

PRELIMINARY ENGINEERING OPINION

POTENTIAL INDUCED CHANNEL BANK EROSION WITHIN SANDALWOOD CANAL/HOGPEN CREEK

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Date: July 23, 2014

Devo's Project No: 14-889.01

To:

LaRue C. Ellis and Lori W. Ellis
2176 San Pablo Road South
Jacksonville, Florida 32224

attention: LaRue C. Ellis
phone: (904) 803-6096; email: llellis@aol.com

Ref:

PRELIMINARY ENGINEERING OPINION

Potential Induced Channel Bank Erosion within Sandalwood Canal/Hogpen Creek adjacent to Residential Property @ 2194 San Pablo Road South, Jacksonville, FL 32224

Tax Parcel ID #1671320150R; 2.95± acres {1.44 acres residential land & 1.51 acre saltwater marsh}

Dear Mr. Ellis:

Per your authorization, Devo Engineering has reviewed available documents and other ancillary material to form a preliminary engineering opinion on the likely cause of the recent observations of induced channel bank erosion on the lower reach of the Sandalwood Canal where it traverses your single-family residential property located at:

2194 San Pablo Road South, Jacksonville, FL 32224.

It is our understanding that this erosion, which only initiated after certain upstream improvements undertaken by the City of Jacksonville (under SJRWMD Permit #4-031-17631-6), has resulted in:

- ① erosion, undermining and collapse of a segment of the sheetpile retaining wall on your property (see Exhibit 8, next page), and
- ② erosion and loss of significant portions of the stream bank adjacent to the upland portion of your property and also to the shoreline of the island within the channel (within the property limits).



Exhibit 8. Collapsed Sheetpile Retaining Wall (4/27/2014)

Based on the information reviewed as of this writing, it is our preliminary engineering opinion that the erosion problem experienced is known as a "downstream transfer" resulting from ① upstream alterations to the drainage conveyance system, and ② substantive adverse changes to the contributory watershed into the canal (i.e., the widening of Hodges Blvd). A combination of these factors have resulted in an increase in downstream discharge volume and flow velocity in the channel at this property location.

In 2007-2008, the City of Jacksonville undertook an upstream project titled "Sandalwood Canal - In-Channel Improvements" in conjunction with the widening of Hodges Blvd (SJRWMD Permit #4-031-17631-6). The key elements of this project included the following:

- ➡ The widening of Hodges Blvd between Beach Blvd and Atlantic Blvd, transforming it from a 2-3 lane roadway with grassed roadside swales and ditches to a 4-lane curb and gutter roadway with storm sewers. A portion of this widened roadway alignment (from Beach Blvd to the Sandalwood Canal) discharges directly into the Sandalwood Canal. The widening project involved an increase in impervious area, elimination of the inherent storage/infiltration in the roadside ditches (which was significant if you look at streetview images prior to the widening project), and a reduction in the time of concentration as a

result of the piping. All of these factors lead to an increase in flow rate and discharge volume in the channel.

- ➡ Widening and stabilizing the Sandalwood Canal using a vertical sheetpile wall from Hodges Blvd eastward to its point of discharge near the saltwater marsh of Hogpen Creek. Among the stated design goals of the improved channel section, were to increase flow capacity in the canal and help reduce upstream flooding potential. However, the changes in the canal section have also likely resulted in an increase in downstream discharge rates (as a result of higher flow capacity and reduced channel friction). Additionally, the canal design originally called for two raised canal weirs east of Hodges Road, of which only one was constructed. The purpose of these weirs was to control the flow velocities in the canal, so failure to construct the easternmost weir has likely resulted in an increase in flow velocities. The weir which was constructed (just east of Hodges Blvd) has had the consequence of reducing storage with the result that stormwater runoff is not attenuated since the weir appears to flow full almost constantly.

Although stormwater modeling was performed by the design engineers (CDM) to assure the proposed changes would not result in an increase in downstream discharge or stage, it appears that this (increased flow rates) has indeed occurred as evidenced by the observed stream bank erosion in the lower reach of the canal; this is a typical problem known as a "downstream transfer". Under the circumstances, it is our opinion that the City of Jacksonville needs to address this situation and devise a long term solution to the new erosion problems in the lower reach of the Sandalwood Canal.

We trust that this report clearly and concisely communicates our preliminary findings. Please do not hesitate to contact us if there are any further questions regarding the contents of this preliminary assessment report.

Sincerely,

Robert Casper

Robert Casper
Project Engineer

Devo Seereeram

Devo Seereeram, Ph.D., P.E.
Principal Engineer
Florida Registration No. 48303
Date: July 23, 2014

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Attachment 1.	Hogpen Creek, San Pablo Road Box Culvert Replacement
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1.0 BACKGROUND INFORMATION

1.1 The Ellis Property

Approximately 17 years ago (in December 1997), LaRue C. Ellis and Lori W. Ellis acquired the 2.95± acre residential-zoned property (which was undeveloped at the time) at the following street address in Duval County, Florida:

2194 San Pablo Road South, Jacksonville, FL 32224.

The property is located adjacent to and north of Hogpen Creek, on the west side of San Pablo Road. The approximate limits of the property are shown in attached Figure 1.1 on the USGS Jacksonville Beach quadrangle map and also in Figure 1.2, which is a recent (2014) aerial photograph. Based on land data published at the property appraiser's website, approximately 1.51 acres of the 2.95 acre property is classified as a saltwater marsh.

From review of the historical aerials, the property was cleared of vegetation in the building area sometime during the period 2009-2010 as seen in the aerial photo from March 20, 2010 in attached Figure 2.4. A sheetpile wall was constructed in 2011 landward of the north shoreline of the lower reach of Sandalwood Canal, above the safe upland line elevation of +2.7 ft NGVD. The approximate alignment of this sheetpile wall is also highlighted in Figure 1.2. Construction of the residential structure on the property commenced in 2013 and is still ongoing as of this writing.

1.2 Hogpen Creek and Sandalwood Canal

The current alignments of Hogpen Creek and Sandalwood Canal are shown in the attached Figure 3.1. As seen in Figure 3.1 (and also on Figure 1.2) Sandalwood Canal merges into Hogpen Creek just west of San Pablo Road. The lower reach of the Sandalwood Canal traverses the Ellis property, while Hogpen Creek flows just south of the Ellis property.

Attached Figure 2.1 shows an historic aerial view of Hogpen Creek in 1943, prior to any residential development, and prior to the excavation of Sandalwood Canal. Hogpen Creek flows from south to north, before turning eastward, flowing just south of the Ellis property, before crossing under San Pablo Road, where it eventually joins with the Intracoastal Waterway.

Sandalwood Canal is a man-made ditch that was constructed sometime in the 1950's to provide drainage for upstream development. The canal does not appear in the historic aerial from 1952 (Figure 2.2), but it is clearly visible in the historic aerial from 1960 (Figure 2.3). The canal is approximately 4.3± miles long, oriented east-west, and drains a basin area of approximately 4,300 acres (6.7 square miles). The watershed limits for Sandalwood Canal are shown on Figure 3.1. The basin is now predominantly comprised of medium-density residential development (overall Directly Connected Impervious Area of 13% per CDM). It is characterized by a flat land surface topography and poorly drained soils. As development has progressed within this basin, adding impervious area, the flow rates and flow velocities in the canal have increased causing erosion and silt buildup downstream.

In 1996-1997, the City made changes to the Hogpen Creek box culvert under San Pablo Road to increase its capacity and added a sediment sump downstream; the upstream invert was also lowered. These improvements are shown in the City of Jacksonville construction plans dated November 7, 1995, with a detail of the box culvert excerpted and included in Attachment 1. From these plans, note the following:

- The crest of roadway is at elevation +8.6 ft
- The top of the headwall is at an approximate elevation of +5.5 ft
- The top of the culvert opening is at an approximate elevation of +3 ft

The datum for the elevations listed above is assumed to be in feet NGVD due to the date of the drawings.

Note that Hogpen Creek is tidally influenced, and experiences daily fluctuations in water level. Exhibit 1 below shows a photograph of the box culvert beneath San Pablo Road. Based on the apparent stain lines, and elevations estimated from the construction plans, the water level in the creek appears to frequently reach an elevation of about +2.5 ft or greater, i.e., 6± inches below the top of the culvert opening, and also appears to exceed the top of the box culvert elevation somewhat frequently (roughly, elevation +3.5 ft).



Exhibit 1. Box Culvert Under San Pablo Road (1/18/2008)

2.0 RECENT CHANGES WITHIN SANDALWOOD BASIN

2.1 Modifications To Sandalwood Canal

In 2007-2008, the City of Jacksonville undertook improvements to a 2,100± lineal ft section of the Sandalwood Canal, from Hodges Blvd eastward to a point of discharge just upstream from the Hogpen Creek marshes. The location of the affected canal section is shown on attached Figure 3.2. These improvements were undertaken concurrently with the widening of Hodges Blvd between Beach Blvd and Atlantic Blvd (SJRWMD Permit #4-031-17631-6). Per the SJRWMD Technical Staff Report of June 28, 2007, the canal improvements were permitted concurrently with the roadway widening since the latter resulted in direct discharges from Hodges Blvd to Sandalwood Canal. From its outfall at the Hogpen Creek marsh, the canal then takes a meandering path through the marsh, and crosses the Ellis property (see Figure 1.2) before joining with Hogpen Creek just west of San Pablo Road.

In the SJRWMD Technical Staff Report, the predevelopment conditions for the improved section of Sandalwood Canal are described as follows:

"The existing channel section has steep side banks and is currently eroding the existing south side bank of the channel. The channel is also eroding beyond the easement limits for the channel."

The series of photographs in Exhibits 2 through 5 shows the condition of this section of the canal prior to improvements (excerpted from a PowerPoint presentation prepared by the City of Jacksonville titled **"Sandalwood Canal Basin Wide Improvements Program"**).

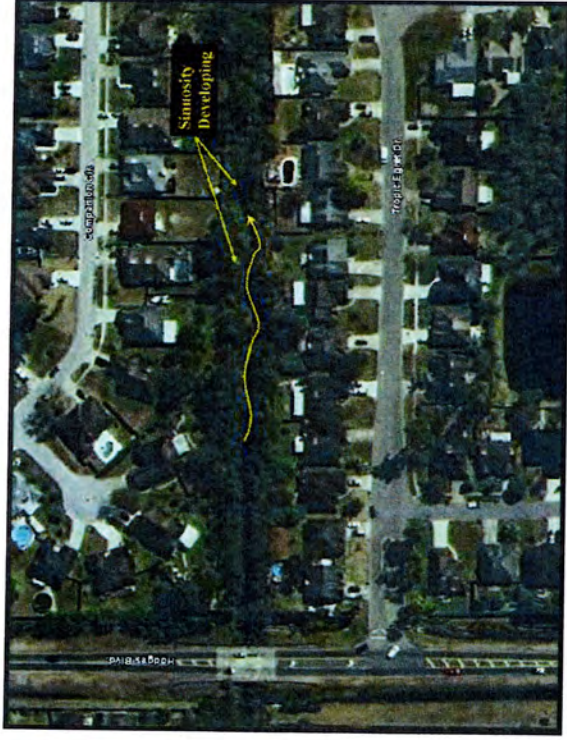


Exhibit 2. Predevelopment Conditions In Sandalwood Canal Section



Exhibit 3. Predevelopment Conditions in Sandalwood Canal Section



Exhibit 4. Predevelopment Conditions In Sandalwood Canal Section



Exhibit 5. Predevelopment Conditions In Sandalwood Canal Section

This section of the Sandalwood Canal (from Hodges Blvd to Hogpen Creek marsh) was redesigned using vertical sheetpile walls as illustrated in Exhibit 6, and in the bird's eye view of the completed construction in Exhibit 7.

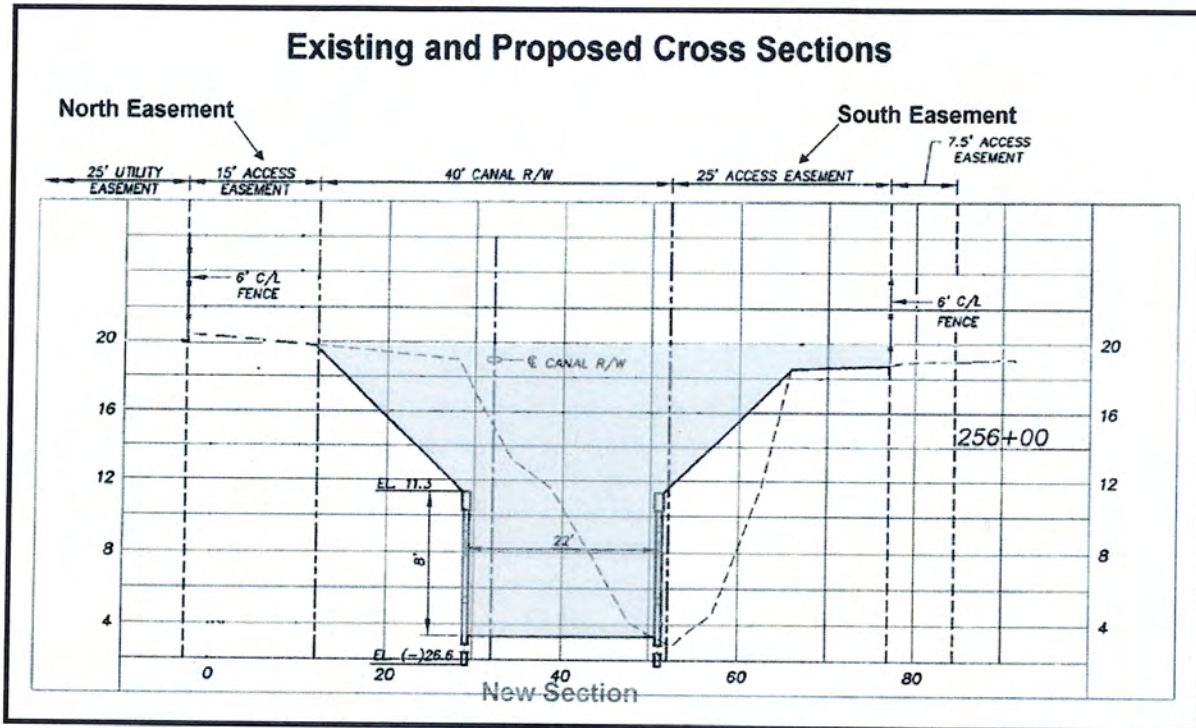


Exhibit 6. New Sandalwood Canal Cross Section (typical)

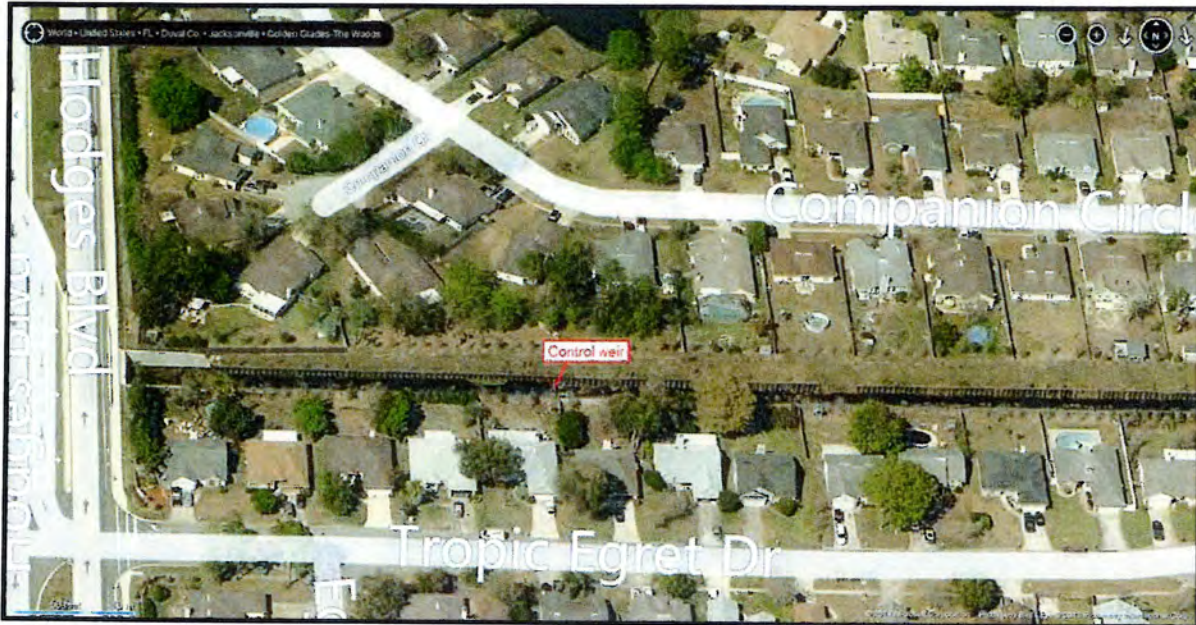


Exhibit 7. Bird's Eye View of Sandalwood Canal Improvements

Originally, the Sandalwood Canal improvements project called for a series of four (4) raised canal weirs (per SJRWMD permit) to reduce channel velocities, spaced between W. Woods Drive and W. Osprey Point Drive (two weirs to the west of Hodges Blvd, and two weirs to the east of Hodges Blvd), at locations shown in attached Figure 3.1. However, only three of the weirs were installed. The western most weir near W. Osprey Point Drive (closest to the point of discharge into the Hogpen Creek marsh) was not installed.

As reflected in the SJRWMD Technical Staff Report, some of the stated design objectives for the canal improvements include the following:

- Stabilization of the canal, control against erosion and bank stability failures
- Reduction in sediment transport and deposition to the downstream Hogpen Creek and its tidal marshes
- Enlargement of channel section to provide additional flood flow capacity and additional flood protection
- Reduction of channel flow velocity

2.2 Widening Of Hodges Boulevard

Concurrent with the improvements to Sandalwood Canal, Hodges Blvd between Beach Blvd and Atlantic Blvd was widened from a two and three lane road served by roadside swales and ditches to a four-lane curb and gutter roadway section.

Stormwater runoff from the northern section of the Hodges Road alignment (from Sandalwood Canal to Atlantic Blvd) is routed through a series of existing retention ponds, some of which were modified and/or enlarged to accommodate the additional roadway runoff, before being discharged to the north into Greenfield Creek (see the attached Figure 3.2).

For the southern section of the Hodges Blvd alignment, from Beach Blvd to Sandalwood Canal (as shown in Figure 3.2), no suitable options were identified to provide stormwater treatment and attenuation for roadway runoff. Stormwater runoff from this section of Hodges Road discharges directly into Sandalwood Canal, through a system of curb and gutter, inlets and storm sewers.

3.0 IMPACT ON ELLIS PROPERTY

Following the roadway and canal improvements in 2007-2008, Mr. Ellis (the owner of the property at 2194 San Pablo Road South, Jacksonville, FL 32224) has experienced excessive stream bank erosion which has culminated in the undermining and collapse of a segment of his retaining wall. The photographs in Exhibits 8 through 11 were all taken after the roadway and canal improvements. Exhibits 8 and 9 predate the collapse of the sheetpile retaining wall, while Exhibits 10 and 11 are post-collapse.



Exhibit 8. Stream Bank Erosion (5/20/2011)



Exhibit 9. Deposition Of Eroded Sediments (6/20/2012)



Exhibit 10. Collapsed Sheetpile Wall (4/27/2014)

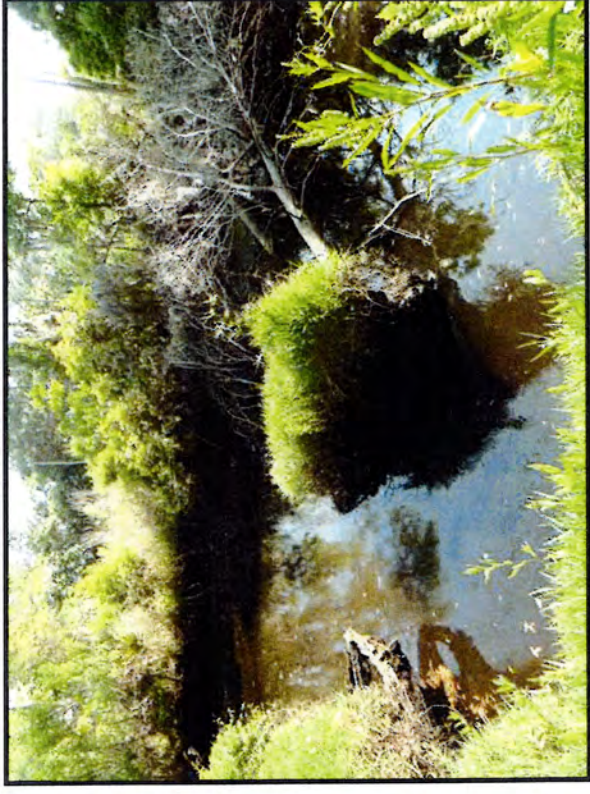


Exhibit 11. Stream Bank Erosion Resulting in Fallen Tree (4/27/2014)

4.0 PRELIMINARY EVALUATION OF CAUSE OF INDUCED STREAM BANK EROSION

Devo Engineering has evaluated the online permit documents for the Hodges Blvd widening and Sandalwood Canal improvements, as well as other ancillary data, to form a preliminary engineering opinion on the cause of the stream bank erosion on the downstream segment of the Sandalwood Canal channel which intersects the Ellis property. It is our opinion that the widening of and drainage modifications to Hodges Blvd in addition to the in-channel modifications to the Sandalwood Canal between Hodges Blvd and the Hogpen Creek marsh have transferred the erosion problem downstream to the Ellis property. Downstream flow rates and discharge volumes have increased and directly contribute to the channel bank erosion on the Ellis property. The following individual impacts have all contributed to the cumulative increase in erosion:

- ① The widening of Hodges Blvd (Beach Blvd to Sandalwood Canal) has resulted in an increase in directly connected impervious area, which results in an increase in stormwater runoff volume.
- ② The elimination of roadside swales/ditches (Beach Blvd to Sandalwood Canal), and the replacement with curb and gutter with storm sewer, has resulted in the loss of storage and attenuation of storm water, as well as a decrease in the time of concentration which likely results in greater peak flow velocities. Exhibit 12 shows a side by side comparison of the December 2007 view of the roadway project under construction with the roadside swales on the east and then in June 2011 after the improvements project and complete elimination of the swales.
- ③ The redesign of the Sandalwood Canal cross section has resulted in greater conveyance capacity, as a result of straightening the channel and reducing Manning's friction coefficient, leading to higher flow velocities.
- ④ The easternmost raised canal weir was never constructed. Failure to construct this weir has likely resulted in higher flow velocities in the downstream channel.
- ⑤ The raised canal weir which was constructed directly east of Hodges Road has been observed to flow almost constantly, with a resulting reduction in upstream storage, and a decrease in the ability to attenuate peak storm discharge rates.

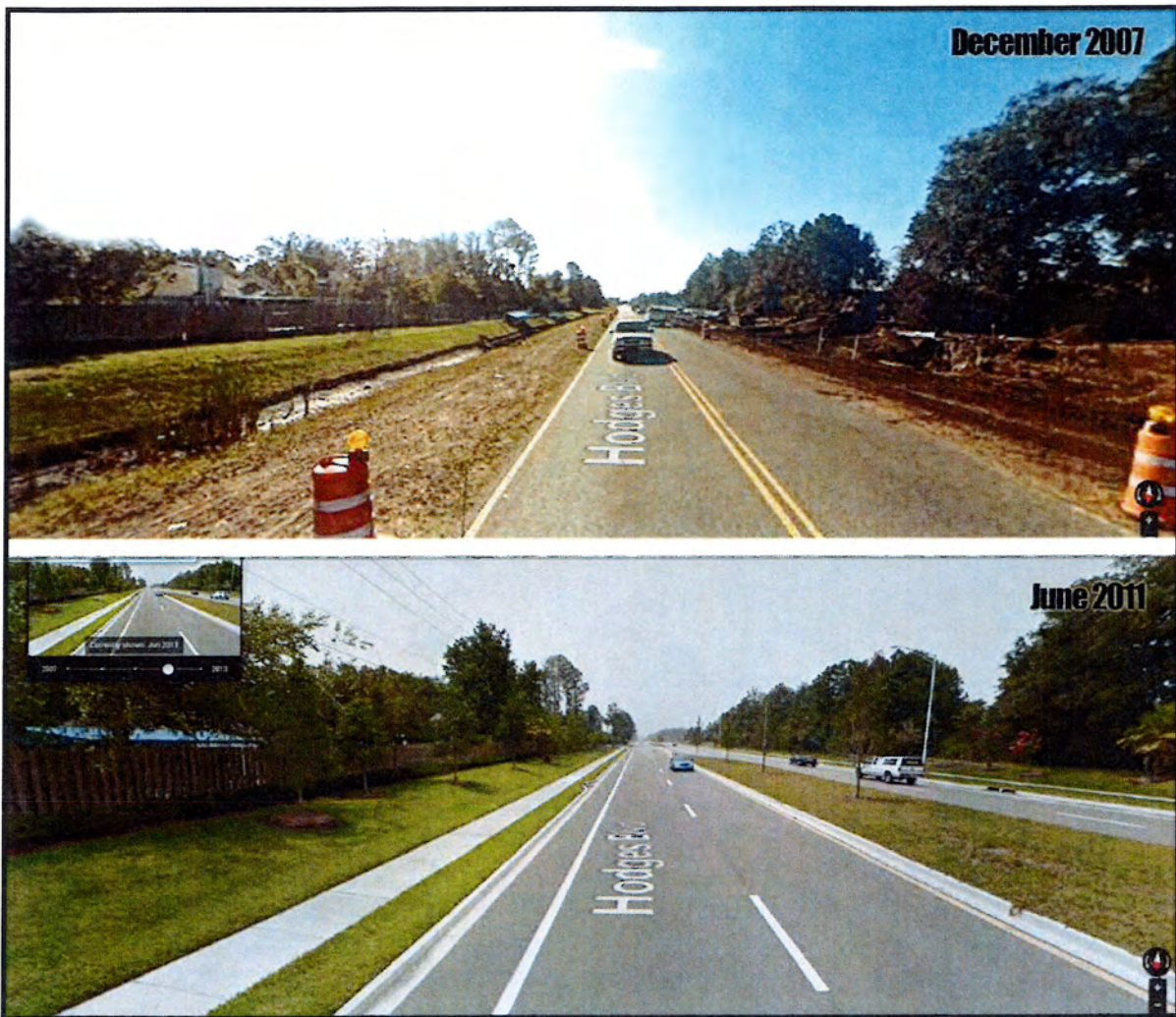
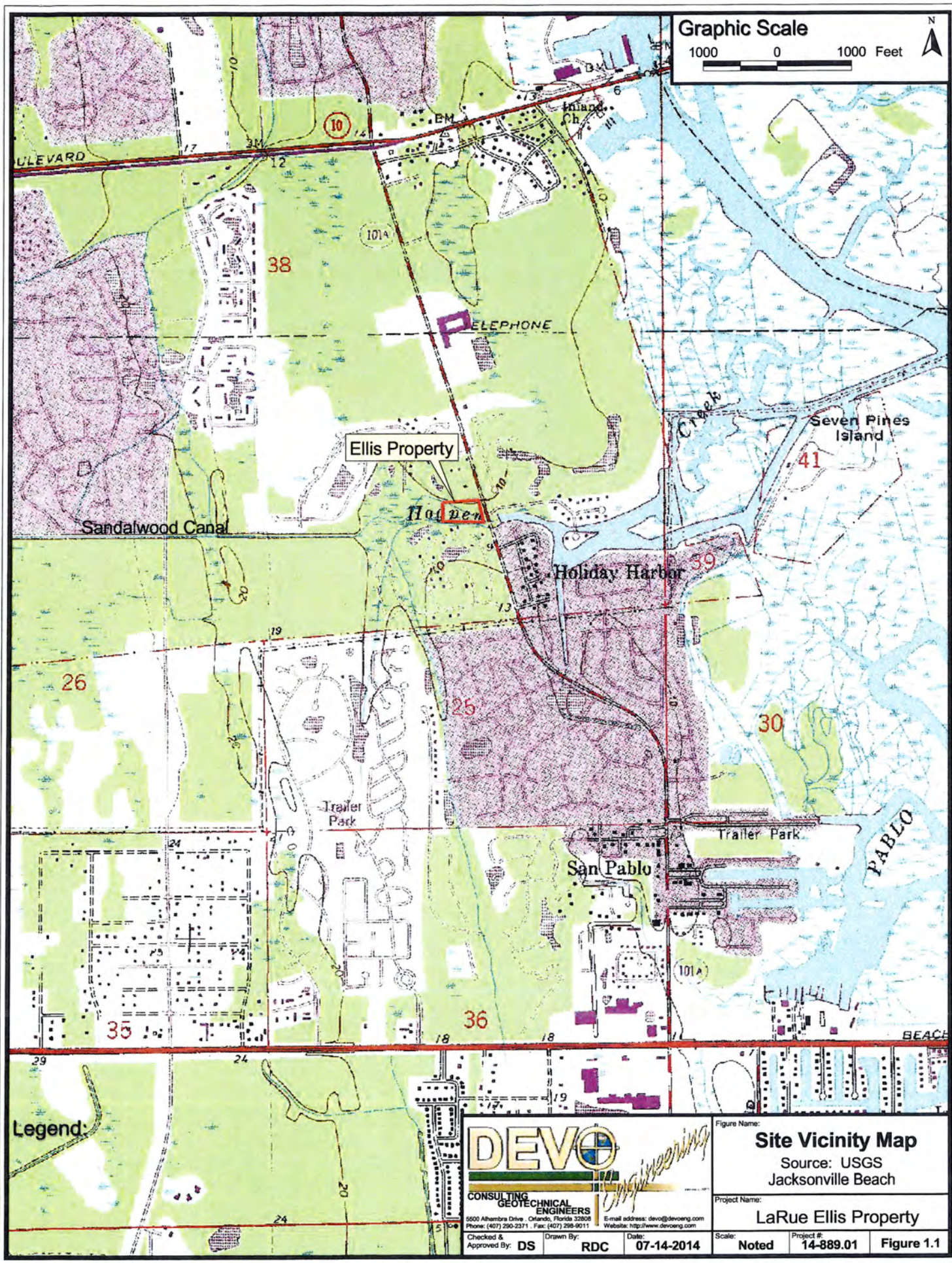


Exhibit 12. Comparison of before and after roadside drainage on Hodges Blvd

FIGURES



Graphic Scale

1000 0 1000 Feet



Ellis Property

Holiday Harbor

Holiday Harbor

San Pablo

Seven Pines Island

Sandalwood Canal

Trailer Park

Trailer Park

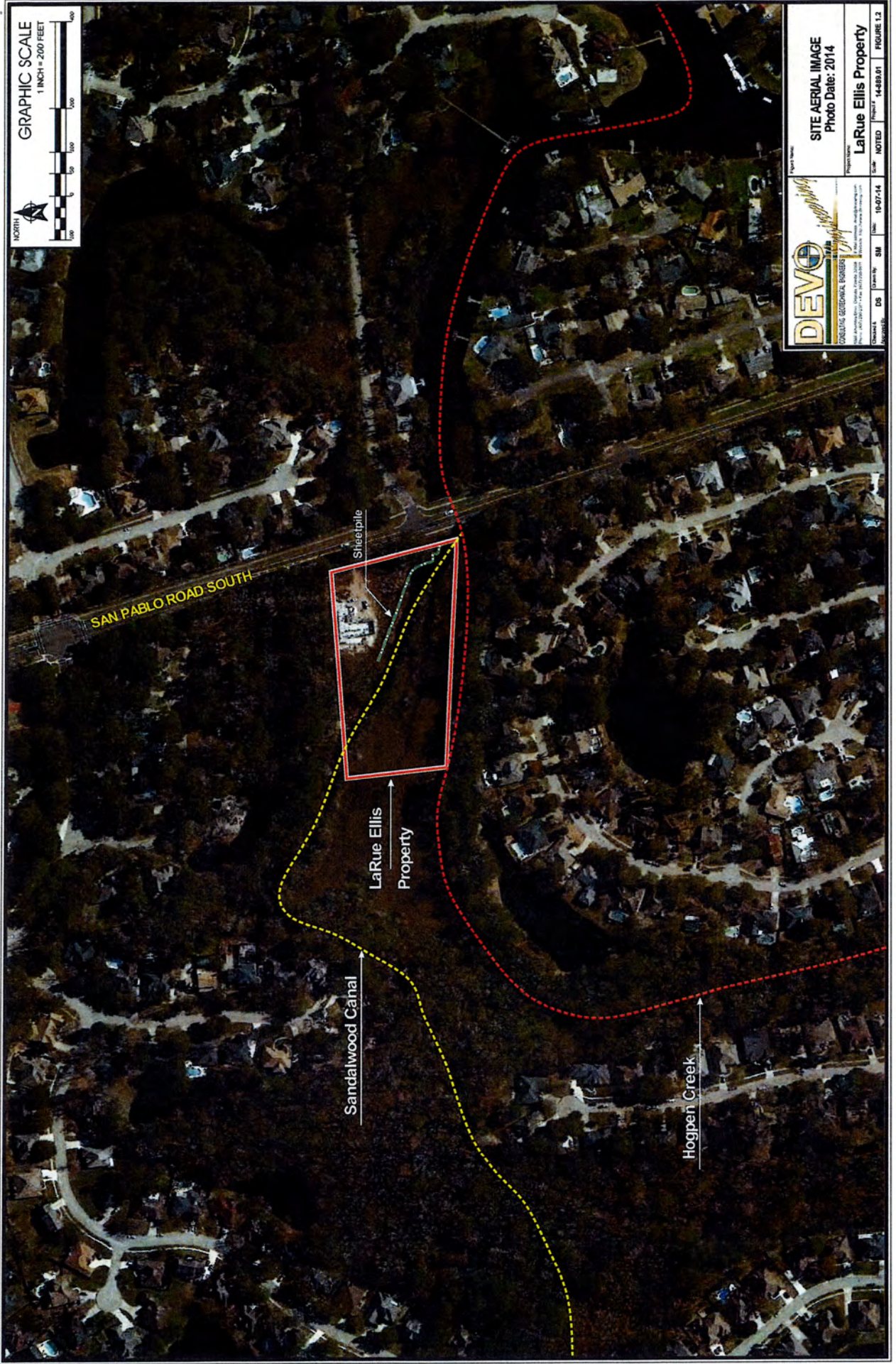
PABLO

BEACH

Legend:

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Website: http://www.devoeng.com
Checked & Approved By: DS
Drawn By: RDC
Date: 07-14-2014

Figure Name:	Site Vicinity Map		
	Source: USGS Jacksonville Beach		
Project Name:	LaRue Ellis Property		
Scale:	Noted	Project #:	14-889.01
			Figure 1.1





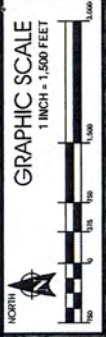
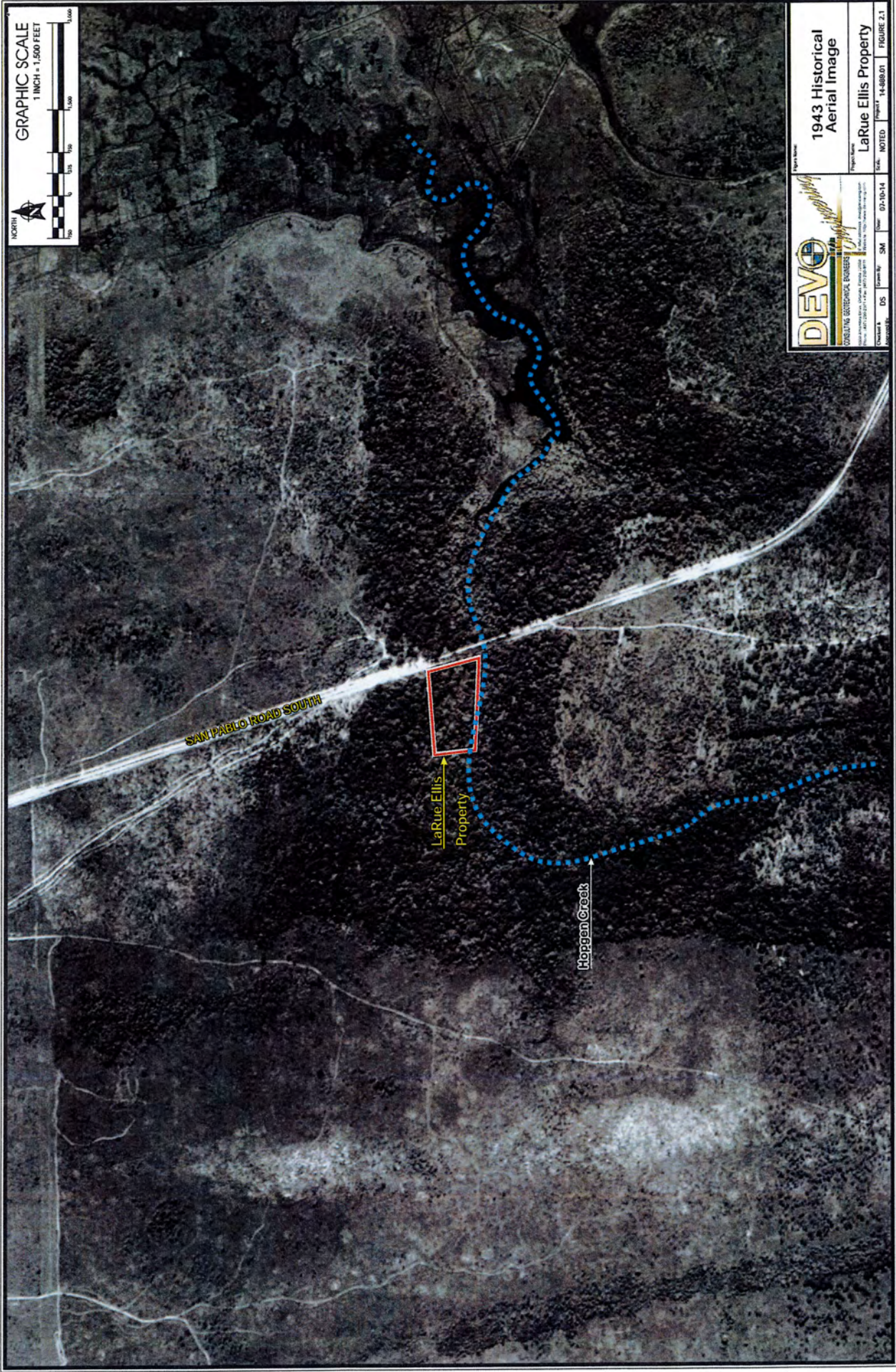
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1400 West 10th Street, Suite 100
Anchorage, Alaska 99501
Phone: 907.561.1234
Fax: 907.561.1235
Email: info@devo.com

SITE AERIAL IMAGE
Photo Date: 2014

Project Name: **LaRue Ellis Property**

Drawn By	Checked By	Date	Notes
SM	DS	10-07-14	NOTED

Figure 1.3



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10000 S. 100th St., Suite 100, Omaha, NE 68131
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Project #	DS	Drawn By	SM	Issue	02-10-14
Project Name	LaRue Ellis Property				
Scale	NOTED				
Project #	14-008.01				
Figure	FIGURE 2.1				

1943 Historical Aerial Image



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1952
Historical Aerial Image

Project Name: LaRue Ellis Property

Scale: Noted

Drawn By: DS

Checked By: RDC

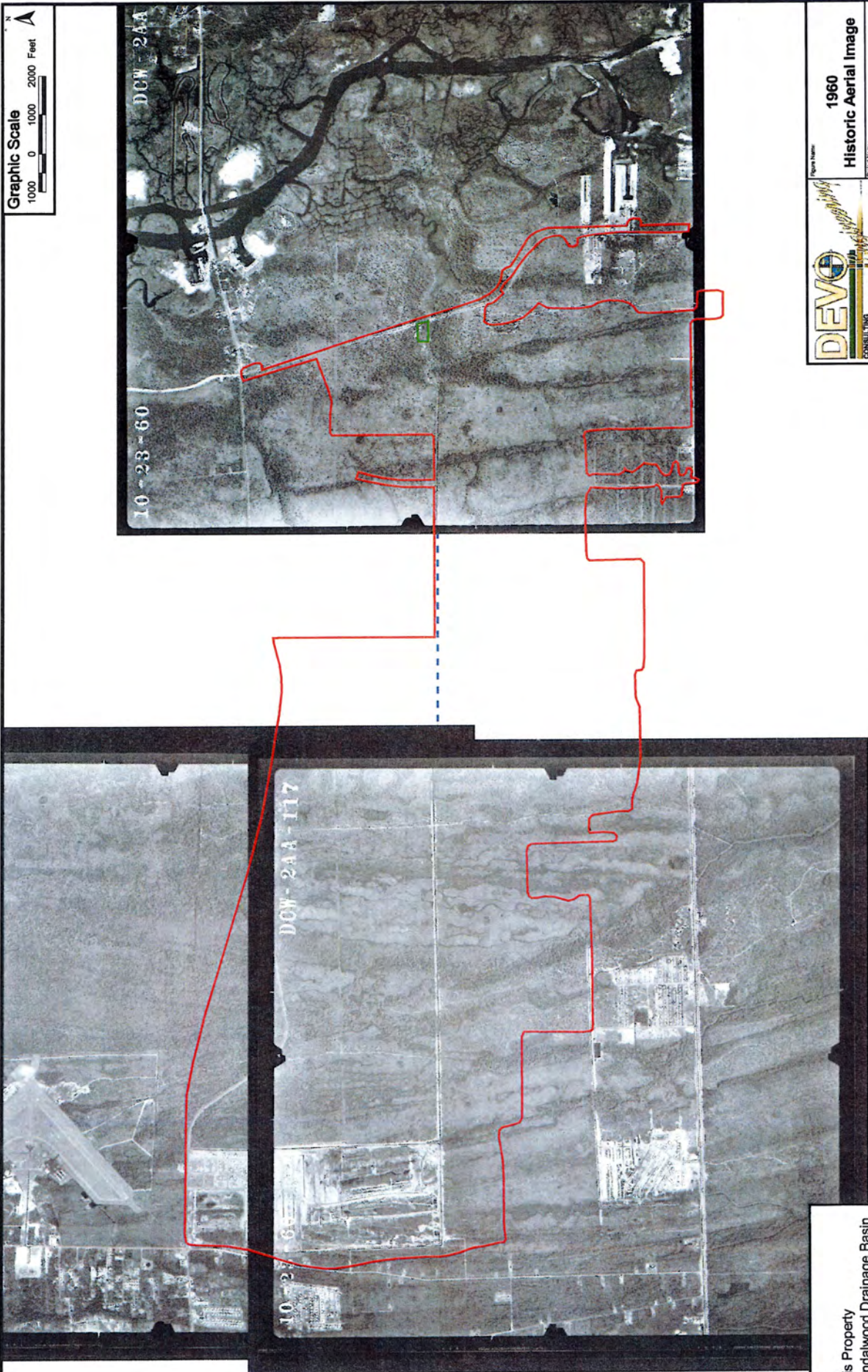
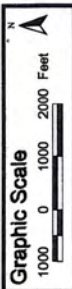
Date: 07-14-2014

Project # 14-889.01

Figure 2.2

Legend:

- Ellis Property
- Sandalwood Drainage Basin
- Canal Alignment





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3800 Airport Blvd., Suite 200
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Project Name: 1960 Historic Aerial Image

Client: LaRue Ellis Property

Project No.: 14-885.01

Date: 07-14-2014

Drawn By: DS

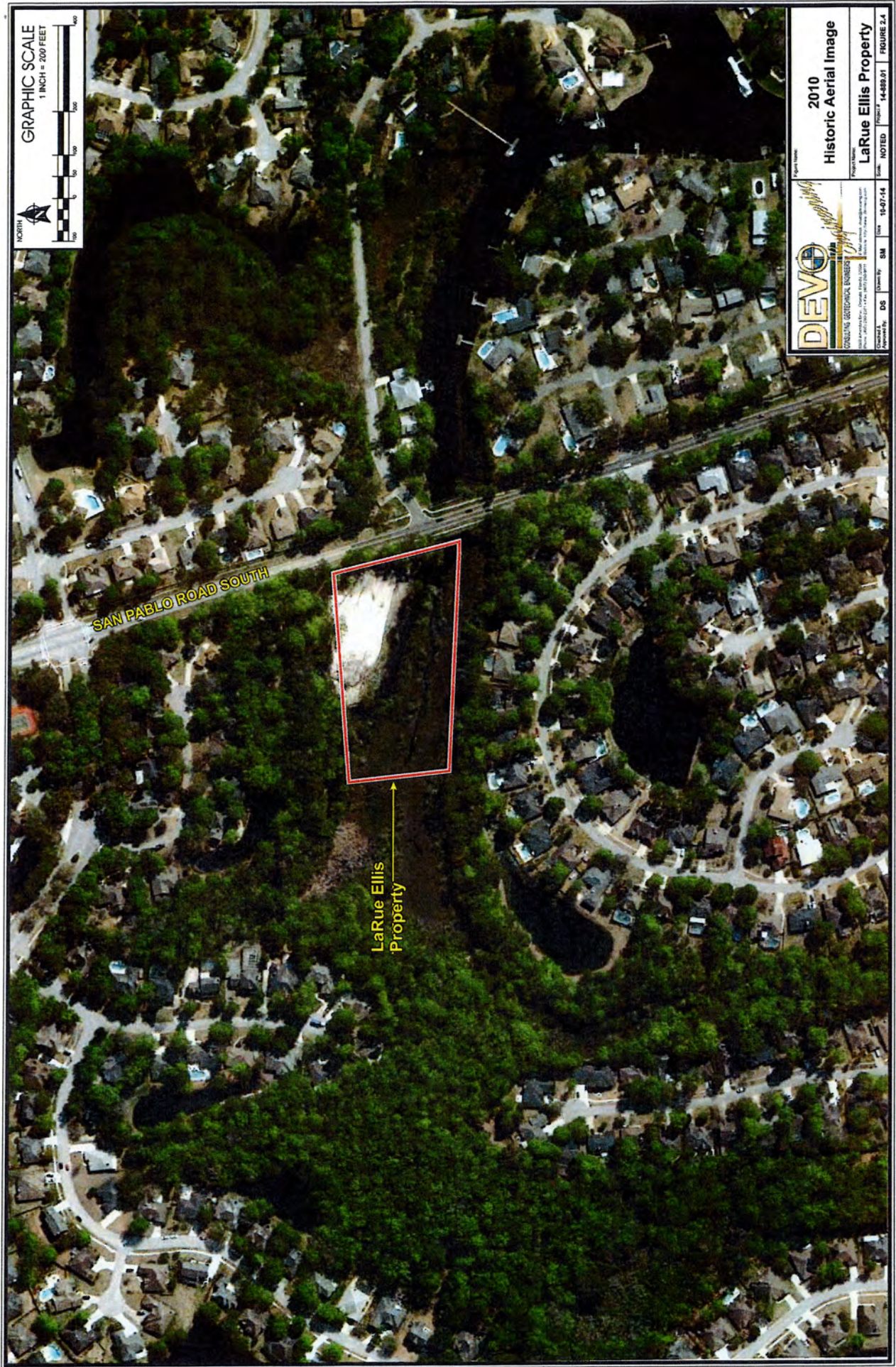
Checked By: RDC

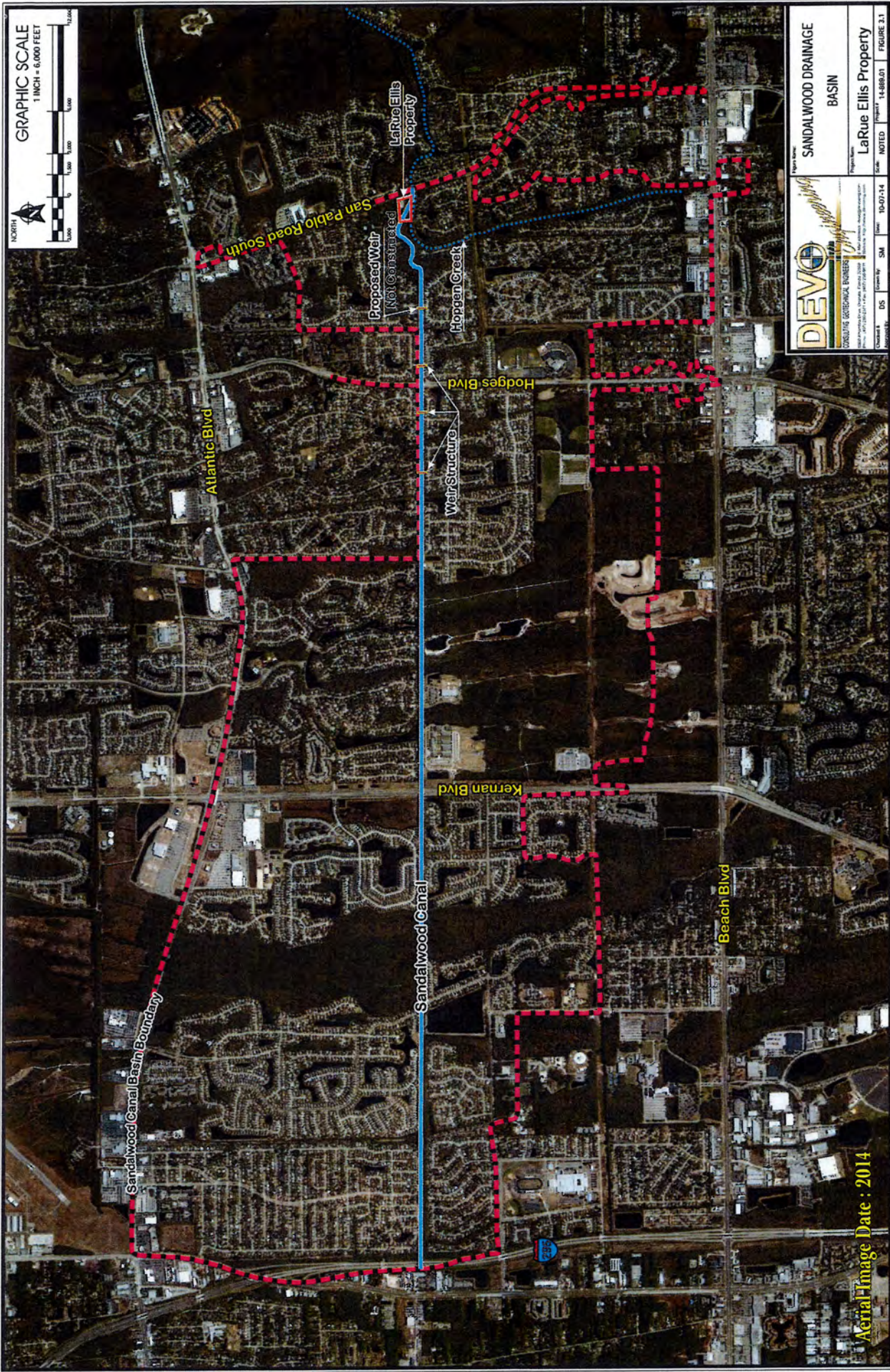
Noted By: 14-885.01

Figure 2.3

Legend:

- Ellis Property
- Sandalwood Drainage Basin
- Canal Alignment

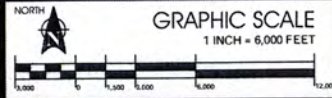




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Owner	City of Denver
Project	SM
Date	10-07-14
Scale	NOTED
Project	14-888.01
Figure	FIGURE 3.1

SANDALWOOD DRAINAGE BASIN
LaRue Ellis Property



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Project Name:
Hodges Blvd and Sandalwood Canal Improvements
LaRue Ellis Property

Checked & Approved By: **DS** Drawn By: **SM** Date: **07-10-14** Scale: **NOTED** Project # **14-089.01** FIGURE 3.2

ATTACHMENT I
HOGPEN CREEK, SAN PABLO ROAD
BOX CULVERT REPLACEMENT

