NJ Transit	$3
EWR South Area	0	No parking available at airport	-
EWR Terminal A	0	No parking available at airport	-
EWR Terminal B	0	No parking available at airport	-
EWR Terminal C	0	No parking available at airport	-
EWR North Area	0	No parking available at airport	-
Lincoln Park	20	Assumed on-street parking	-
Court House	20	Assumed on-street parking	-
Downtown Newark	20	Assumed on-street parking	-
Newark Penn Station	500	Field observation	$8

Description of Express Bus Routes

Route WS1

- Begin at Outerbridge on West Shore.
- Stop at Huguenot, Victory, and Bloomfield on West Shore.
- Cross Goethals Bridge/I-278 on reserved lane.
- Exit I-278 at Bayway Ave.
- Bayway Ave. west to South Broad St.
- South Broad St. northwest to NJT Elizabeth train station.
- From NJT Elizabeth train station, west on Morris Ave.
- Morris Ave. west to NJT Union Township train station.
- From NJT Union Township train station, continue west on Morris Ave.
- Morris Ave. west, with stops every ½ mile, to Broad St. in the City of Summit.
- South and southwest on Broad St. to NJT Summit train station.
- Terminate at NJT Summit train station.
- Reverse route for return trip.

Headway=20 min.

Route WS2

- Begin at Outerbridge on West Shore.
- Stop at Huguenot, Victory, and Bloomfield on West Shore.
- Cross Goethals Bridge/I-278 on reserved lane.
- Exit I-278 to NJ Turnpike north.
- NJ Turnpike north to Exit 13A.
- Exit NJ Turnpike to Earhart Dr.
- Earhart Dr. northwest to stop at NWK South Area at corner of Wiley Post Rd.
- Continue northwest on Earhart Rd. to airport terminal roadway.
- Stop at Terminal A, Terminal B, and Terminal C (one stop at each terminal).
- Exit airport terminal roadway to US 1&9 north.
- North on US 1&9 and exit to Brewster Rd.
- Terminate at intersection of Brewster Rd. and Conrad Rd. to serve NWK North Area.
- Reverse route for return trip (including stops at airport terminals)

Headway=20 min.

Route WS3

- Begin at Outerbridge on West Shore.
- Stop at Huguenot, Victory, and Bloomfield on West Shore.
- Cross Goethals Bridge/I-278 on reserved lane.
- Exit I-278 to NJ Turnpike north.
- NJ Turnpike north to Exit 14.
- Exit NJ Turnpike to US 1&9 south.
- South of US 1&9 south to SR 21.
- North on SR 21 to Broad Street in the City of Newark.
- North to Broad Street to Raymond Blvd.
- East on Raymond Blvd. to Newark Penn Station.
- Terminate at Newark Penn Station
- Reverse route for return trip, except use Market St. from Newark Penn Station to Broad Street.

Headway=20 min.

Route SIE1

- Begin at Hylan on Staten Island Expressway.
- Stop at Targee, Clove, Bradley, Victory, and Richmond.
- Cross Goethals Bridge/I-278 on reserved lane.
- Exit I-278 at Bayway Ave.
- Bayway Ave. west to South Broad St.
- South Broad St. northwest to NJT Elizabeth train station.
- From NJT Elizabeth train station, west on Morris Ave.
- Morris Ave. west to NJT Union Township train station.
- From NJT Union Township train station, continue west on Morris Ave.
- Morris Ave. west, with stops every ½ mile, to Broad St. in the City of Summit.
- South and southwest on Broad St. to NJT Summit train station.
- Terminate at NJT Summit train station.
- Reverse route for return trip.

Headway=20 min.

Route SIE2

- Begin at Hylan on Staten Island Expressway.
- Stop at Targee, Clove, Bradley, Victory, and Richmond.
- Cross Goethals Bridge/I-278 on reserved lane.
- Exit I-278 to NJ Turnpike north.
- NJ Turnpike north to Exit 13A.
- Exit NJ Turnpike to Earhart Dr.
- Earhart Dr. northwest to stop at NWK South Area at corner of Wiley Post Rd.
- Continue northwest on Earhart Rd. to airport terminal roadway.
- Stop at Terminal A, Terminal B, and Terminal C (one stop at each terminal).
- Exit airport terminal roadway to US 1&9 north.
- North on US 1&9 and exit to Brewster Rd.
- Terminate at intersection of Brewster Rd. and Conrad Rd. to serve NWK North Area.
- Reverse route for return trip (including stops at airport terminals)

Headway=20 min.

Route SIE3

- Begin at Hylan on Staten Island Expressway.
- Stop at Targee, Clove, Bradley, Victory, and Richmond.
- Cross Goethals Bridge/I-278 on reserved lane.
- Exit I-278 to NJ Turnpike north.
- NJ Turnpike north to Exit 14.
- Exit NJ Turnpike to US 1&9 south.
- South of US 1&9 south to SR 21.
- North on SR 21 to Broad Street in the City of Newark.
- North to Broad Street to Raymond Blvd.
- East on Raymond Blvd. to Newark Penn Station.
- Terminate at Newark Penn Station
- Reverse route for return trip, except use Market St. from Newark Penn Station to Broad Street.

Headway=20 min.

Route NS1

- Begin at St. George on North Shore.
- Stop at Sailor's Snug Harbor, West Brighton, Port Richmond, Elm Park, Mariner's Harbor, and Arlington on North Shore.
- Cross Goethals Bridge/I-278 on reserved lane.
- Exit I-278 at Bayway Ave.
- Bayway Ave. west to South Broad St.
- South Broad St. northwest to NJT Elizabeth train station.
- From NJT Elizabeth train station, west on Morris Ave.
- Morris Ave. west to NJT Union Township train station.
- From NJT Union Township train station, continue west on Morris Ave.
- Morris Ave. west, with stops every ½ mile, to Broad St. in the City of Summit.
- South and southwest on Broad St. to NJT Summit train station.
- Terminate at NJT Summit train station.
- Reverse route for return trip.

Headway=20 min.

Route NS2

- Begin at St. George on North Shore.
- Stop at Sailor's Snug Harbor, West Brighton, Port Richmond, Elm Park, Mariner's Harbor, and Arlington on North Shore.
- Cross Goethals Bridge/I-278 on reserved lane.
- Exit I-278 to NJ Turnpike north.
- NJ Turnpike north to Exit 13A.
- Exit NJ Turnpike to Earhart Dr.
- Earhart Dr. northwest to stop at NWK South Area at corner of Wiley Post Rd.
- Continue northwest on Earhart Rd. to airport terminal roadway.
- Stop at Terminal A, Terminal B, and Terminal C (one stop at each terminal).
- Exit airport terminal roadway to US 1&9 north.
- North on US 1&9 and exit to Brewster Rd.
- Terminate at intersection of Brewster Rd. and Conrad Rd. to serve NWK North Area.
- Reverse route for return trip (including stops at airport terminals)

Headway=20 min.

Route NS3

- Begin at St. George on North Shore.
- Stop at Sailor's Snug Harbor, West Brighton, Port Richmond, Elm Park, Mariner's Harbor, and Arlington on North Shore.
- Cross Goethals Bridge/I-278 on reserved lane.
- Exit I-278 to NJ Turnpike north.
- NJ Turnpike north to Exit 14.
- Exit NJ Turnpike to US 1&9 south.
- South of US 1&9 south to SR 21.
- North on SR 21 to Broad Street in the City of Newark.
- North to Broad Street to Raymond Blvd.
- East on Raymond Blvd. to Newark Penn Station.
- Terminate at Newark Penn Station
- Reverse route for return trip, except use Market St. from Newark Penn Station to Broad Street.

Headway=20 min.

Revisions to Preliminary Bus Transit System for Purposes of Managed Lane Option

Based on review of the screening analysis of the preliminary BRT alternative, as well as comments received from the Port Authority and the MTA-NYCT, the following modifications were made to the original definition of the potential bus transit system and used for the Express Bus routes assumed in the Managed Lane option:

- The fare for all services should be set at $4.00, instead of $2.00.
- The headway for all services should be set at 15 minutes, instead of 20 minutes.
- The routes that run along the Staten Island Expressway (designated as SIE1, SIE2, and SIE3) should be extended across the Verrazano-Narrows Bridge to serve 86th Street Station on the BMT Fourth Avenue Line (R route). After beginning at 86th Street Station, the route should cross the Verrazano-Narrows Bridge and enter the SIE, stopping at Hylan. From there, the routes should resume the routing described in the original definition .
- In coding the Express Bus system, existing NYCT local and express bus routes that intersect the SIE at Hylan Boulevard (particularly the S78 and S79, but also the X1, X2, X3, X9, and X20) are assumed to have a convenient transfer to and from these bus routes that stop at Hylan .
- In coding the Express Bus system, existing NYCT local and express bus routes that intersect the SIE at Richmond Avenue (S44, S59, S94, X10, and X17) are assumed to have a convenient transfer to and from the bus routes that stop at Richmond .