Palm Beach Isles, Singer Island
Canal Crossing Structures Condition Report
2nd Draft Report: November 25, 2015

Alan Gerwig & Associates, Inc.
Consulting Engineers

Palm Beach Isles, Singer Island Canal Crossing Structures Condition Report
(2nd Draft)

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1. Introduction & Background

The City of Riviera Beach is proposing to carry out a series of street improvements in the Palm Beach Isles neighborhoods on Singer Island. Palm Beach Isles includes a series of structures over canals that provide boat access to the Intracoastal Waterway from the various residences.

There are a total of six structures. Four of the structures are on Island Drive that crosses the main canal around Palm Beach Isles. These structures connect the neighborhood to North Ocean Drive (A1A). The other two structures on Grand Bahama Lane cross an interior canal within Palm Beach Isles. The layout of the Palm Beach Isles neighborhood and canals and the location of the structures is shown in Figure 1.

It is not known when the structures were constructed because no original design drawings are available for the structures. The structures are showing signs of deterioration with areas of cracking and spalled concrete clearly visible from the bulkhead walls surrounding the structures. For this reason the City of Riviera Beach has requested that the scope of the neighborhood improvements include the preparation of a condition report of the structures based on detailed inspections under the structures and from the surface.

This report details the findings of inspections performed by Alan Gerwig & Associates, Inc. (AGA) and also provides a series of recommendations resulting from the inspections. This work has been performed under a sub-contract to Erdman Anthony who are the engineering consultant for the City of Riviera Beach for the neighborhood improvements.

2. Existing Structures

The existing Structures consist of a superstructure with reinforced concrete deck units supported by reinforced concrete beams. The superstructure is supported by a substructure consisting of a concrete cap with concrete pile foundations. In each case the substructure continues as a concrete bulkhead wall consisting of a concrete cap and concrete piles with tie-back anchors.

Each of the canal crossings consists of two separate structures with a landscaped island in the middle of the canal. The landscaped islands are surrounded by bulkhead walls.

Island Drive Structures

Island Drive connects the neighborhood to North Ocean Drive (A1A) and consists of two separate crossings of the canal – one for eastbound traffic and the other for westbound traffic (see the location plan in Figure 2). Each crossing consists of a structure on either side of the canal separated by a landscape island surrounded by bulkhead walls.

All four structures have a span of approximately 17’ and a width between curbs of approximately 12’. The superstructure consists of three rectangular reinforced concrete beams with reinforced concrete deck slabs spanning between the beams to form the deck (riding surface) of the structure. The beams are approximately 1’ 4” wide; the depth of the beams to the underside of the deck slab units is approximately 1’ 8” at mid span 2’ at the supports. The beams are at a spacing of 5’ 8” on centers. The outer sections of deck, which contain planters and are raised from the riding surface to form a curb, are approximately 3’ 8” from the outside face of the edge beams. These outer sections of the deck appear to span the length of the deck independent of the beams and do not appear to connect to the beams. A schematic of the Island Drive deck section is shown in Figure 3. A view of the upper and side of a typical structure is shown in Figures 4 and 5.

The beams are supported by reinforced concrete caps on concrete piles at each end. Concrete sheet panels span between the piles to form an abutment at the ends of the structure and to act as retaining walls. The concrete caps are approximately 3’ 10” deep and 2’ wide. The piles are 1’ 6” wide and are at 6’ 8” on centers.

The four structures at Island Drive underwent repairs in the late 1990s. The plans for the repairs are dated August 1998 and include replacing the deck slabs of the structures and making repairs to the underside of the beams due to deterioration resulting from corrosion of the reinforcing steel. The bulkhead walls around the islands between the structures were also repaired by adding additional batter piles connected to a new concrete cap, which in turn was connected to the existing cap.

Grand Bahama Lane Structures

Grand Bahama Lane crosses the interior canal within Palm Beach Isles. The crossing consists of two structures – one at either side of the canal, separated by an island (see Figure 6). The structures on Grand Bahama Lane each consist of two lanes – one in each direction for two-way traffic.

The span of the structures is the same as those on Island Drive. The width between curbs is approximately 23’ 6”. The form of the structures is very similar to those on Island Drive. The main differences are that the superstructure consists of five beams due to the extra deck width and spacing between piles is 7’ 6”. A view of the upper surface of a typical structure is shown in Figures 7.

The two structure on Grand Bahama Lane do not appear to have been repaired at the same time that those on Island Drive were repaired in the late 1990s.

3. Assessment of Existing Structure Conditions

An assessment of the condition of the existing structures was conducted by AGA Engineers on August 26 and included detailed inspections of the structures from a boat in the canals and from the surface. Details of the inspections are provided below.

Island Drive Structures

Figures 8 to 15 show representative photographs of the substructure and foundations of the structures at Island Drive. Generally, the piles, sheet panels and cap are in fairly reasonable condition given the age of the structures and the corrosive salt water environment that they are located in.

The piles supporting the structures contain some cracking as shown in Figure 12 and some general deterioration as shown in Figure 9, but no signs of major concrete spalls due to corrosion of the reinforcing steel. The cracks in the piles show signs of previous repairs – see Figures 10 and 12, where cracks have been sealed.

The sheet panels spanning between the piles show some horizontal cracks – see Figure 8, 9, 12 and 13. Some of the cracks have been filled at the time of previous repairs. Although the sheet panels are cracked, they are not showing signs of significant deterioration. The sheet panels are not part of the main support structure for the canal crossings as their role is primarily to retain the material under the roadway off the structures.

The concrete caps supporting the decks of the structures are in reasonable condition. Figure 14 shows a minor concrete spall exposing reinforcing steel. The reinforcing is corroded. However, it is possible that the concrete spall is due to an impact rather than a result of the steel corroding. Figure 15 shows some cracks that have been repaired on one of the caps. However, these cracks are not showing any signs of significant deterioration or likely concrete spalling.

The underside of the deck slabs of the four structures are in good condition as these elements were replaced in the late 1990s. Other than some surface defects at what appears to be a previous repair of the slab under one of the planters as shown in Figure 16, the deck slabs are in good condition. Representative photographs of the underside of the slabs are shown in Figures 17 and 18, which show the surface of the concrete in good condition with no signs of deterioration.

The condition of the beams of the decks is shown in Figures 19 to 31. Figures 19 to 26 show a range of cracks on the underside and lower sides of a selection of the beams. Some of the cracks appear to be at the site of previous repairs. Most of the cracks are fairly wide and it appears that it is only a matter of time before the concrete starts to spall, exposing the reinforcing steel.

A case where a significant concrete spall has taken place is for one of the beams on the southwest structure shown in Figures 27 to 30. Figure 27 shows a large concrete spall and an exposed corroded reinforcing bar towards one end of the beam with a large crack continuing to the other end of the beam. Figure 28 and 29 show close-up views of the spall and Figure 30 shows the continuation of the cracking to the other side of the beam. It appears from the surface that the exposed reinforcing bar has already undergone significant corrosion and some loss of section. It is only a matter of time before more of the concrete spalls off, resulting in further corrosion of the underlying steel.

Figure 31 shows a beam that has been repaired. Even though the newer concrete is not showing signs of cracking, in many of these cases impact tests with a hammer indicate that the newer concrete is delaminated and not properly bonded to the original concrete.

A number of the piles for the structures have a light colored sand at the bottom of the pile that is a different color to the material at the bed of the channel. This is a sign that some of the joints in the sheet panels behind the piles are leaking material from behind the panels. This shown in Figure 32, where a light tan color ring of sand can be seen around the bottom of the pile.

On each side of the canal the bulkhead walls between the structures have deflected significantly in the middle. This is shown in Figure 33. This deflection, which could be due to a tie-back failure or a lack of horizontal restraint, has resulted in significant cracking in the cap and the adjacent sheet panels. These cracks can be seen in Figure 34 to 36.

Grand Bahama Lane Structures

Figure 37 shows the substructure and beams of one of the two structures on Grand Bahama Lane. The substructure is in reasonable condition for the age of the structures. In addition, the beams are in reasonable condition.

Figures 38 to 40 show the underside of the deck slab and show significant deterioration with multiple exposed reinforcing bars resulting from significant concrete spalls. The reinforcing bars are showing significant corrosion.

Figure 41 shows the water main suspended from the bottom of the deck of the structures. From Figure 41 it can be seen that the pipe support has corroded and is no longer supporting the pipe.

Figure 42 shows the corner of the east structure on Grand Bahama Lane. The asphalt cracking is a sign of settlement due to loss of subgrade materials through the joints between the sheet panels under the deck. In addition, the asphalt at this location appeared to be very thick indicating that additional asphalt had been placed on numerous occasions due to the loss of material.

4. Recommendations

It is recommended that all the existing structures be replaced due to the level of deterioration that has taken place. Repairing the existing structures is not a cost-effective option due to the level of work involved and the relatively short extension of the effective life of the structures. For this reason, repairing the existing structures is not recommended.

Island Drive

It is recommended that the four structures and the bulkhead walls between the structures be replaced due to the significant deterioration detailed in this report. This represents the best value based on the life of the replacement structures.

Grand Bahama Lane

It is recommended that the two structures be replaced due to the significant deterioration detailed in this report. This represents the best value based on the life of the replacement structures.

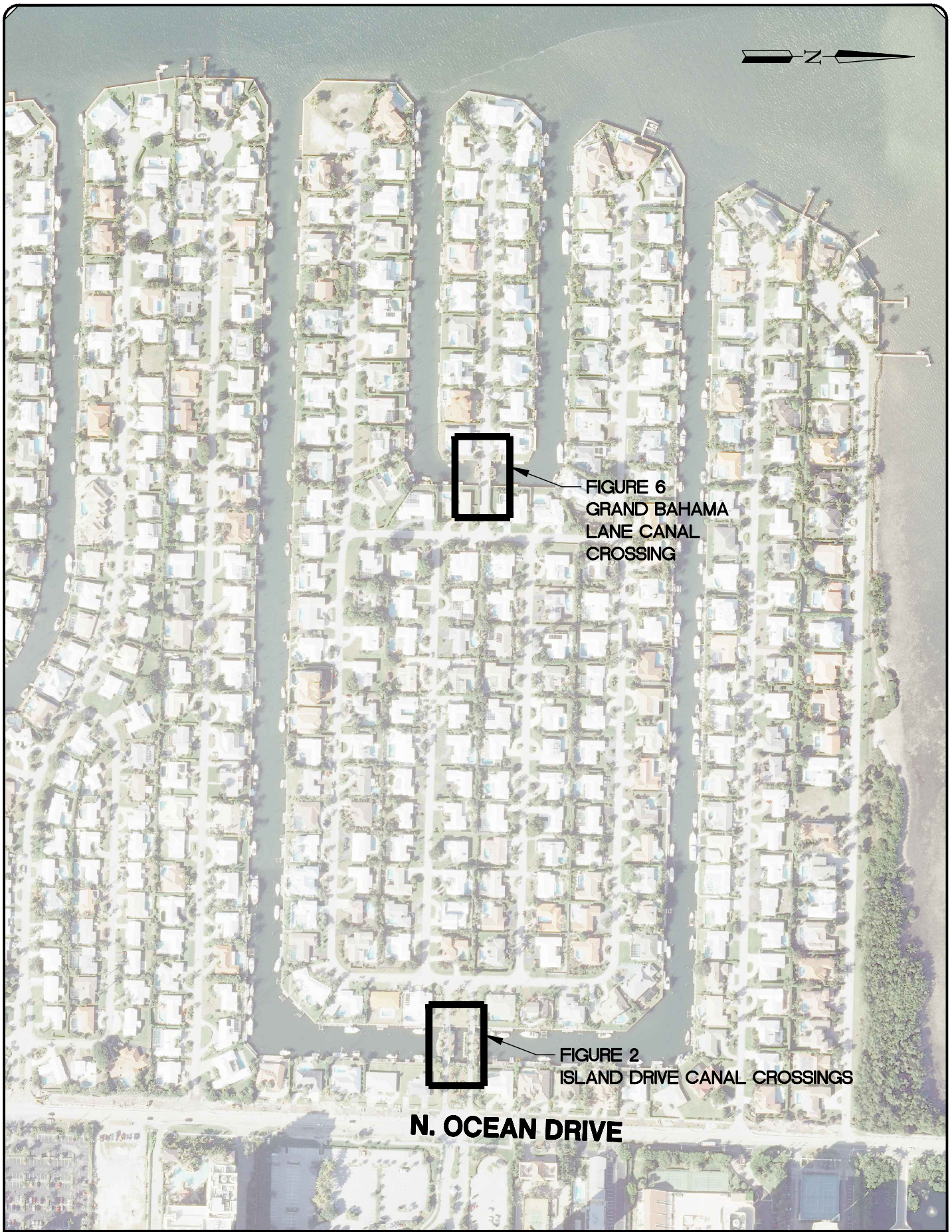
Preliminary Estimate of Replacement Cost

An initial estimate of the cost of replacing the structures is $350/SF. This gives $120,000 per structure on Island Drive (based on a 17’ x 20’ deck) and $190,000 per structure on Grand Bahama Lane (based on a 17’ x 32’ deck). An initial estimate for the bulkhead walls on Island Drive is $1,500/LF. This gives a total of $150,000 for the bulkhead walls (based on 100 LF of wall). The total preliminary budget estimate for all six structures is $1,010,000. This estimate does not include engineering, permit fees or any other incidental construction.

Alternative Replacement Option

An alternative to replacing the existing structures like-for-like, is to construct two bulkhead walls across the canals at Island Drive and Grand Bahama Lane. The section of canal between the bulkhead walls would be filled for the required roadways and would provide areas for landscaping. It is recommended that a large diameter pipe run between the two bulkhead walls to maintain the tidal flow at these locations and prevent dead ends in the canals.

Initial cost estimates for this alternative option are $400,000 for Island Drive and $300,000 for Grand Bahama Lane for a total of $700,000. This estimate does not include landscaping, engineering, permit fees or any other incidental construction.



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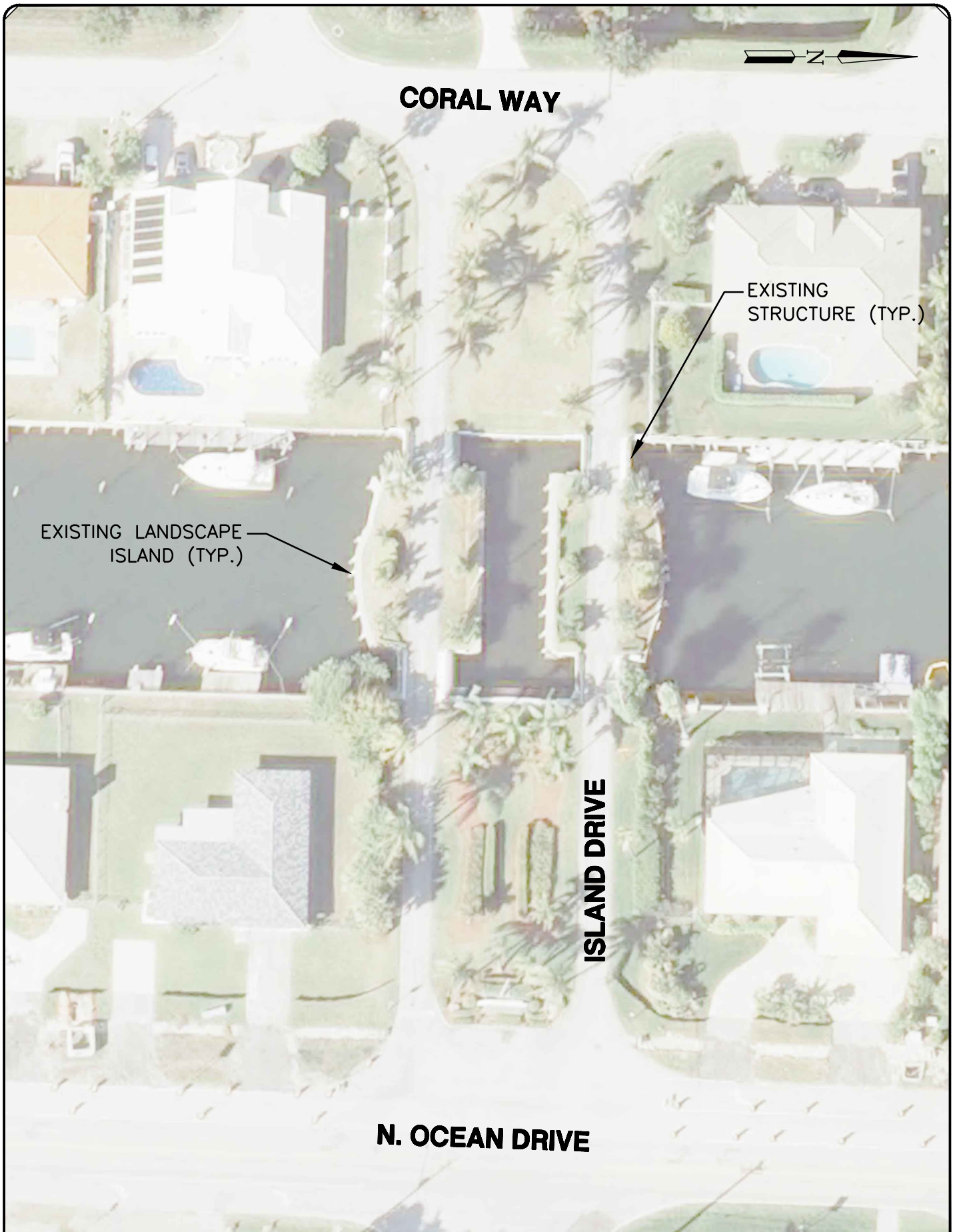
RIVIERA BEACH CANAL CROSSING STRUCTURES INSPECTIONS

- PALM BEACH COUNTY -

KEY PLAN

Drawn By: M.R.G.
Date: 09-17-15
Drawing No.
FIG. 1



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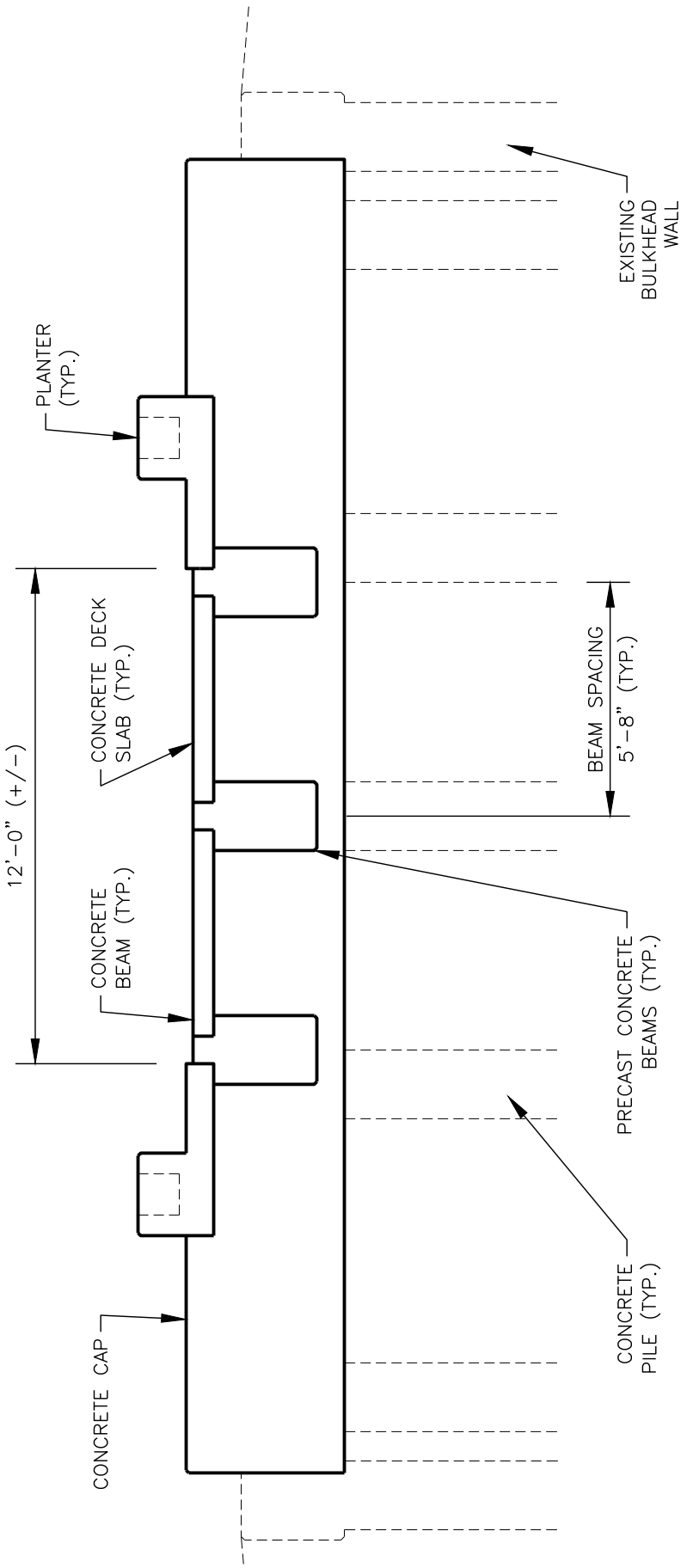
RIVIERA BEACH CANAL CROSSING STRUCTURES INSPECTIONS

- PALM BEACH COUNTY -

ISLAND DRIVE BRIDGES

Drawn By: M.R.G.
Date: 09-17-15
Drawing No.
FIG. 2



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RIVIERA BEACH CANAL CROSSING STRUCTURES INSPECTIONS

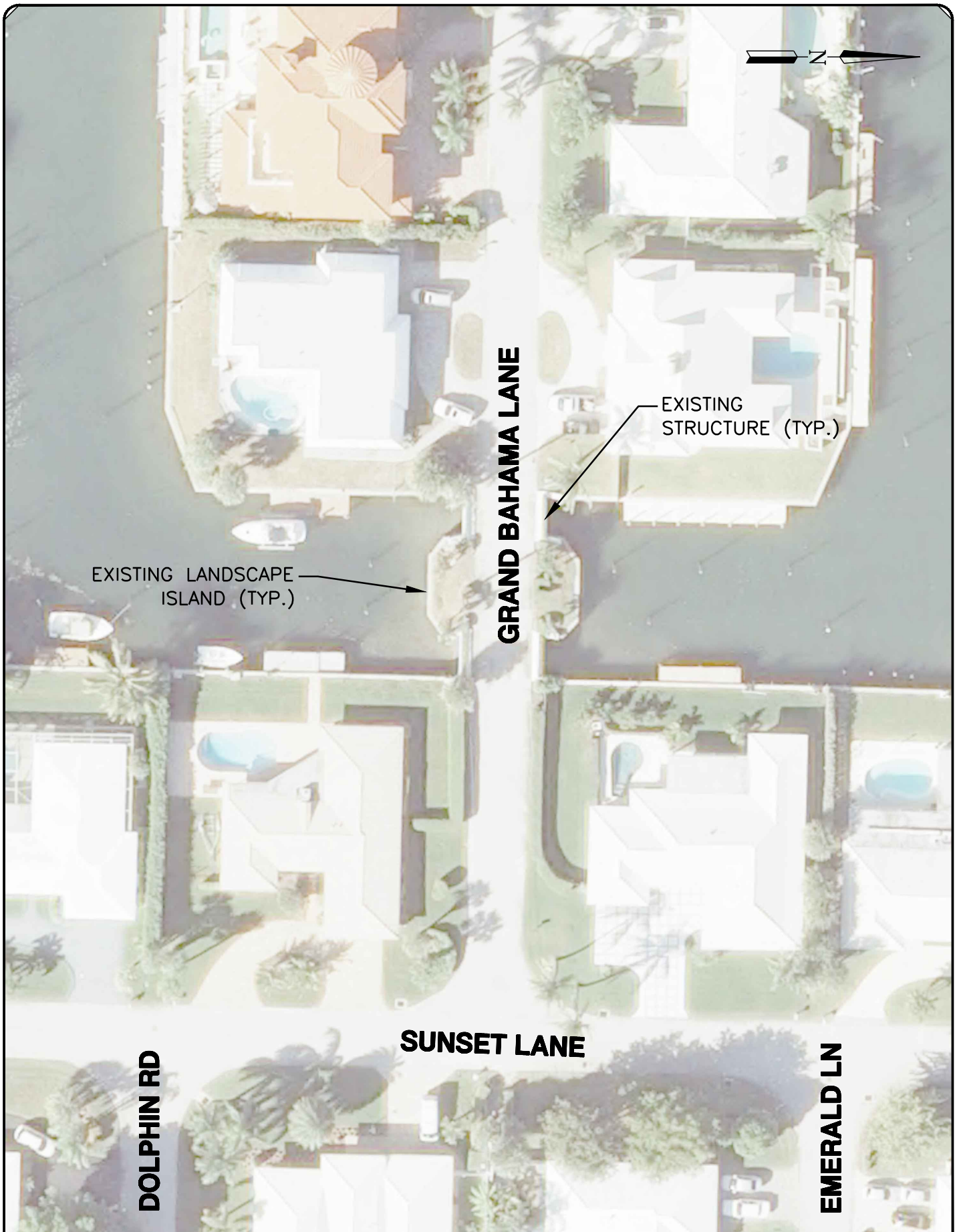
- PALM BEACH COUNTY -

TYPICAL EXISTING BRIDGE SECTION ISLAND DRIVE

Drawn By: M.R.G.
Date: 09-17-15
Drawing No. FIG. 3

Figure 4: Structure at Island Drive

Figure 5: Structure at Island Drive



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RIVIERA BEACH CANAL CROSSING STRUCTURES INSPECTIONS

- PALM BEACH COUNTY -

GRAND BAHAMA LANE BRIDGES

Drawn By: M.R.G.
Date: 09-17-15
Drawing No.
FIG. 6

Figure 7: Structure at Grand Bahama Lane

Figure 8: Substructure Island Drive

Figure 9: Substructure Island Drive

Figure 10: Substructure Island Drive

Figure 11: Substructure Island Drive

Figure 12: Pile Cracking Island Drive Structure

Figure 13: Sheet Panel Cracking Island Drive Structure

Figure 14: Cap Spall Island Drive Structure

Figure 15: Cap Cracks Island Drive Structure

Figure 16: Slab Under Planter Island Drive Structure

Figure 17: Deck Slab & Beam Island Drive Structure

Figure 18: Deck Slab & Beam Island Drive Structure

Figure 19: Beam Cracking Island Drive Structure

Figure 20: Beam Cracking Island Drive Structure

Figure 21: Beam Cracking Island Drive Structure

Figure 22: Beam Cracking Island Drive Structure

Figure 23: Beam Cracking Island Drive Structure

Figure 24: Beam Cracking Island Drive Structure

Figure 25: Beam Cracking Island Drive Structure

Figure 26: Beam Cracking Island Drive Structure

Figure 27: Concrete Spall & Beam Cracking Island Drive Structure

Figure 28: Concrete Spall & Reinforcing Corrosion Island Drive Structure

Figure 29: Reinforcing Corrosion Island Drive Structure

Figure 30: Beam Cracking Island Drive Structure

Figure 31: Beam Repair Island Drive Structure

Figure 32: Retained Material Leak Island Drive Structure

Figure 33: Bulkhead Wall Deflection Island Drive Structures

Figure 34: Bulkhead Cap & Sheet Panel Cracking Island Drive Structures

Figure 35: Bulkhead Cap Cracking Island Drive Structures

Figure 36: Sheet Panel Cracking Island Drive Structures

Figure 37: Substructure & Deck Beams Grand Bahama Lane Structure

Figure 38: Deck Spalling & Reinforcing Corrosion Grand Bahama Lane Structure

Figure 39: Deck Spalling & Reinforcing Corrosion Grand Bahama Lane Structure

Figure 40: Deck Spalling & Reinforcing Corrosion Grand Bahama Lane Structure

Figure 41: Pipe & Pipe Support Corrosion Grand Bahama Lane Structure

Figure 42: Asphalt Settlement Grand Bahama Lane Structure