TECHNOS INC.

Revised Report
Geophysical Induction Logging
Of Ten Saltwater Monitoring Wells
In Martin, Palm Beach, Broward and
Miami-Dade Counties, Florida

for
South Florida Water Management District
West Palm Beach, Florida

January 23, 2008

SFWMD Purchase Order No.: 4100000026
Technos Project No. 07-174

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BACKGROUND AND APPROACH

South Florida Water Management District contracted Technos, Inc. to conduct geophysical induction logging of as many as ten saltwater monitoring wells located in Martin and Palm Beach Counties. The purpose of the logging was to provide data that can be used to aid in the interpretation of saltwater intrusion. Limited interpretation of the logs were included in this effort based upon the results of the water quality sampling completed by the district personnel. The work was carried out in two field efforts. Martin and Palm Beach County wells were logged July 2nd and 3rd, 2007 and included:

- Lantana – LT1-N and LT4-C;
- Lake Worth – LWMW-2 and LWMW-4;
- Stuart – M1011 and M1147; and
- Jensen – S1B and S4C.

Broward and Dade County wells were logged December 4th, 2007 and included:

- Broward County – MW-6 and
- Dade County – DMW-4.

GEOPHYSICAL INDUCTION LOGGING

Electrical conductivity measurements were made using an induction probe that measures conductivities to a radius of about 2.5 feet from the probe. This log provides continuous data through a PVC-cased or open borehole both above and below the water table. Above the water table, the log responds to soil and rock conductivities plus the degree of moisture present and the specific conductance of the moisture. Below the water table, the log responds to soil and rock conductivity plus the saturated pore fluids. The specific conductance of the pore fluid will often have the dominant effect on the measurement. Data acquire within steel casing is not valid and are not used for interpretation.

The induction logs were digitally recorded as the probe moved both down and up the boreholes at approximately 13 feet per minute. The induction log measures conductivity in units of milliSiemens per meter (mS/m). Resistivity (ohm-m) is calculated from this measurement and included in the data file. The data were plotted using WellCAD.

RESULTS

A plot of the geophysical log for each well has been created using WellCAD. Electronic versions of these plots have been provided with this report as PDF files. Digitally logging data has been provided as *.LAS ASCII files showing depth, induction conductivity and induction resistivity values. In addition, maps for each well were developed.

All wells were cased with PVC except one, LT4-C in Lantana which was cased with steel and had an open hole interval from about 140 to 154 feet. Well MW-6 in Fort Lauderdale indicated the present of metal between 195 and 200 feet deep. This could be due to a centralizer.

The geophysical log plots have used consistent scales for each of the log types so the data from one well can easily be compared to data from another well. When measured values for a log exceed the scale, the data wraps itself around the log scale. For example, the induction conductivity log is plotted using a scale of 0 to 100 mS/m. When the measured values exceed 100 mS/m, which occurs in five wells, the data will wrap around and continue plotting.

CORRELATION WITH WATER QUALITY

In 1996, Technos completed a project in Broward County correlating induction conductivity values to chloride values[11] resulting in a linear regression of y = 20.526x - 464.62. This correlation shows that a conductivity value of about 35 mS/m indicates a chloride value of about 250 mg/l and a conductivity values of about 71 mS/m indicates a chloride value of about 1,000 mg/l. While this relationship was based upon data

[1] Technos, Inc. 1996. Broward County Saltwater Intrusion Monitoring Program Final Report: Task 1-100 TDEM Soundings and Task 2-Quantitative Relationship Between Time Domain Electromagnetic Measurements and Water Quality Data.

specifically acquired in Broward County, it should generally be applicable to other areas with similar geologic conditions.

Water quality data was acquired by the district in all ten of these monitoring wells at the time of logging and was used to develop a correlation between the induction logs and chloride values. Table 1 shows a summary of the water quality data from these ten wells.

Table 1
Summary of Water Quality Data

Well ID	Specific Conductance (umhos/cm)	Chloride (mg/L)	Induction Conductivity (mS/m)
PB-1717	5380	1566	116
LT4-C	11340	3596	290
PB-1723	5170	1476	99
LWMW-2	6000	1819	93
STL-317	591	30.3	28
M-1293	18290	5675	435
M-1011	577	34	47
M-1147	1234	198	47
MW-6	1034	152	110
DMW-4	3570	884	75

Figure 1 shows the correlation plot using chloride values and induction conductivity values. The correlation between chloride values and induction conductivity values in these wells resulting in a linear regression of $y = 0.0676x + 29.697$ with an r-squared value of 0.9259 (using Microsoft Excel). This correlation shows that a conductivity value of about 46 mS/m indicates a chloride value of about 250 mg/l and a conductivity values of about 97 mS/m indicates a chloride value of about 1,000 mg/l. However, this relationship is based upon only 10 data points.

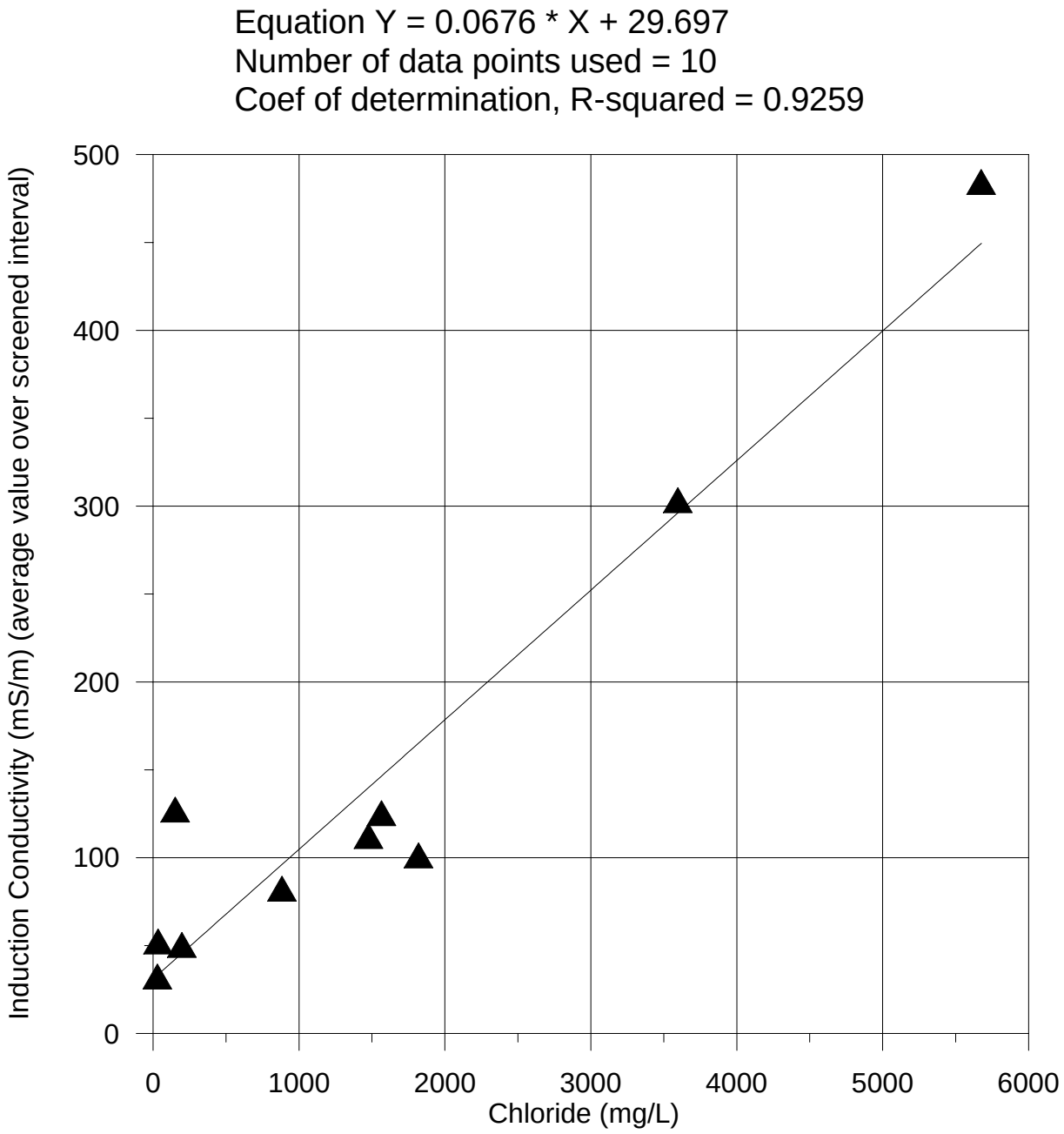
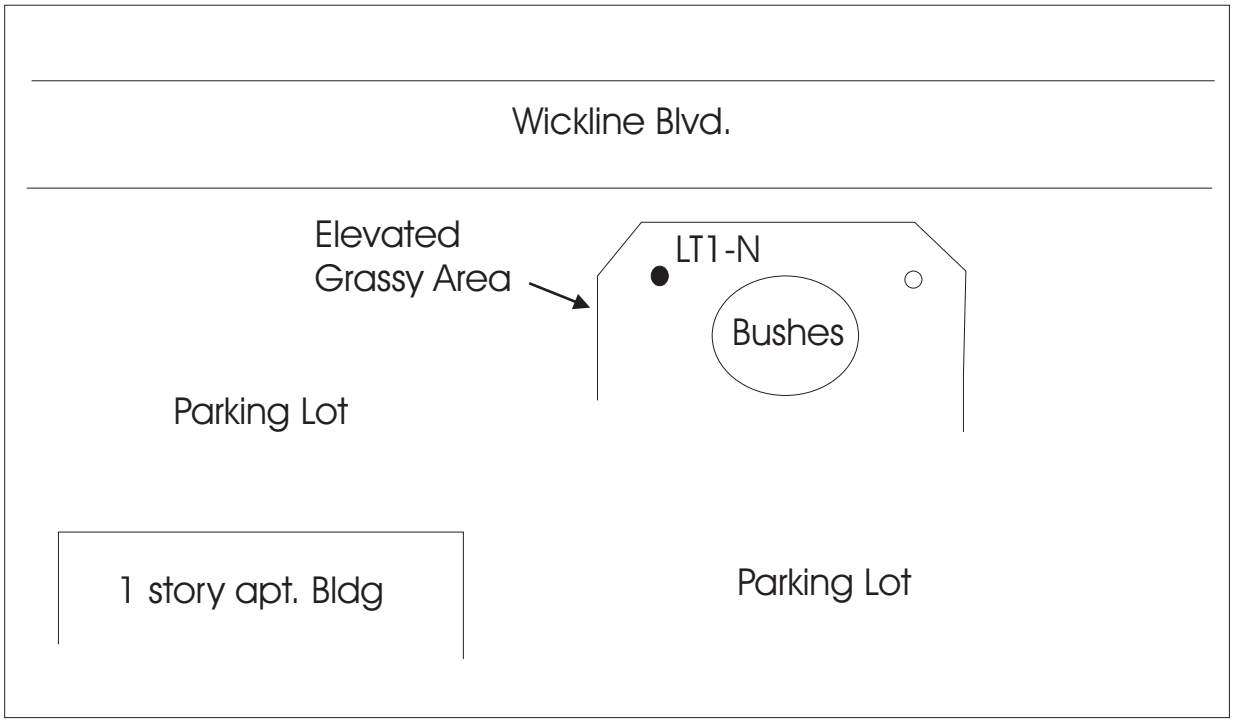


Figure 1. Correlation between induction conductivity logs and chloride values from water quality sampling



Lantana LT1-N

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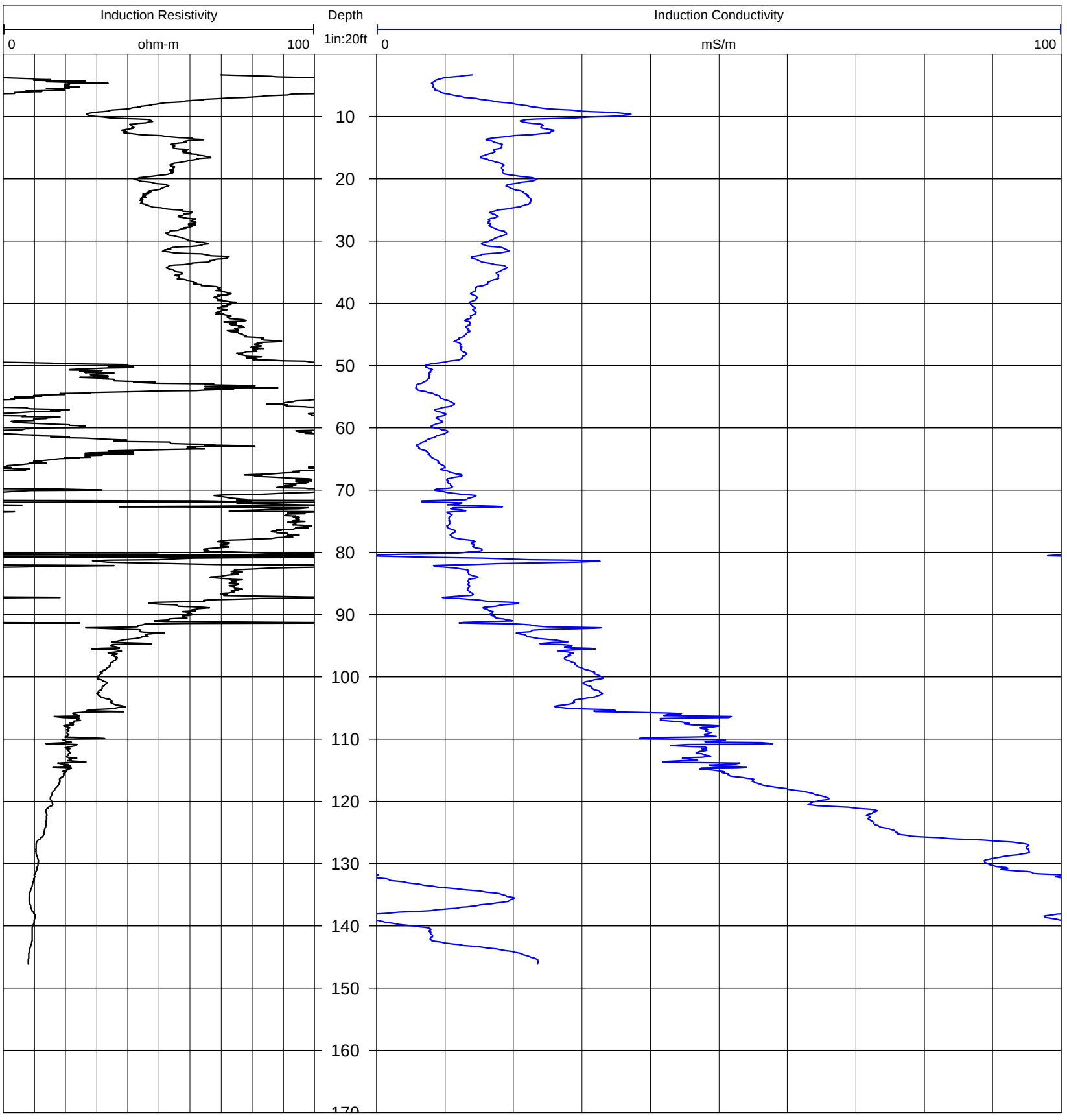
Project #: 07-174 **Client:** SFWMD **Date:** July 2, 2007
Boring Name: LT1-N **Operator:** L. Yuhr
Site Location: Westernmost well on south side of Wickline Blvd.

Depth Units: feet **Depth Ref.:** ground surface **Ref. Elev.:** unknown
Casing Material/Dia.: 2-in PVC **Casing Stickup:** flush mount **Casing Depth:**
Water Level: 8.3 ft **Hole Depth:** 146 ft

Logging System: Mount Sopris MGXII **Log UP/DOWN:** Up **Logging Speed:** 13ft/min
Logs: Induction
Measurement Units: mS/m



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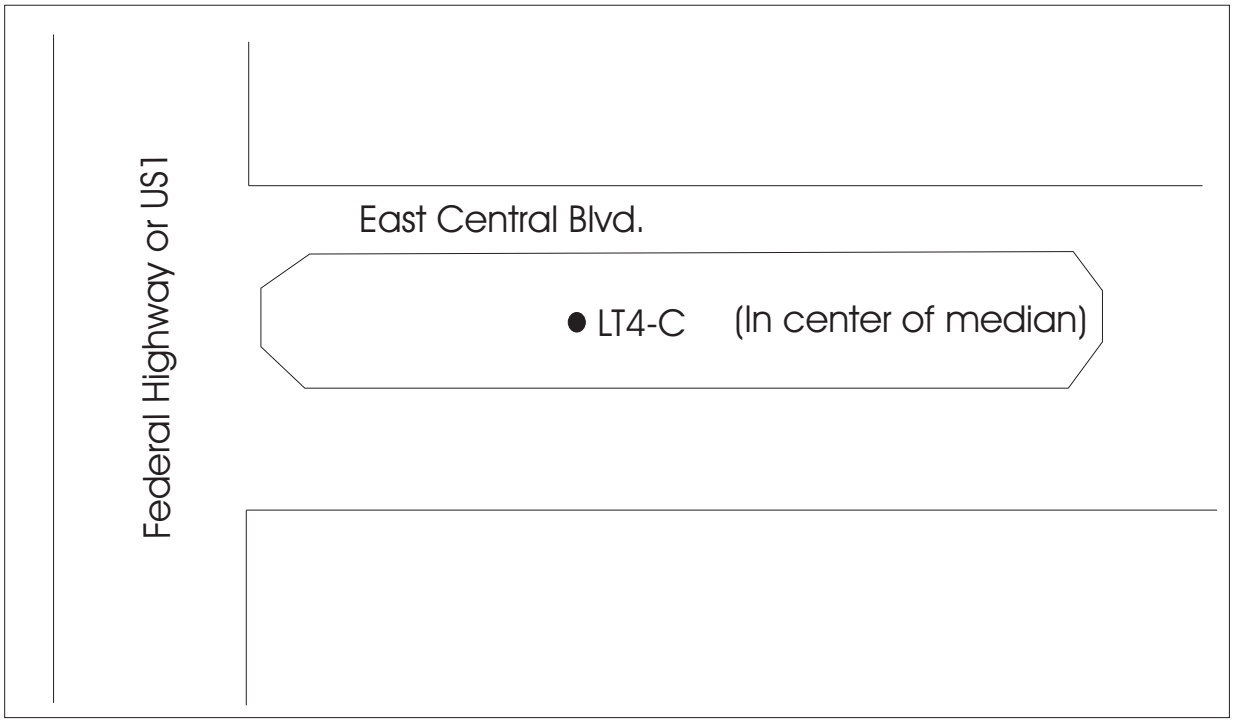

Lantana LT4-C

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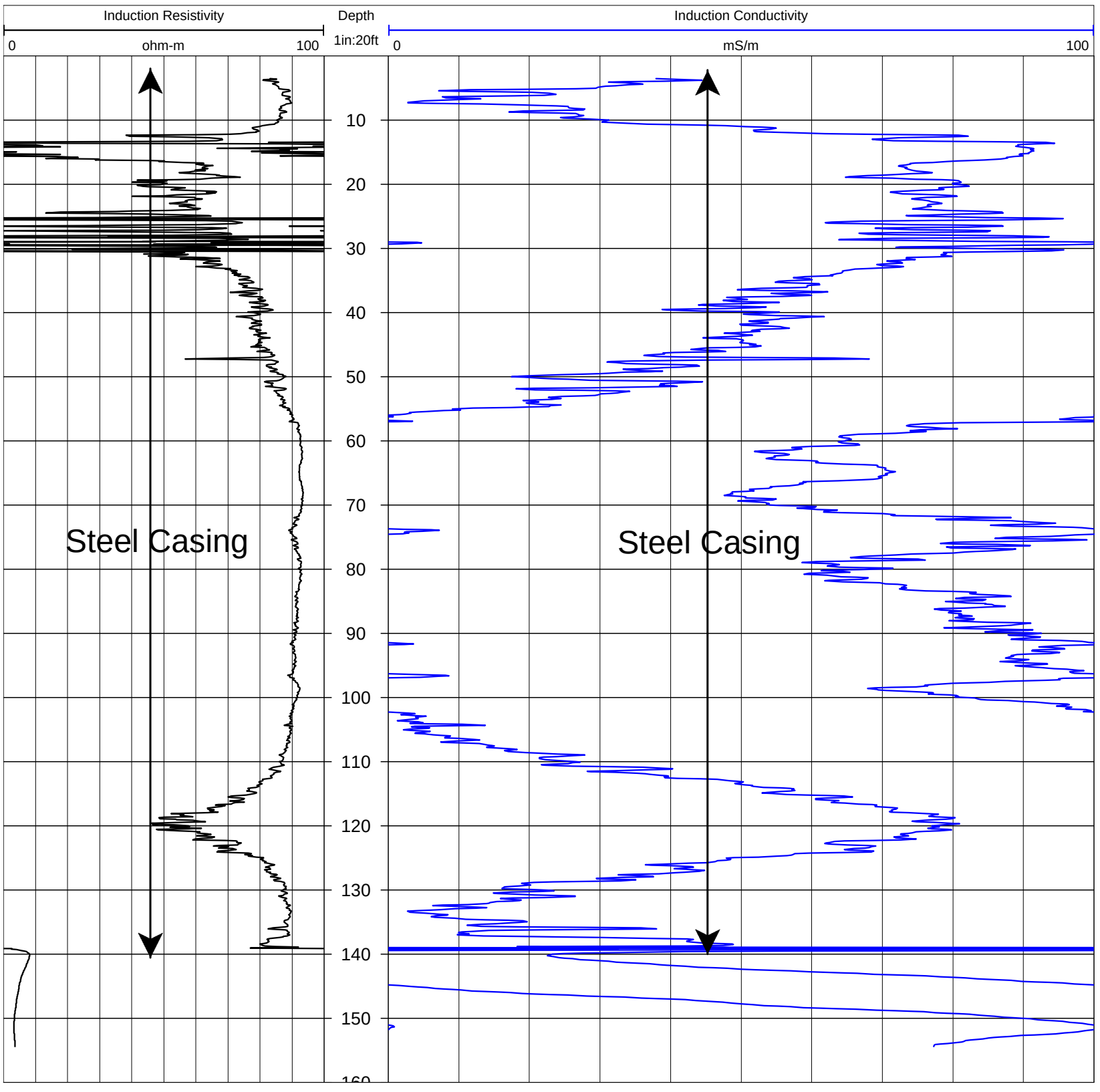
Project #: 07-174 **Client:** SFWMD **Date:** July 2, 2007
Boring Name: LT4-C **Operator:** L. Yuhr
Site Location: East of US1 in median of Central Blvd.

Depth Units: feet **Depth Ref.:** ground surface **Ref. Elev.:** unknown
Casing Material/Dia.: 2-in PVC **Casing Stickup:** flush mount **Casing Depth:**
Water Level: 5.0 ft **Hole Depth:** 154 ft

Logging System: Mount Sopris MGXII **Log UP/DOWN:** Up **Logging Speed:** 13ft/min
Logs: Induction
Measurement Units: mS/m



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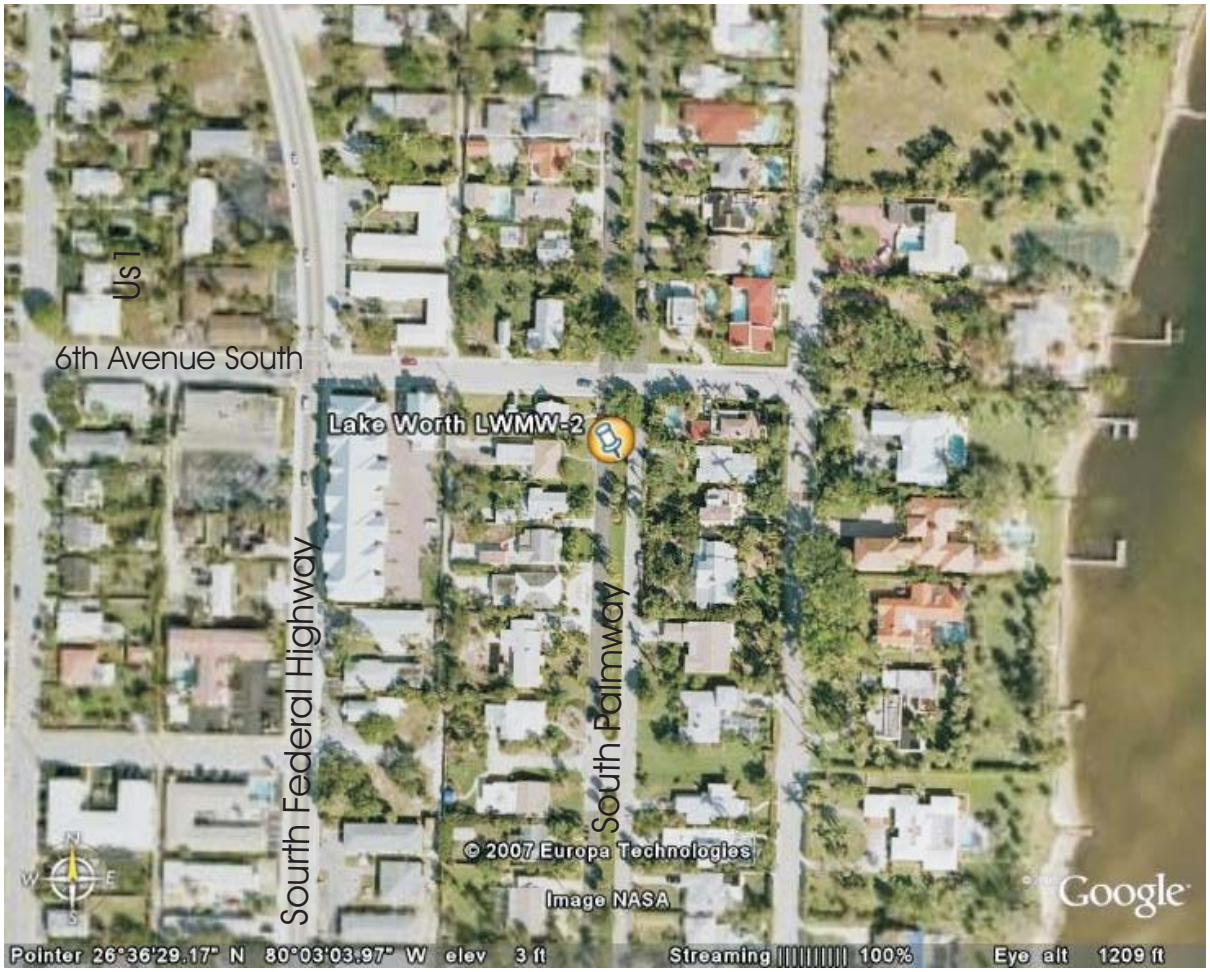

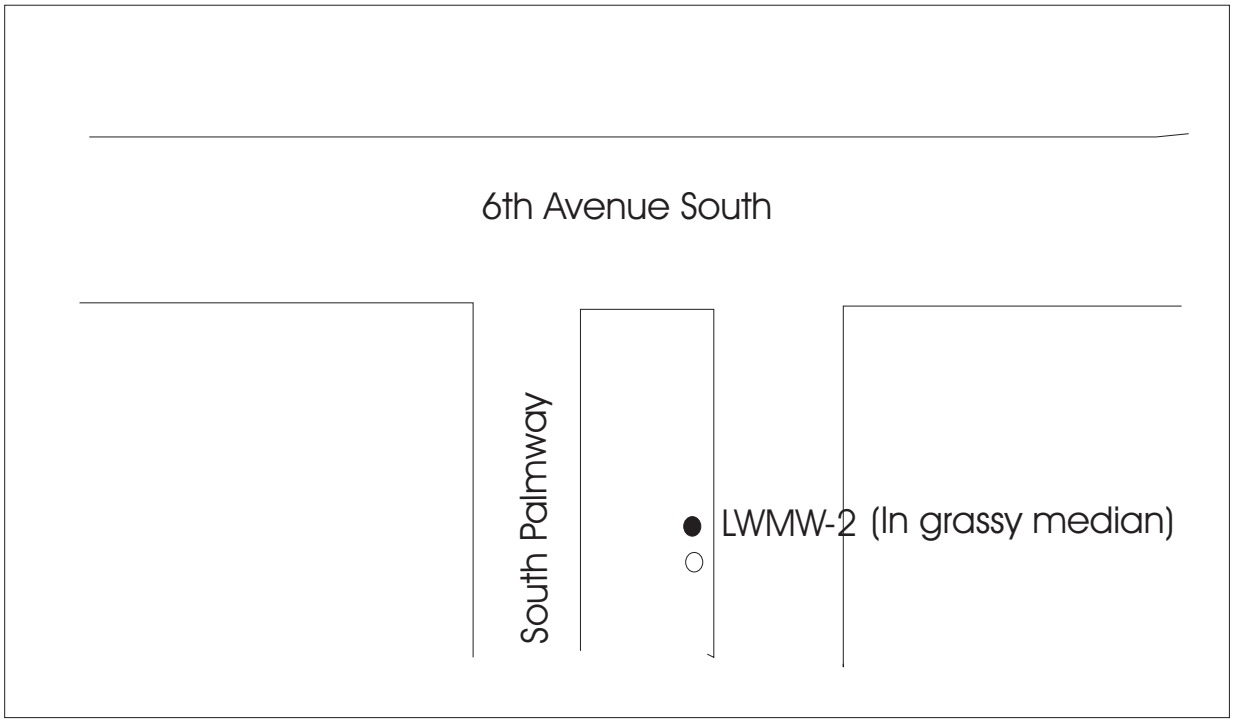

Lake Worth LWMW-2

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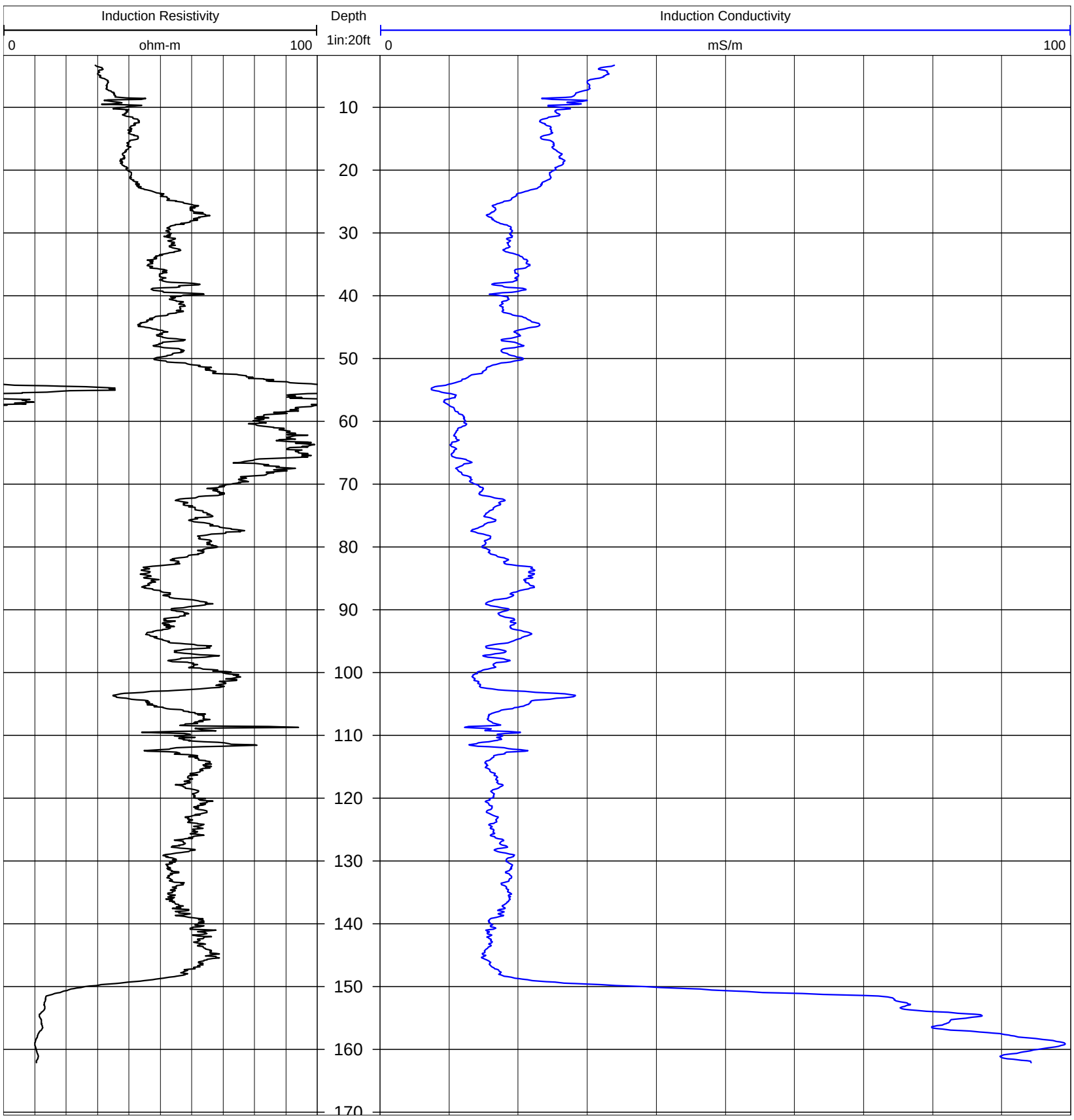
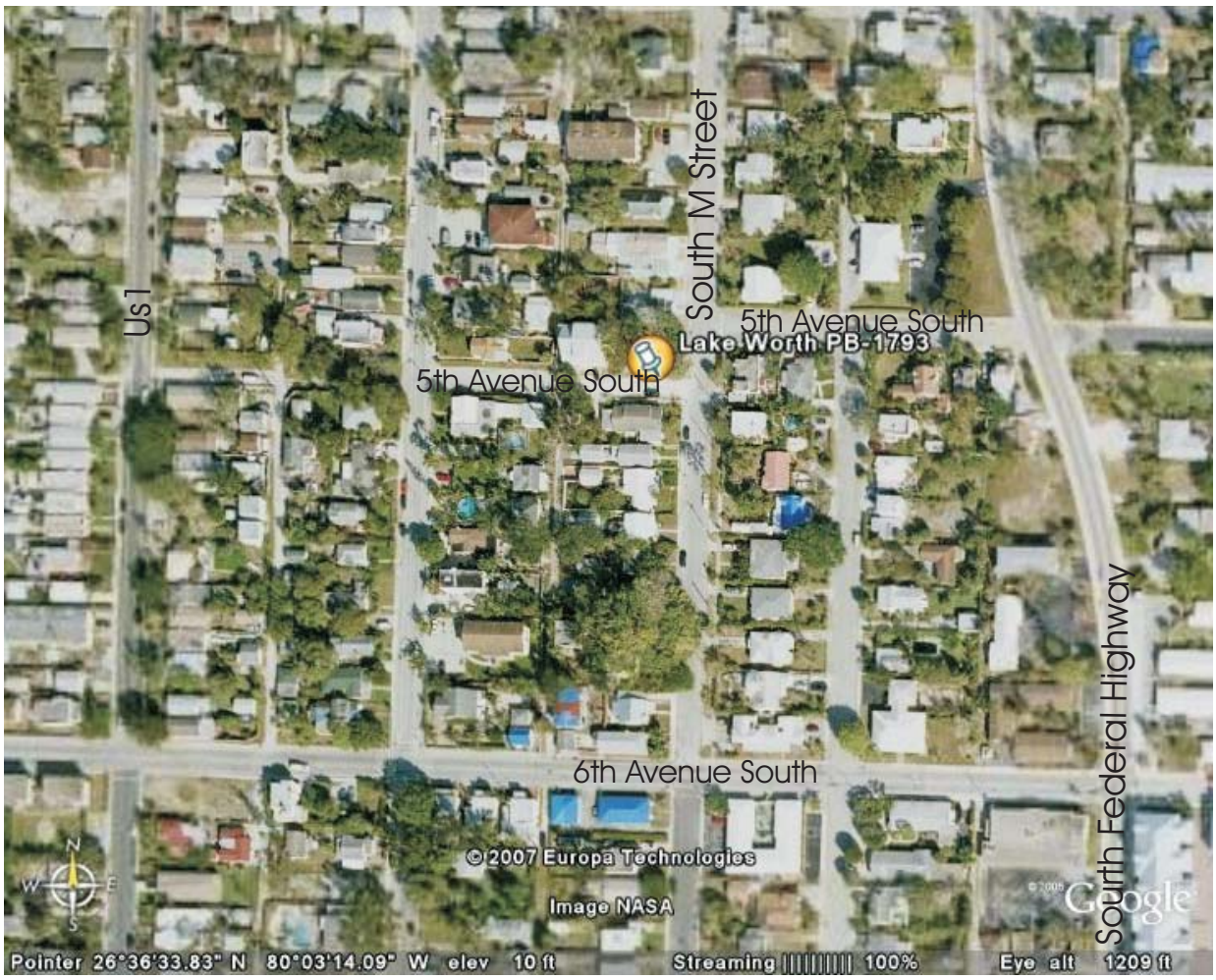
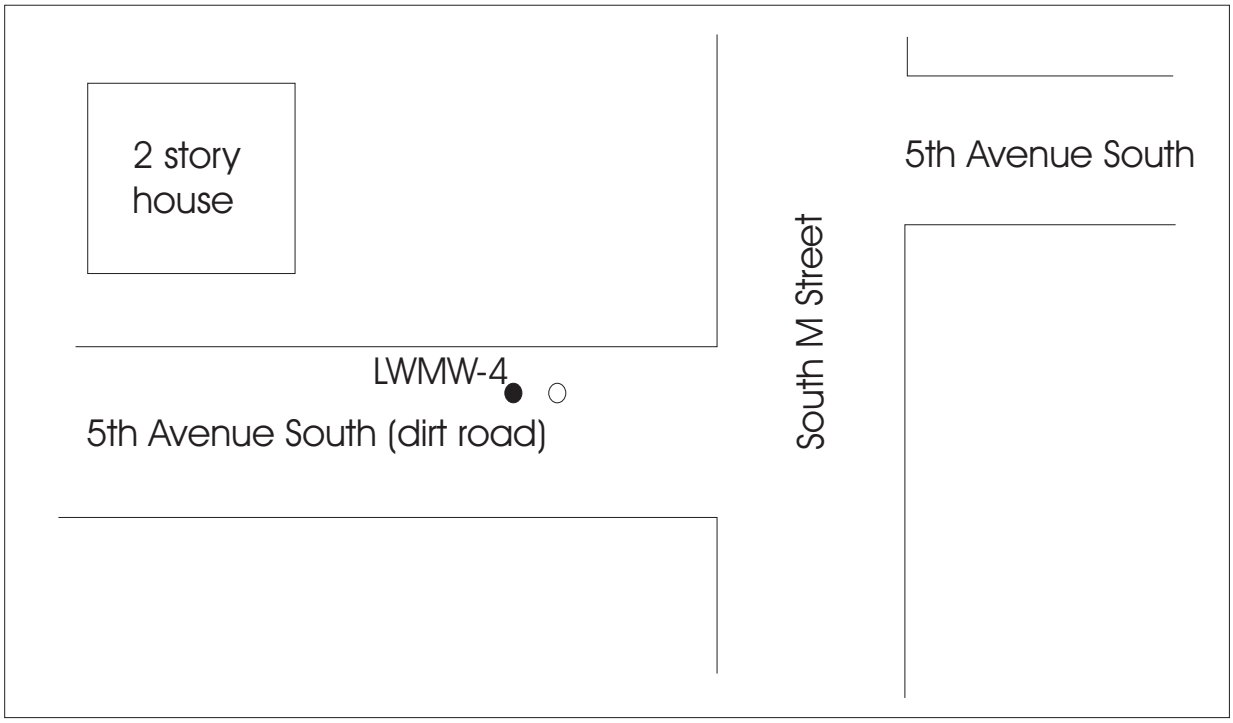
Project #: 07-174 **Client:** SFWMD **Date:** July 3, 2007
Boring Name: LWMW-2 **Operator:** L. Yuhr
Site Location: Northernmost well in median of So. Palmway, south of 6th Ave.

Depth Units: feet **Depth Ref.:** ground surface **Ref. Elev.:** unknown
Casing Material/Dia.: 2-in PVC **Casing Stickup:** flush mount **Casing Depth:**
Water Level: 3.73 ft **Hole Depth:** 162 ft

Logging System: Mount Sopris MGXII **Log UP/DOWN:** Up **Logging Speed:** 13ft/min
Logs: Induction
Measurement Units: mS/m







Lake Worth LWMW-4

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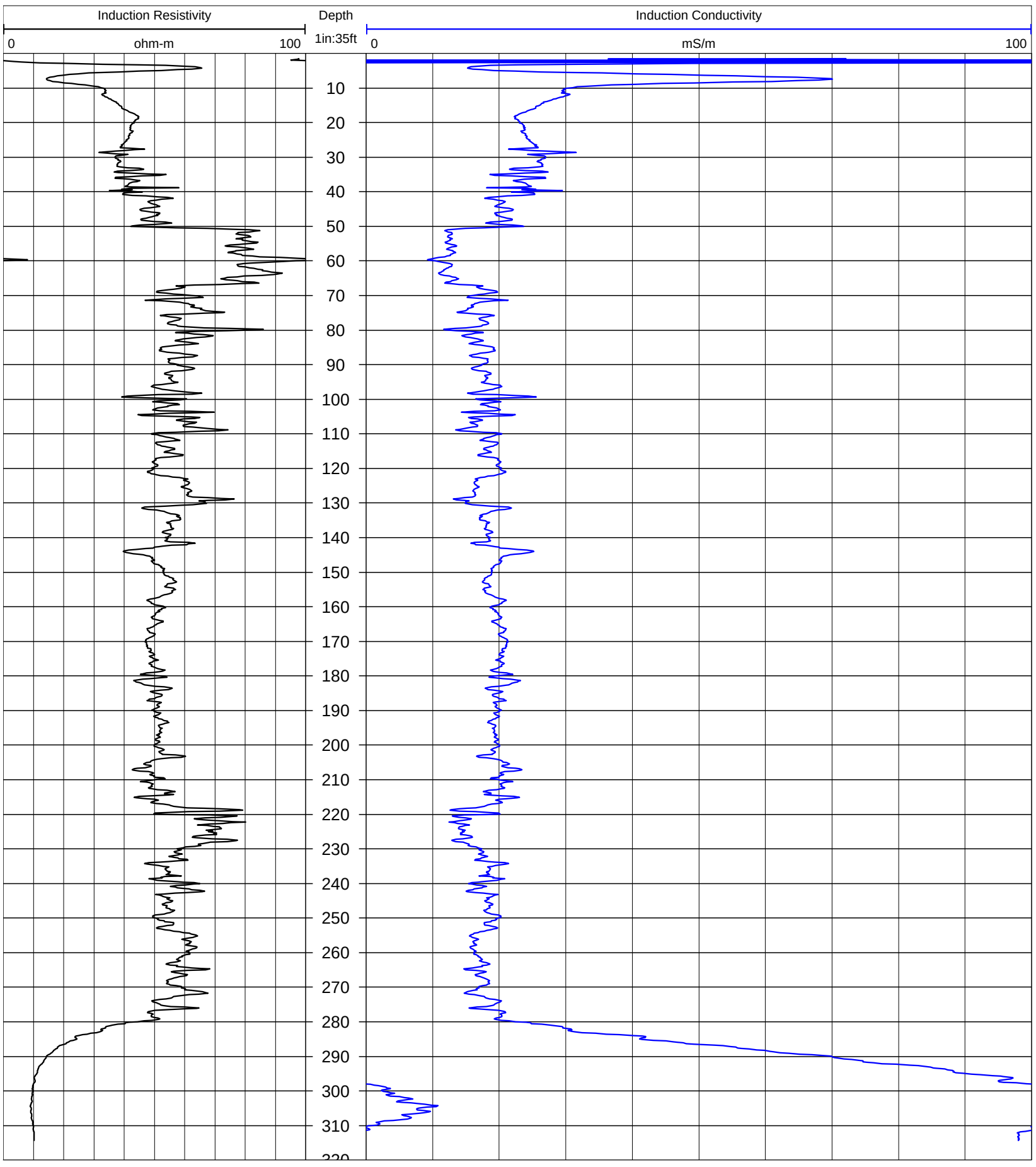
Project #: 07-174 **Client:** SFWMD **Date:** July 3, 2007
Boring Name: LWMW-4 (PB-1723) **Operator:** L. Yuhr
Site Location: Westernmost well, north of 5th Ave. & west of M St.

Depth Units: feet **Depth Ref.:** ground surface **Ref. Elev.:** unknown
Casing Material/Dia.: 2-in PVC **Casing Stickup:** flush mount **Casing Depth:**
Water Level: 5.9 ft **Hole Depth:** 316 ft

Logging System: Mount Sopris MGXII **Log UP/DOWN:** Up **Logging Speed:** 13ft/min
Logs: Induction
Measurement Units: mS/m



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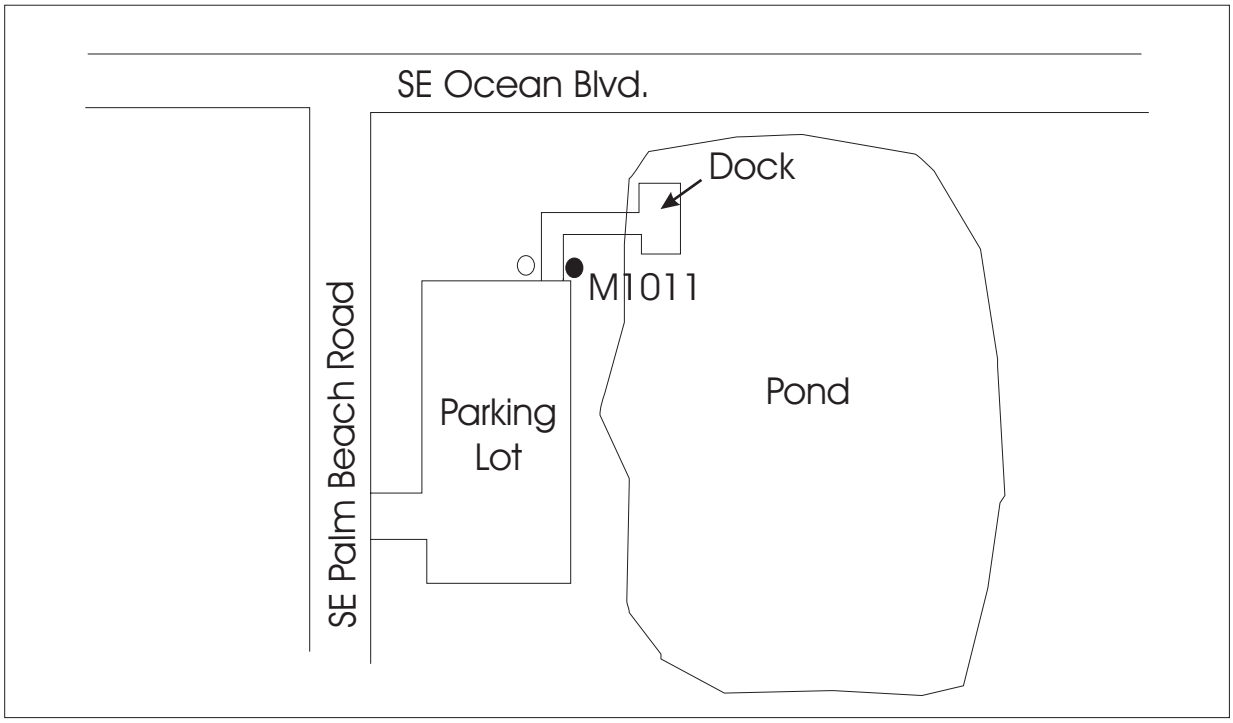

Stuart M1011

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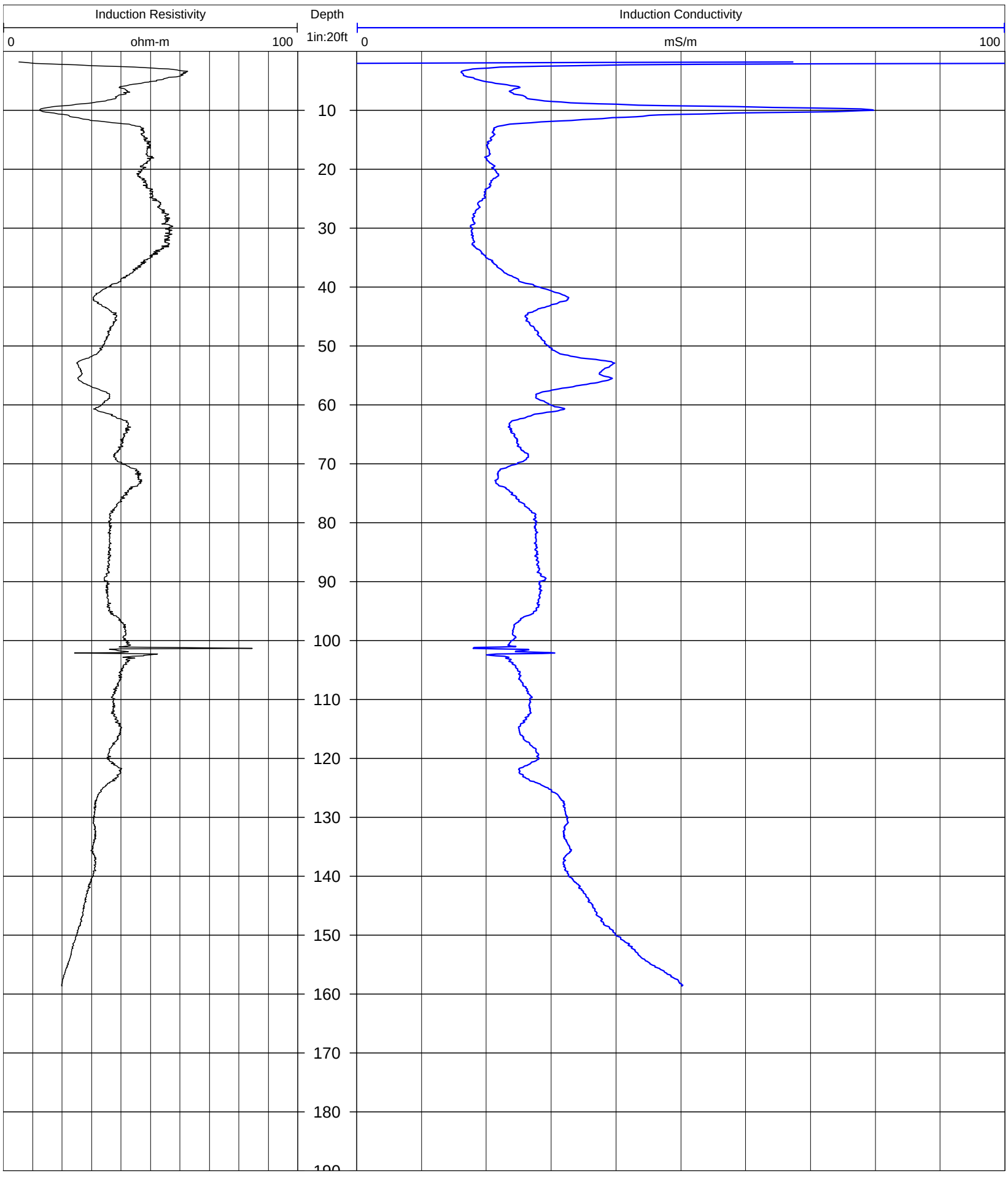
Project #: 07-174 **Client:** SFWMD **Date:** July 3, 2007
Boring Name: M1011 **Operator:** L. Yuhr
Site Location: East of path to dock at park (SE Ocean Blvd & Palm Beach Road)

Depth Units: feet **Depth Ref.:** ground surface **Ref. Elev.:** unknown
Casing Material/Dia.: 2-in PVC **Casing Stickup:** flush mount **Casing Depth:**
Water Level: 4.75 ft **Hole Depth:**

Logging System: Mount Sopris MGXII **Log UP/DOWN:** Up **Logging Speed:** 13ft/min
Logs: Induction
Measurement Units: mS/m



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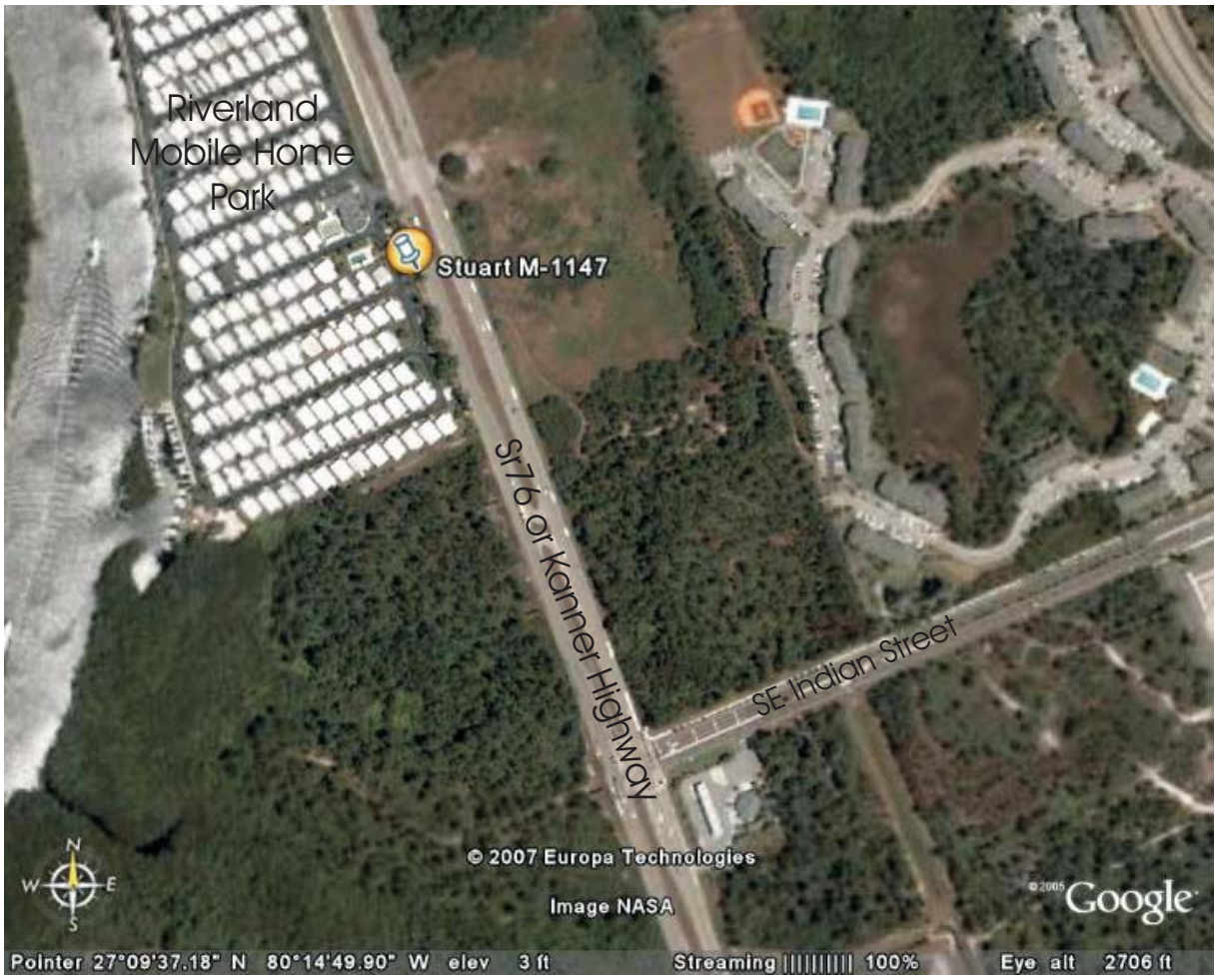

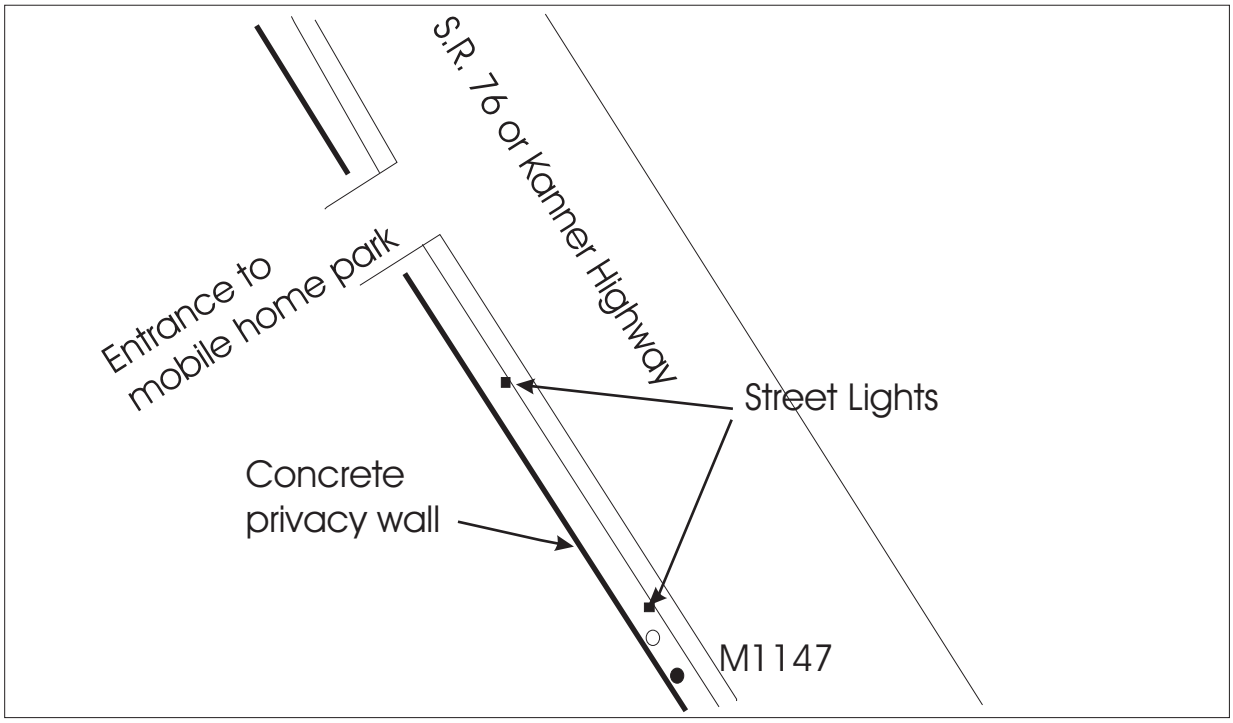

Stuart M1147

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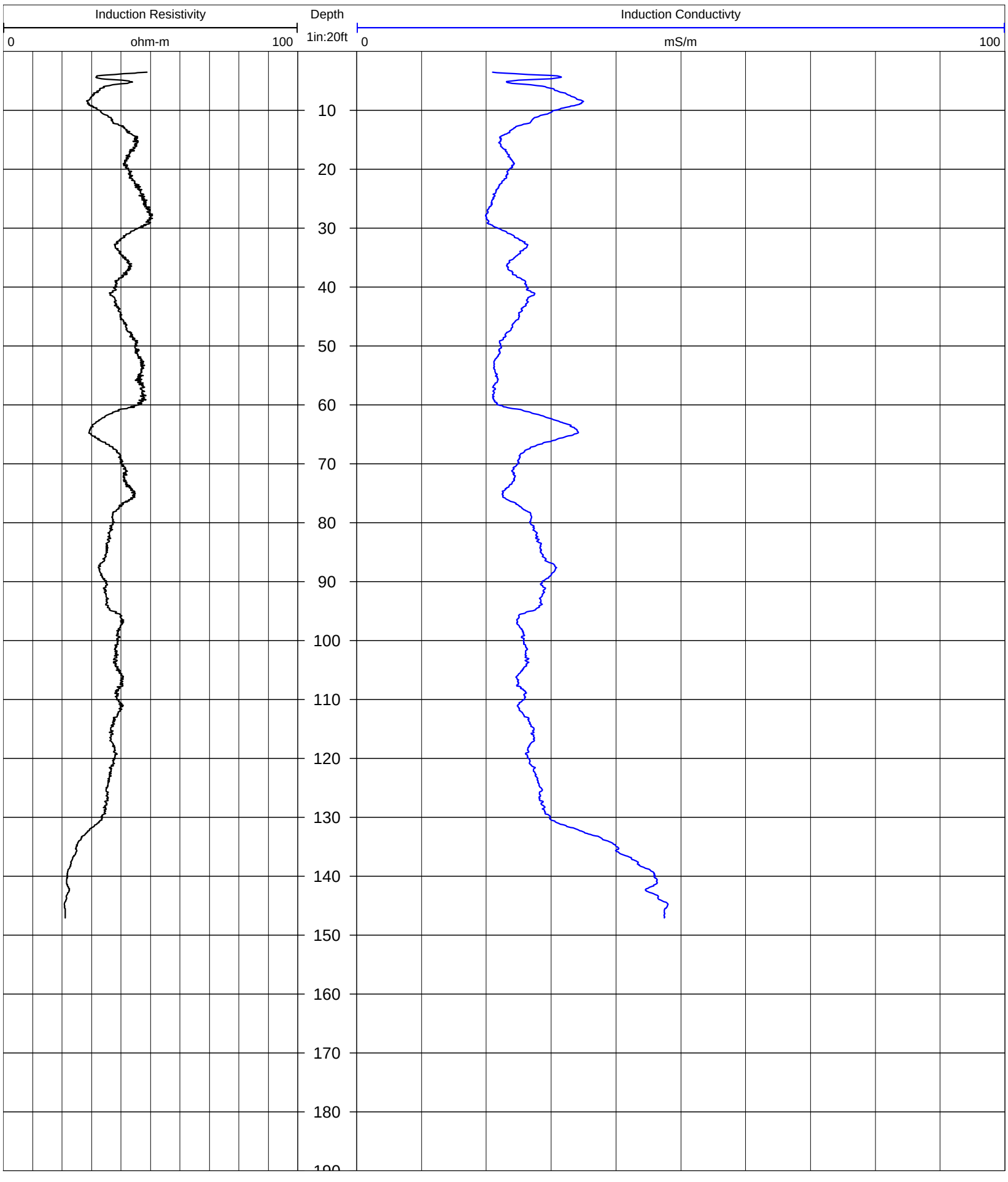
Project #: 07-174 **Client:** SFWMD **Date:** July 3, 2007
Boring Name: M1147 **Operator:** L. Yuhr
Site Location: West side of SR76, south of Riverland Mobile Home Park entrance

Depth Units: feet **Depth Ref.:** ground surface **Ref. Elev.:** unknown
Casing Material/Dia.: 2-in PVC **Casing Stickup:** flush mount **Casing Depth:**
Water Level: **Hole Depth:** 147 ft

Logging System: Mount Sopris MGXII **Log UP/DOWN:** Up **Logging Speed:** 13ft/min
Logs: Induction
Measurement Units: mS/m



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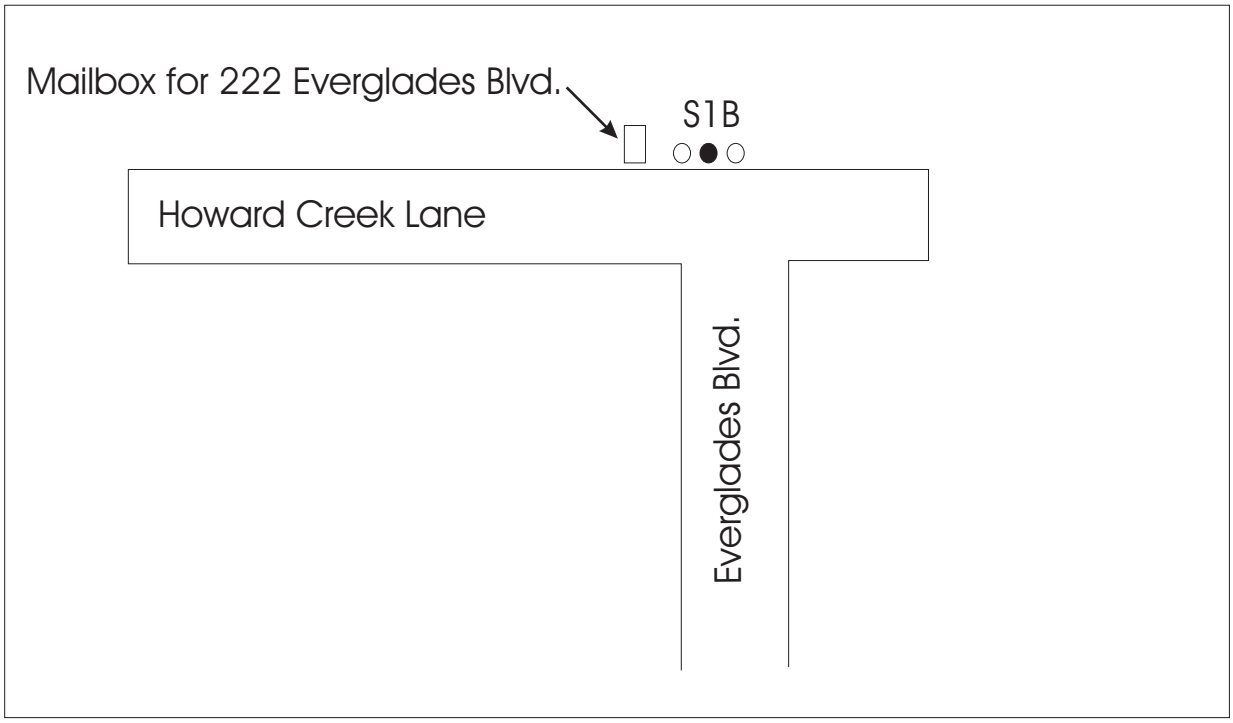

Jensen - S1B

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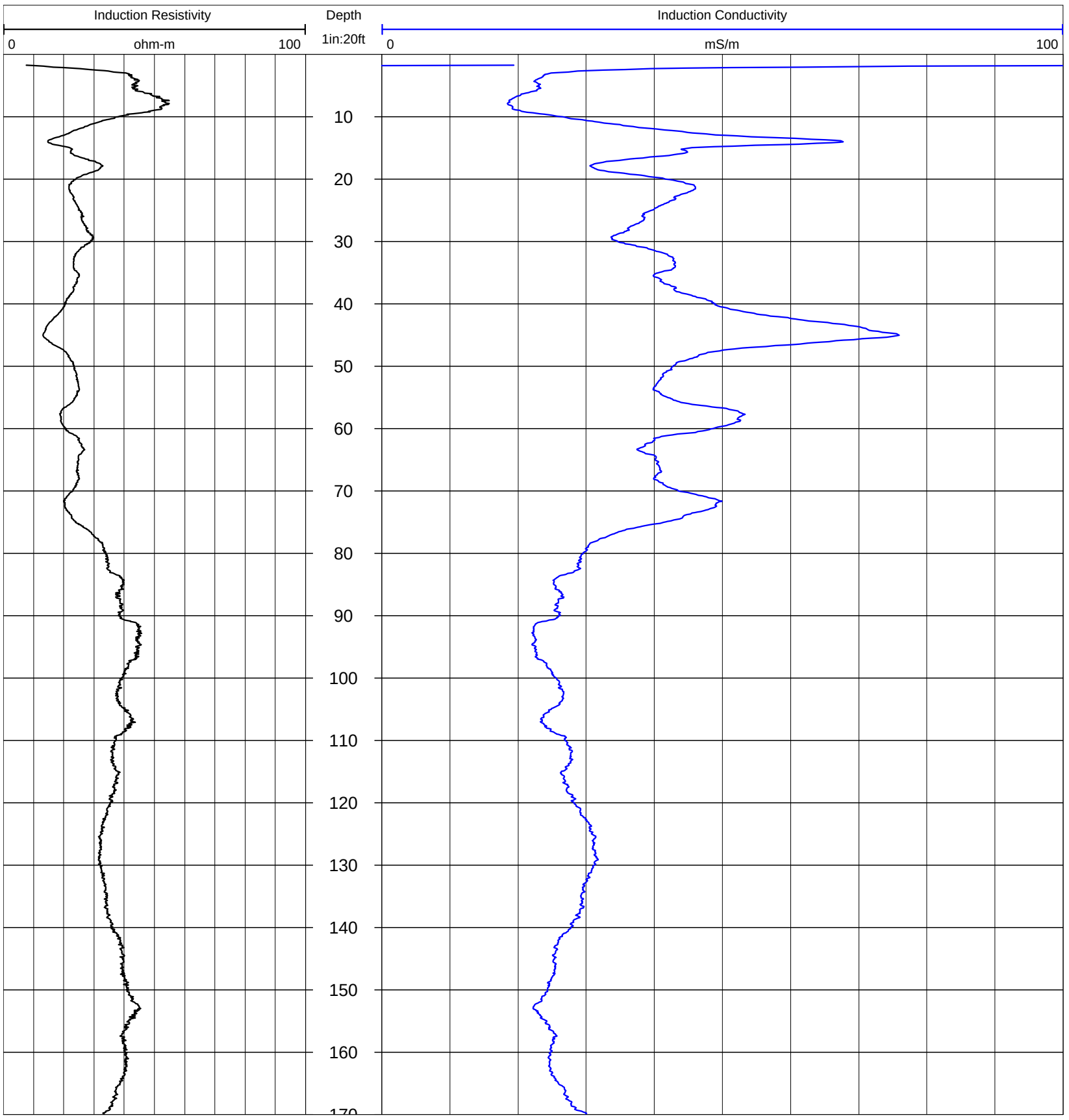
Project #: 07-174 **Client:** SFWMD **Date:** July 2, 2007
Boring Name: S1B (STL-317) **Operator:** L. Yuhr
Site Location: 222 Everglades Blvd.

Depth Units: feet **Depth Ref.:** ground surface **Ref. Elev.:** unknown
Casing Material/Dia.: 2-in PVC **Casing Stickup:** flush mount **Casing Depth:**
Water Level: 3.41 ft **Hole Depth:** 170 ft

Logging System: Mount Sopris MGXII **Log UP/DOWN:** Up **Logging Speed:** 13ft/min
Logs: Induction
Measurement Units: mS/m



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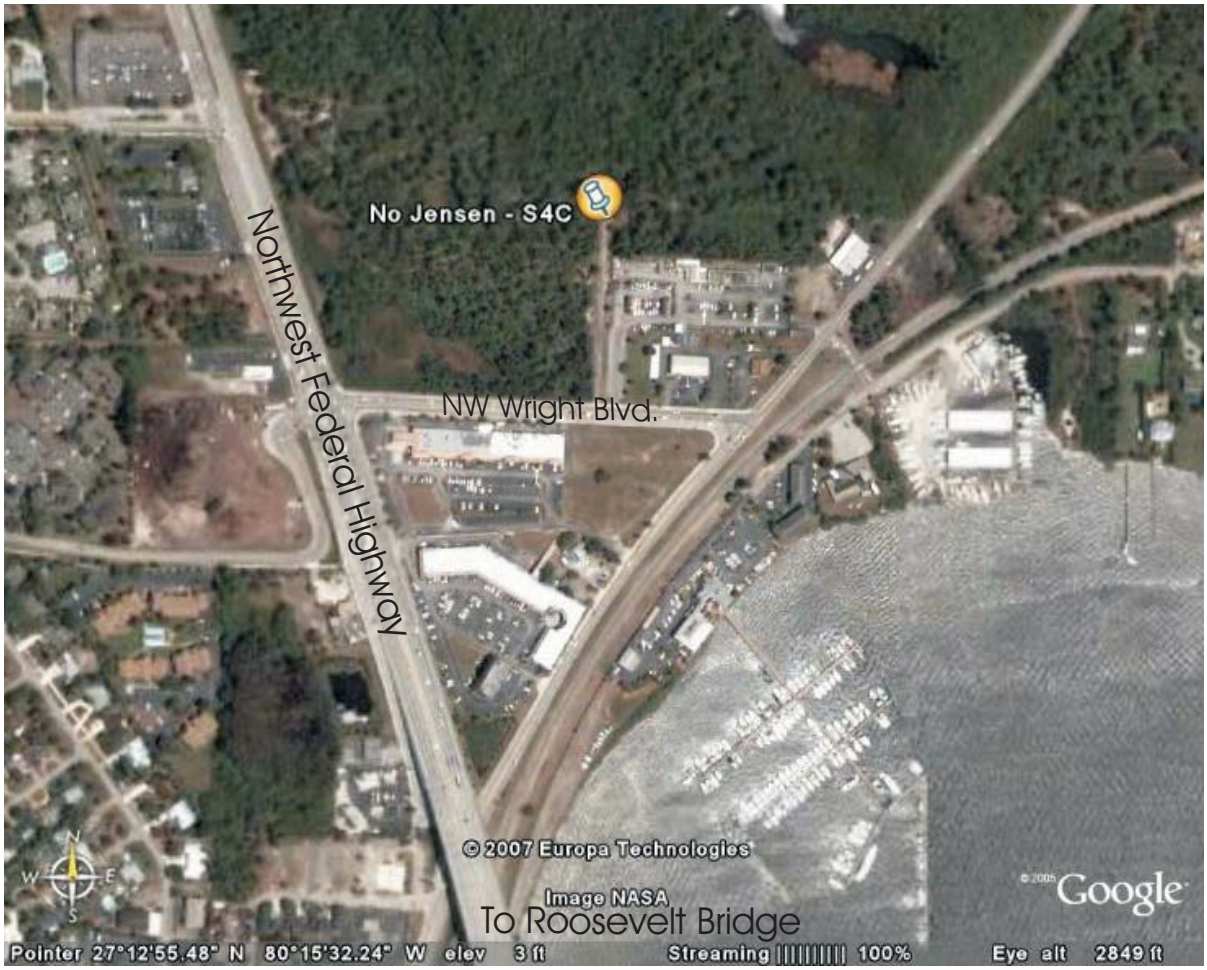

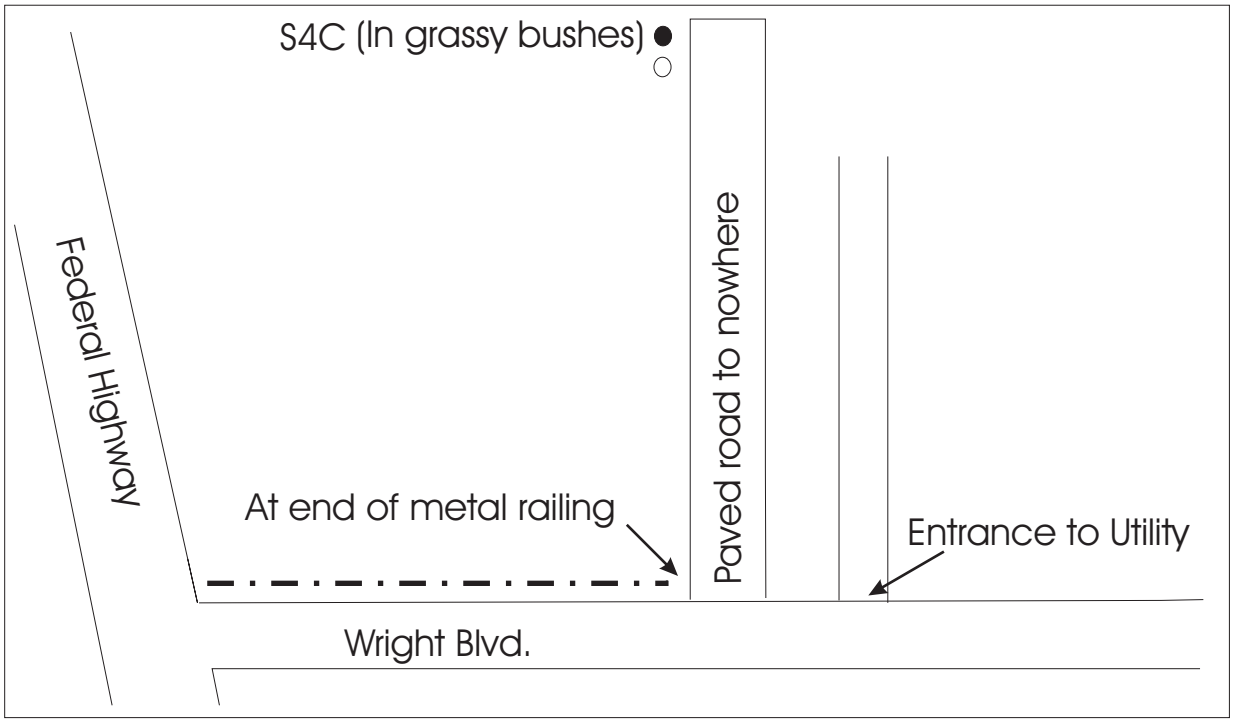

Jensen - S4C

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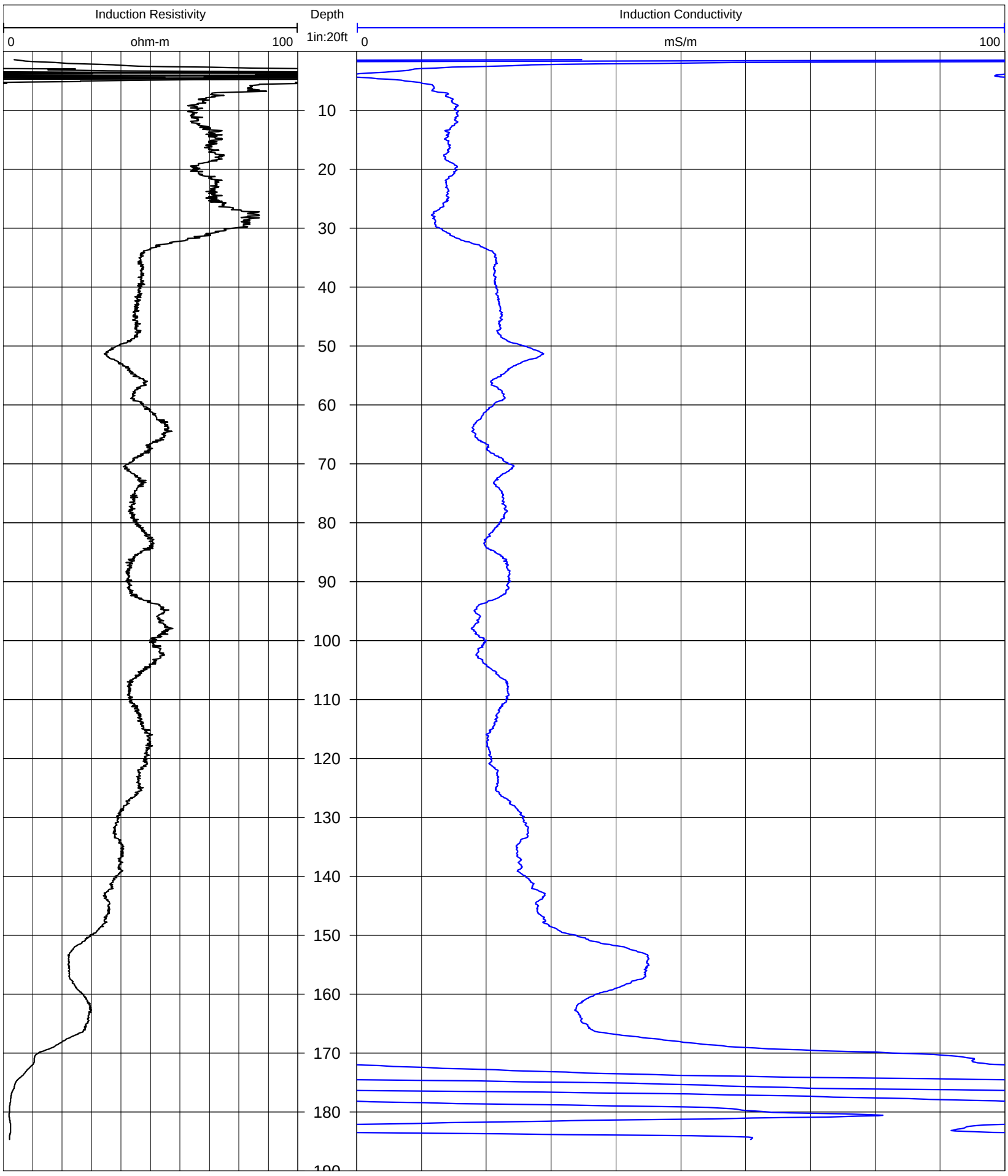
Project #: 07-174 **Client:** SFWMD **Date:** July 2, 2007
Boring Name: S4C (M1293) **Operator:** L. Yuhr
Site Location: West of utilities at end of paved road, north of Wright Blvd. in Jensen

Depth Units: feet **Depth Ref.:** ground surface **Ref. Elev.:** unknown
Casing Material/Dia.: 2-in PVC **Casing Stickup:** flush mount **Casing Depth:**
Water Level: 3.71 ft **Hole Depth:** 185 ft

Logging System: Mount Sopris MGXII **Log UP/DOWN:** Up **Logging Speed:** 13ft/min
Logs: Induction
Measurement Units: mS/m



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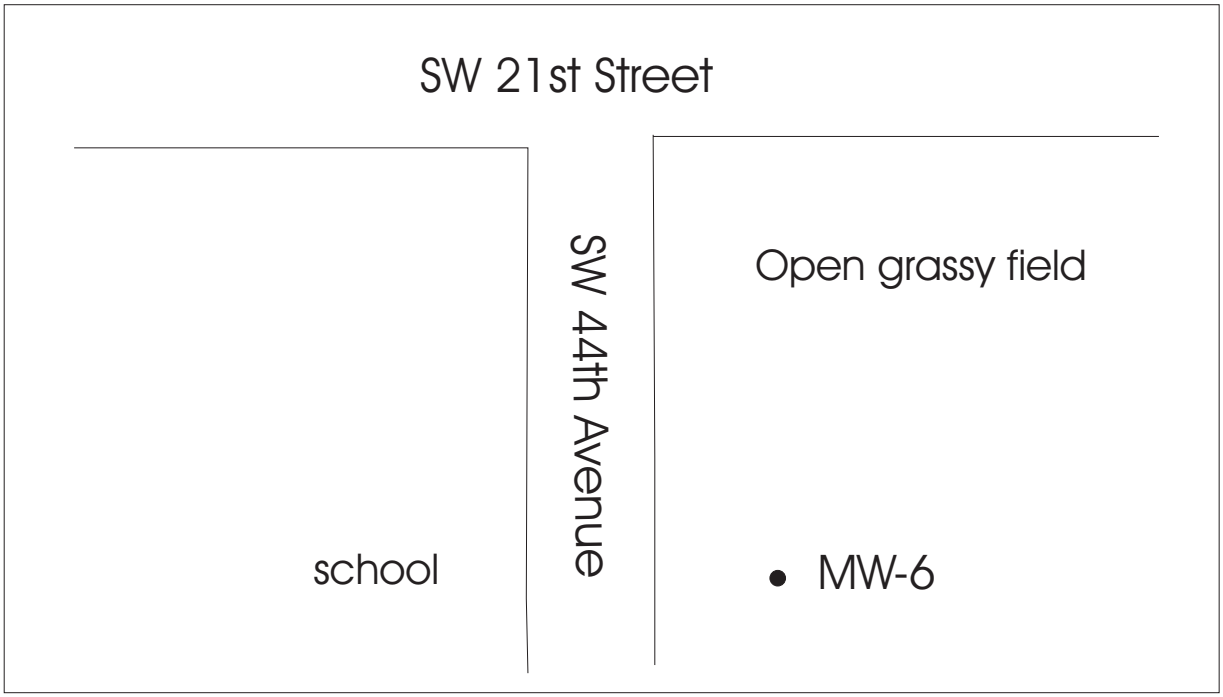

Ft. Lauderdale MW-6

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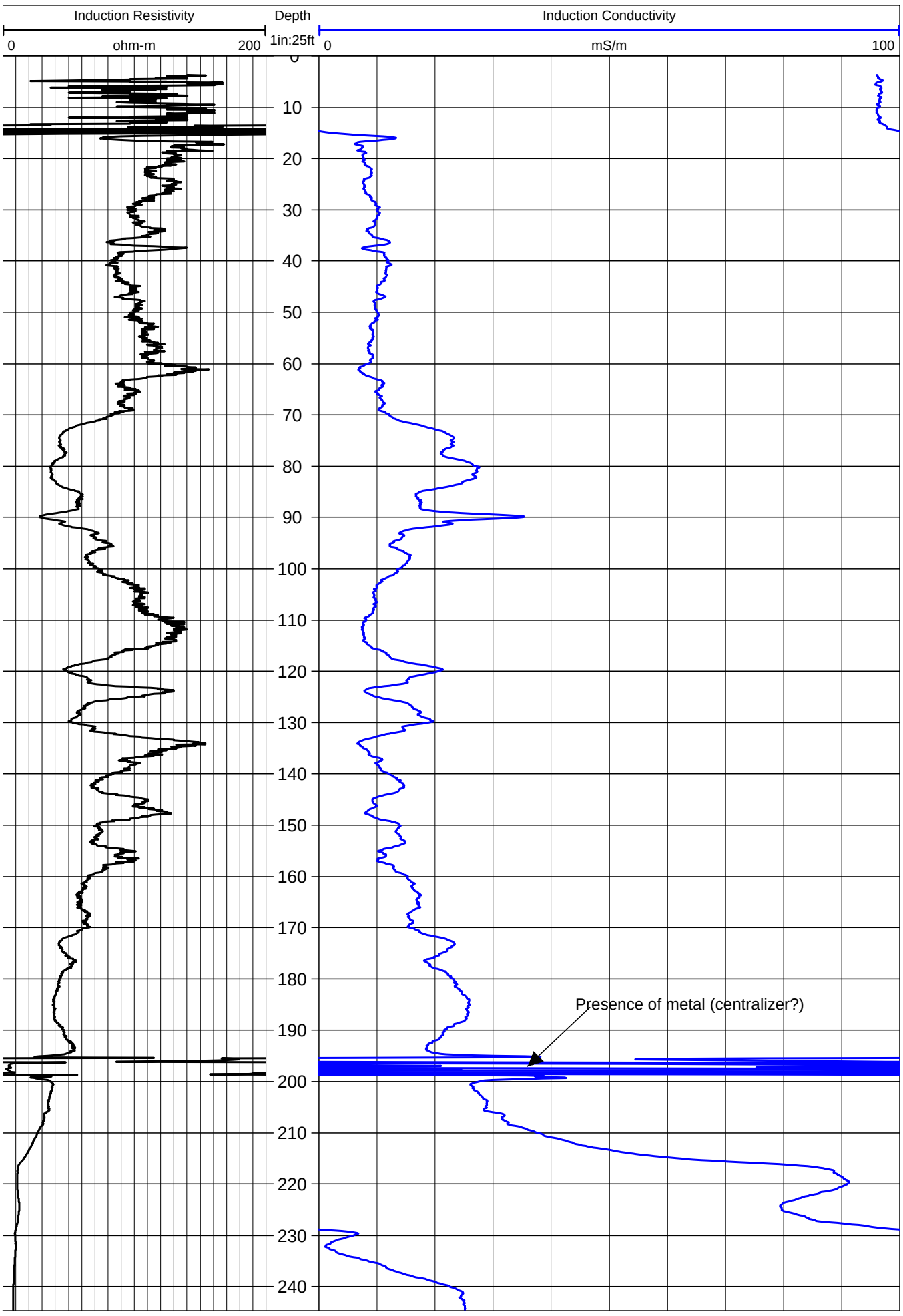
Project #: 07-174 **Client:** SFWMD **Date:** Dec 4, 2007
Boring Name: Fort Lauderdale MW-6 **Operator:** L. Yuhr
Site Location: 100 yards south of SW 44 Ave/Way and SW 21st Street

Depth Units: feet **Depth Ref.:** ground surface **Ref. Elev.:** unknown
Casing Material/Dia.: 2-in PVC **Casing Stickup:** flush mount **Casing Depth:** 247 ft
Water Level: 17.04 ft **Hole Depth:** 247 ft

Logging System: Mount Sopris MGXII **Log UP/DOWN:** Up **Logging Speed:** 15ft/min
Logs: Induction
Measurement Units: mS/m



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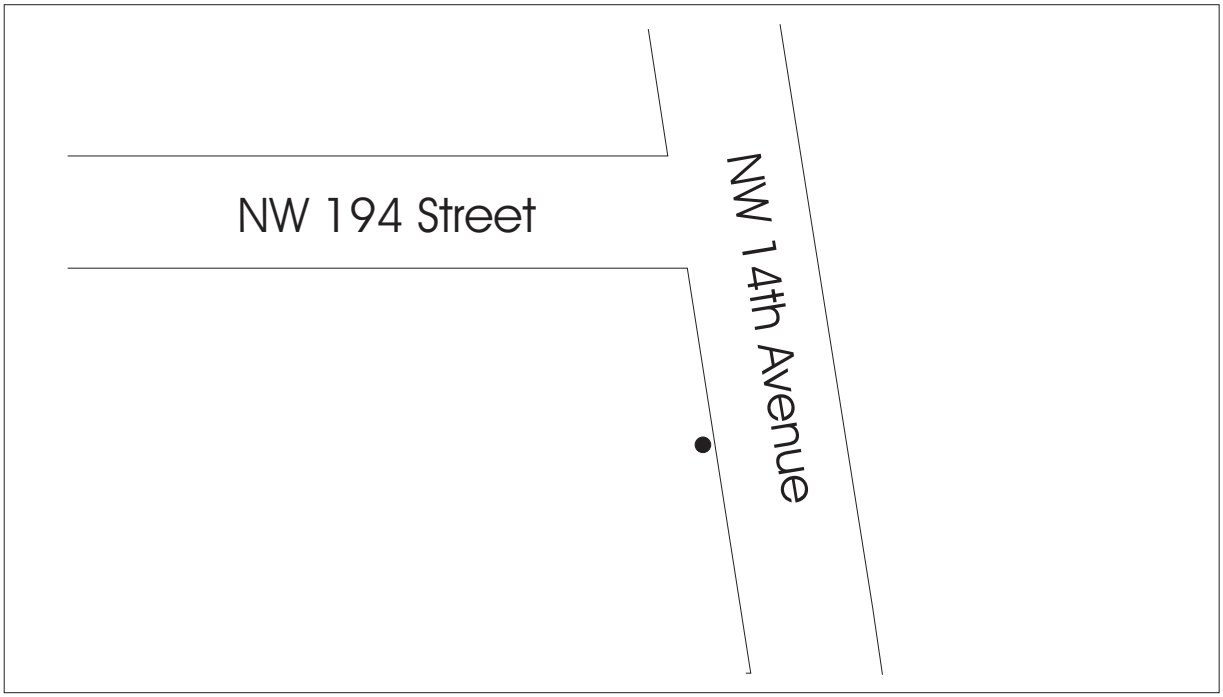

Dade DMW-4

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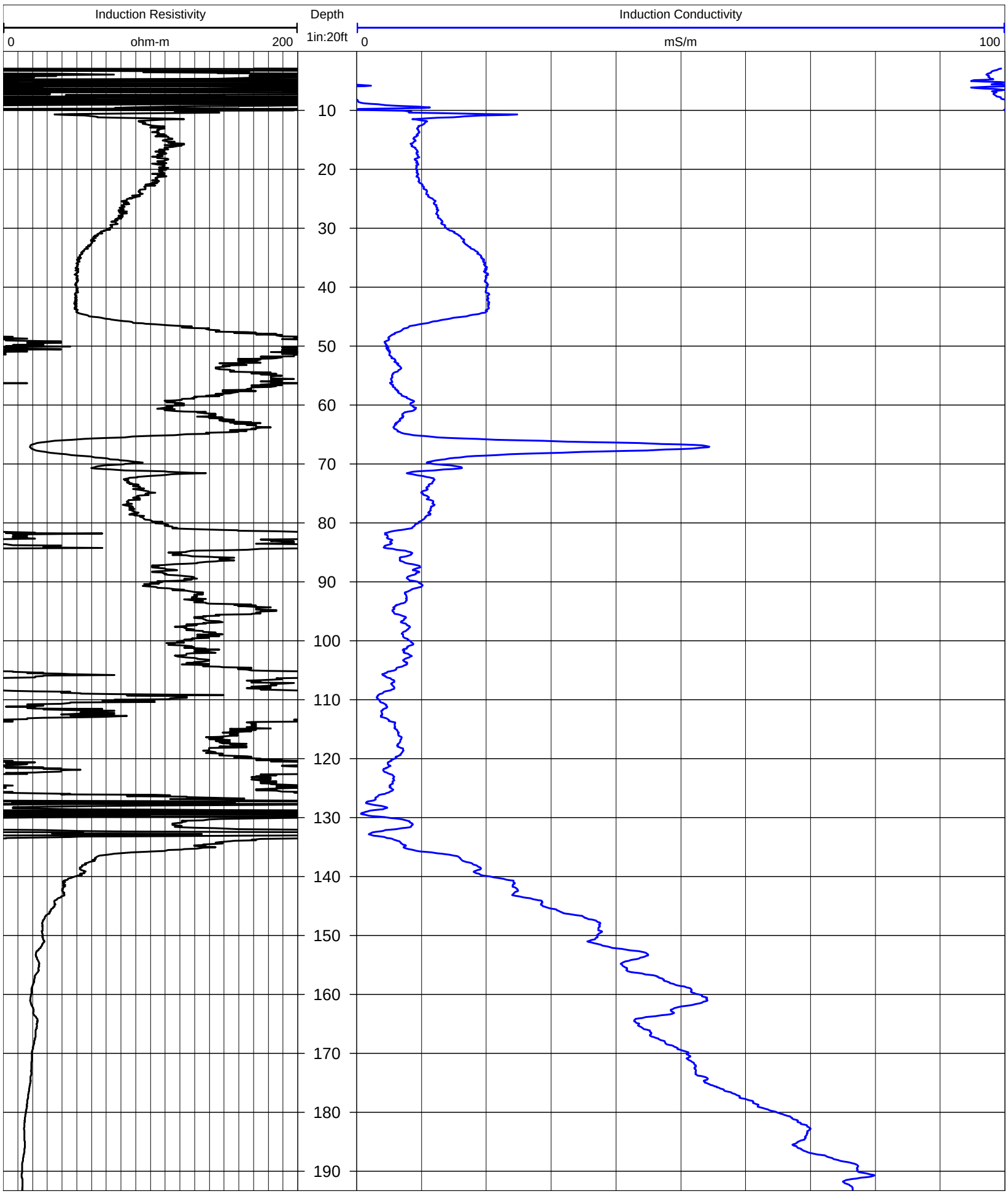
Project #: 07-174 **Client:** SFWMD **Date:** Dec 4, 2007
Boring Name: Dade County DMW-4 **Operator:** L. Yuhr
Site Location: west side of NW 14 Ave, 100 south of NW 194 St

Depth Units: feet **Depth Ref.:** ground surface **Ref. Elev.:** unknown
Casing Material/Dia.: 2-in PVC **Casing Stickup:** flush mount **Casing Depth:** 196 ft
Water Level: na **Hole Depth:** 196 ft

Logging System: Mount Sopris MGXII **Log UP/DOWN:** Up **Logging Speed:** 15ft/min
Logs: Induction
Measurement Units: mS/m



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