SURVEY REPORT

Bayou De Cade Ridge and Marsh Creation (TE-138) Terrebonne Parish, Louisiana

September 11, 2019

Prepared for:

Coastal Protection and Restoration Authority of Louisiana
150 Terrace Avenue
Baton Rouge, La 70802

Attention: Ms. April Newman, Project Manager

Prepared by:

Lonnie G. Harper & Associates, Inc.
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Bell City, La 70630
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Author: Chris Wheat, PE

Reviewed: Leonard Harper, PE

Approved: Lonnie Harper, PE, PLS
Principal

Lonnie G. Harper & Associates, Inc.
CIVIL ENGINEERING AND LAND SURVEYING CONSULTANTS

Contents

Scope of Work

The Bayou De Cade Ridge and Marsh Creation (TE-138) Project is located along the western shore line of Lake Decade in southern Terrebonne Parish, Louisiana. Lonnie G. Harper & Associates, Inc. (LHA) has been tasked by the Coastal Protection and Restoration Authority (CPRA) of Louisiana, with performing topographic, bathymetric, and magnetometer surveys of the project areas. More specifically, the work was limited to the following: 1.) transect and cross-section surveys at an existing water control structure and proposed location for a dredge discharge pipeline; 2.) bathymetric survey of a transect along the rim of Lake Decade; 3.) magnetometer survey of the entire project area; and 4.) probing and identifying anomalies discovered by the magnetometer survey. The location and frequency of all transect lines associated with this work were established by CPRA and provided to LHA.

Site Access

LHA obtained Access Permit from Apache Louisiana Minerals, LLC to gain access to the project and complete the necessary data collect. LHA utilized traditional shallow draft boats and an airboat to access to the various types of terrain associated with each of the project areas.

Survey Control

As defined in LHA's Scope of Work, the secondary control monuments shown in Table 1.1 below served as the horizontal and vertical control for all surveys completed at the project site. The reported positions of the secondary monuments were provided by CPRA. The RTK base receiver was setup on secondary monument "TE34-SM-01" each day for all data collection activities. For quality assurance, on each setup LHA obtained an RTK position on secondary monument "TE28-SM-A" to verify RTK equipment is measuring horizontal and vertical positions that are consistent with the secondary control network. Reference Appendix 2 for the secondary control monument data sheets.

Table 1.1 – Bayou De Cade Ridge and Marsh Creation (TE-138)
Survey Control

Monument Name	Northing	Easting	Latitude	Longitude	Orthometric Height (NAVD 88)
TE34-SM-01	315,518.71	3,408,657.28	N29°22'01.13868"	W90°55'55.39026"	0.37
TE28-SM-A	324,457.88	3,408,054.70	N29°23'29.6538"	W90°56'01.8481"	1.53

[1]Horizontal coordinates are referenced to the North American Datum of 1983 (NAD83) 2011 realization, Epoch 2010.00, La SPC, South Zone-1702 and are presented in U.S. survey feet.
[2]Orthometric heights (elevations) are referenced to the North American Vertical Datum of 1988 (NAVD 88), Geoid 12A and are presented in U.S. survey feet.

Topographic Surveys (Real Time Kinematic)

Profiles and cross-section transect lines that fell on land/marsh or in areas with shallow open water conditions (less than 4ft in depth) where surveyed using conventional GPS Real Time Kinematic

(RTK) surveying equipment and methodologies. RTK equipment consists of Trimble R8 and R10 dual frequency receivers placed on a fixed height tripod (RTK base) with multiple fixed-height rover poles equipped with flat, aluminum base plates, which prevented the rover poles from sinking into soft soils when taking GPS observations.

GPS RTK topographic survey shots were taken at intervals of approximately 10 feet along each profile transect, with significant intermittent grade changes of 0.5 feet or more recorded. Cross-section transects associated with the water control structure were spaced at intervals of 10 feet and extended a minimum of 25 feet from the structure centerline. Data points along each transect were also collected at an interval of 10 feet, with significant intermittent grade changes of 0.5 feet or more recorded.

Bathymetric Survey

Profiles and cross-section transect lines that fell in areas with deep water conditions (4 feet in depth or greater) where surveyed using an 18-foot aluminum surface drive boat equipped with a single-beam, single-frequency (200 kHz) echosounder (SonarMite). Bar checks were performed periodically during the survey for QA/QC purposes. These bar checks consisted of taking a conventional RTK shot on the water bottom and SonarMite reading at the same physical location. For quality assurance, SonarMite data overlapped the topographic survey data. During data processing, the SonarMite data was compared to the manual RTK observations to ensure the data is consistent.

Magnetometer Survey

The magnetometer survey performed for the TE-138 project was essentially completed in two phases. The first phase consisted of surveying sample lines in a grid pattern to help locate any anomalies that may be present in the area. Magnetometer data was collected using a Geometrics G882 magnetometer, Trimble SPS461 differential GPS, and Hypack data collection software. All magnetometer data was collected with the magnetometer and GPS receiver mounted off the bow of an airboat. The GPS receiver was mounted directly over the magnetometer to maintain an offset distance of zero feet between the two devices.

Each day before data collection commenced, the operator started the magnetometer giving it sufficient time to "zero" itself to establish the baseline gamma reading. It should be noted that the baseline gamma value will change depending on transportation equipment used, geographical location, direction of travel, and survey methodology. During post-processing, this baseline gamma value was calculated and used to eliminate any signatures within ±50 units from the baseline(s). Once processed, the anomaly hits were superimposed over aerial imagery and geo-referenced shape files obtained from www.sonris.com showing the permitted locations of oil and gas infrastructure within the project area. Anomaly signatures were compared to the permitted infrastructure locations to help determine their true position and identity.

On July 25, 2019, LHA personnel met with the CPRA project team to review the anomalies located during the initial magnetometer survey and to discuss the need for probing and identification of said anomalies. It was concluded that all anomalies identified by the survey would need to be investigated by LHA survey crews.

LHA survey crews utilized a SubSurface Instruments, Inc. MUL-1 Magnetic Underwater Locator (gradiometer) to pinpoint the location of the associated anomalies. This was done by traversing tightly spaced grid patterns or concentric circles around suspected target locations. Once the anomalies were found, crews then used hand probes and/or visual observations to determine the anomalies identity, position, elevation, depth of cover, etc. Observed locations and corresponding data were then recorded using a Trimble R8/R10 receivers and Trimble TSCIII data collector.

Quality Control/Quality Assurance

Default settings within the Trimble TSCIII data collectors result in RTK data that is accurate within 5 centimeters. All RTK data was collected using the Trimble's recommended default settings, which include a minimum of 3 epochs per RTK observation. The multiple epochs are averaged to produce the reported positions. This provides an internal statistical accuracy with a confidence interval of approximately 95 percent. Any interference with the radio link, poor satellite geometry, excessive Root Mean Square (RMS), etc. which would result in data not adhering to these precision standards, cannot be stored in the data collector without manually overriding the control settings.

LASARD

RTK and magnetometer data collected at the site has been post-processed and provided to CPRA, conforming to the Louisiana Sand Resources Database (LASARD) Program requirements. LASARD data was provided digitally to the CPRA project manager.

Conclusion

The results of these surveying efforts are shown on the drawings in Appendix 1. The corresponding field notes and surveying equipment specifications are included in Appendix 3 and 4, respectively.

APPENDIX 1

SURVEY DRAWINGS

BAYOU DE CADE RIDGE AND MARSH CREATION, (TE-138)

TERREBONNE PARISH, LOUISIANA

COASTAL PROTECTION AND RESTORATION AUTHORITY OF LOUISIANA

SEPTEMBER 2019

Prepared by:

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STATE OF LOUISIANA
COASTAL PROTECTION AND RESTORATION AUTHORITY

TE-0138 BAYOU DECADE RIDGE & MARSH CREATION PROJECT
TE-0138
TERREBONNE PARISH

GENERAL NOTES

THE HORIZONTAL COORDINATES AND ELEVATIONS ON THIS SURVEY ARE REFERENCED TO THE NATIONAL SPATIAL REFERENCE SYSTEM AND WERE DERIVED BY RECENT GPS OBSERVATIONS. THE HORIZONTAL AND VERTICAL DATUMS FOR THIS REFERENCE SYSTEM ARE NAD 83 AND NAVD 88, RESPECTIVELY. THE REFERENCE FRAME FOR NAD 833 AND NAVD88 IS CURRENTLY 2011, MA11, PA11 (EPOCH 2010). THE NAVD 88 ELEVATIONS ARE BASED ON GEOID 12A. BASIS OF BEARINGS IS SPC LSZ-1702.

BENCHMARK	ELEVATION	NORTHING	EASTING
TE34-SM-01	0.37'	315,518.71	3,408,657.25
TE28-SM-A	1.53'	324,457.88	3,408,054.70

THE ELEVATIONS DEPICTED ON THE PLANS ARE BASED ON SURVEYS PERFORMED IN AUGUST 2019 BY LONNIE HARPER & ASSOCIATES, INC.

THE AERIAL PHOTOGRAPHY IS BASED OF GOOGLE EARTH IMAGERY DATED MARCH 20, 2019.

STATE OF LOUISIANA
LONNIE G. HARPER
REG. NO. 4326
REGISTERED
LAND SURVEYOR
8/31/2019

STATE OF LOUISIANA
UNION JUSTICE CONFIDENCE

CPRA
Louisiana Coastal Protection and Restoration Authority

ENGINEERING CHIEF

ENGINEER MANAGER

PROJECT ENGINEER

LICENSURE CLASSIFICATION REQUIREMENTS

SEE LA RS.37 FOR CLASSIFICATIONS

REV.	DATE	DESCRIPTION	BY

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COASTAL PROTECTION AND RESTORATION AUTHORITY
150 TERRACE AVENUE
BATON ROUGE, LOUISIANA 70802

DRAWN BY: A.P.H. | DESIGNED BY: L.P.H.

TE-0138 BAYOU DE CADE RIDGE & MARSH CREATION PROJECT

STATE PROJECT NUMBER: TE-0138

FEDERAL PROJECT NUMBER:

APPROVED BY: L.G.H.

TITILE SHEET

DATE: 07/24/2019

SHEET 1 OF 19

STATE OF LOUISIANA
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REG. NO. 4326
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TE-0138 BAYOU DE CADE RIDGE & MARSH CREATION PROJECT

PROJECT LOCATION

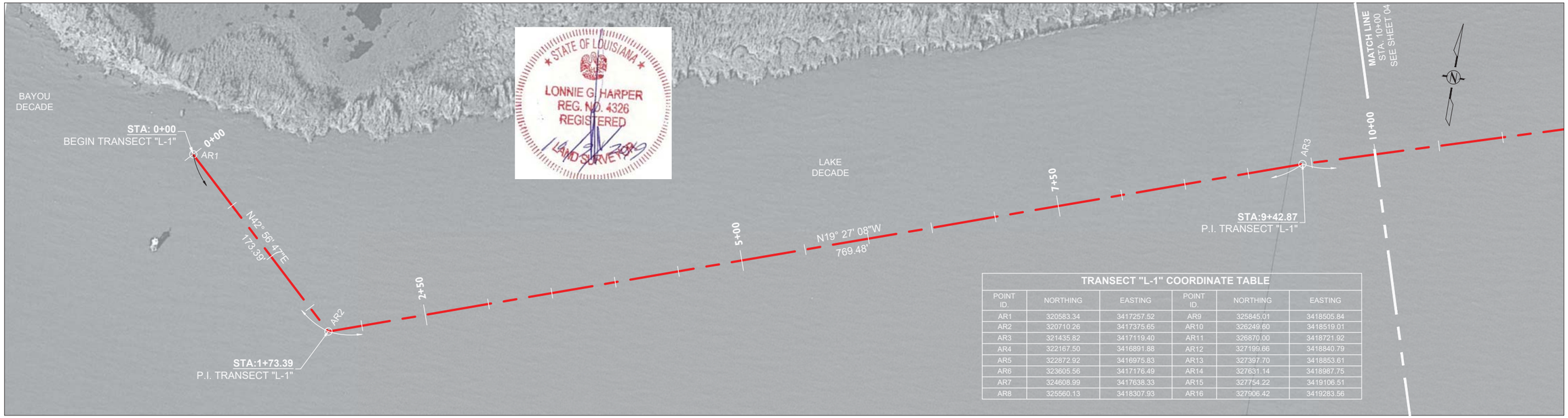
STATE PROJECT NUMBER: TE-0138

FEDERAL PROJECT NUMBER:

DATE: 07/24/2019

APPROVED BY: L.G.H.

SHEET 2 OF 19



TRANSECT "L-1" COORDINATE TABLE

POINT ID.	NORTHING	EASTING	POINT ID.	NORTHING	EASTING
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AR2	320710.26	3417375.65	AR10	326249.60	3418519.01
AR3	321435.82	3417119.40	AR11	326670.00	3418721.92
AR4	322167.50	3416891.88	AR12	327199.66	3418840.79
AR5	322872.92	3416975.83	AR13	327397.70	3418853.61
AR6	323605.56	3417176.49	AR14	327631.14	3418987.75
AR7	324608.99	3417638.33	AR15	327754.22	3419106.51
AR8	325560.13	3418307.93	AR16	327906.42	3419283.56

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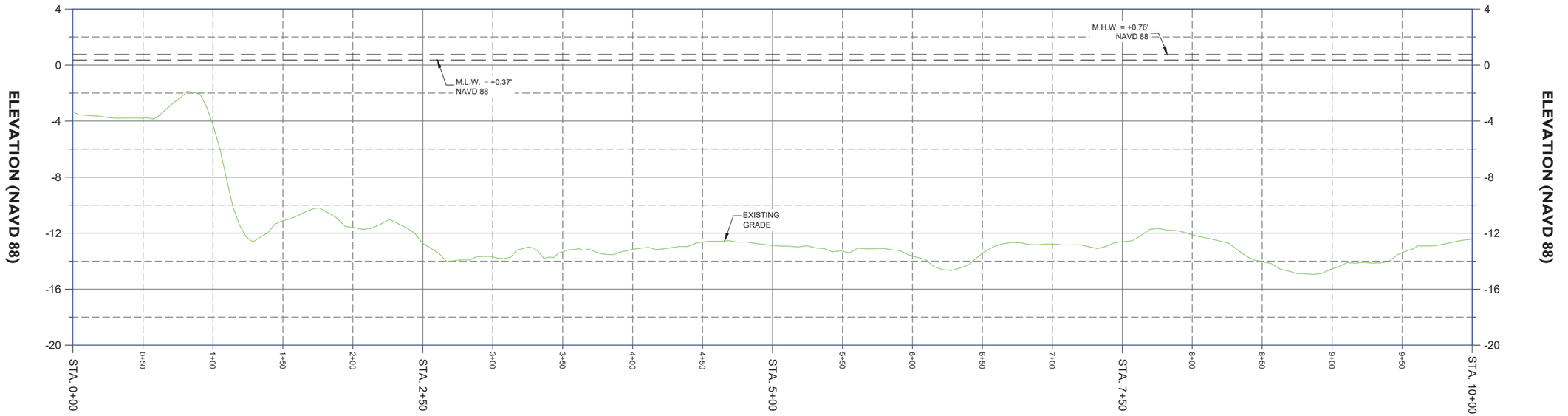

"L1-1" (PROFILE VIEW)

HORIZONTAL SCALE :
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VERTICAL SCALE :
8' 4' 0' 8' 16'

REV.	DATE	DESCRIPTION	BY

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TE-0138 BAYOU DECADE RIDGE & MARSH CREATION PROJECT

STATE PROJECT NUMBER: TE-0138

FEDERAL PROJECT NUMBER:

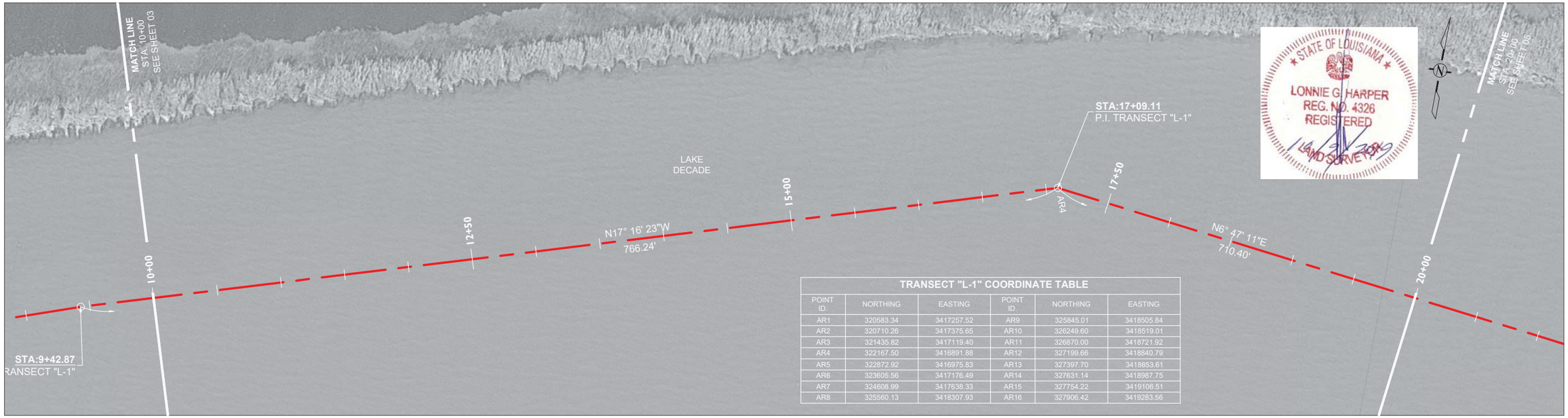
TRANSECT "L-1"
PLAN & PROFILE VIEW

DRAWN BY: A.P.H. | DESIGNED BY: L.P.H.

APPROVED BY: L.G.H.

DATE: 07/24/2019

SHEET 3 OF 19



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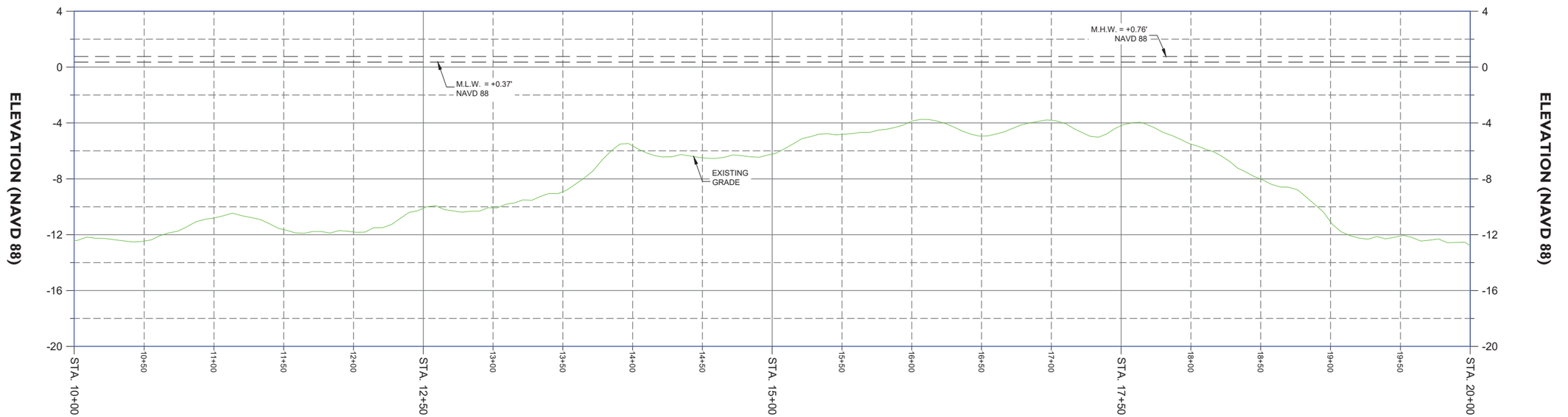

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HORIZONTAL SCALE :

80' 40' 0' 80' 160'

VERTICAL SCALE :

8' 4' 0' 8' 16'

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TE-0138 BAYOU DE CADE RIDGE & MARSH CREATION PROJECT

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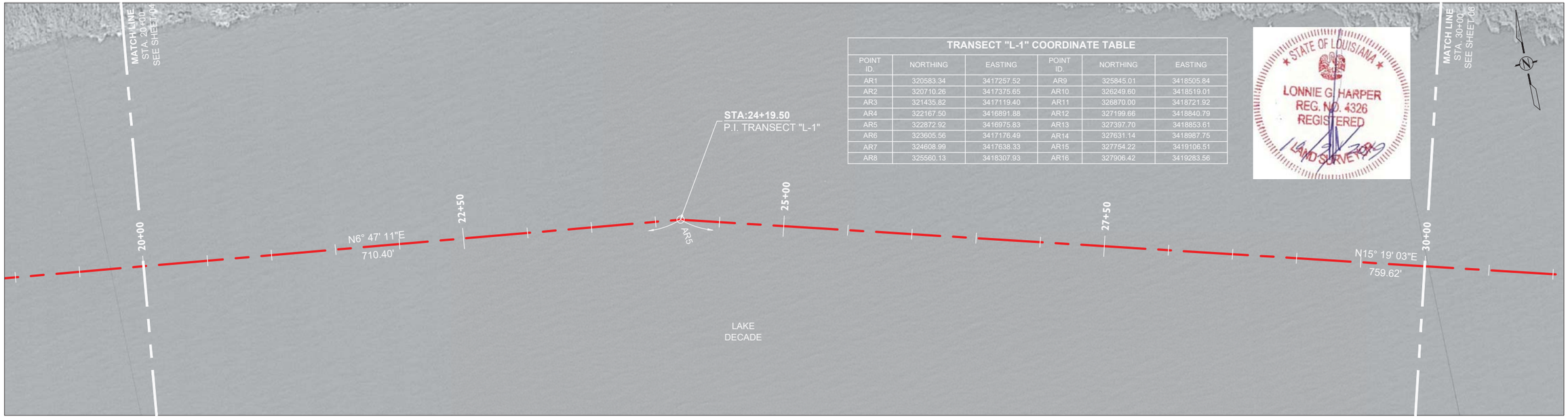
TRANSECT "L-1" PLAN & PROFILE VIEW

DRAWN BY: A.P.H. | DESIGNED BY: L.P.H. | APPROVED BY: L.G.H. | DATE: 07/24/2019 | SHEET 4 OF 19



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STATE OF LOUISIANA
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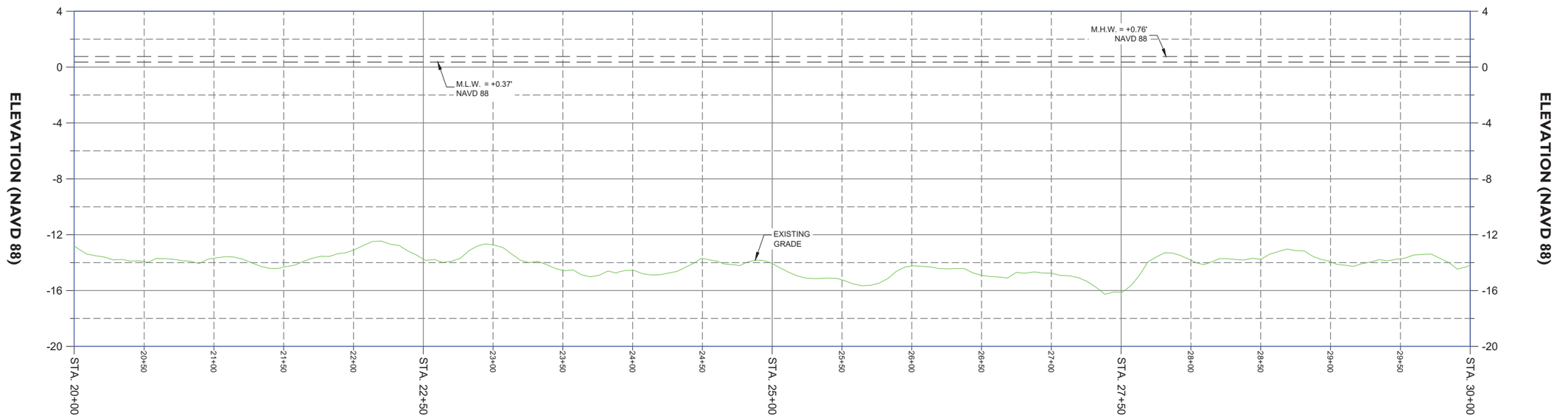
DETAIL "L1-3" (PLAN VIEW)



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VERTICAL SCALE :
8' 4' 0' 8' 16'

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TE-0138 BAYOU DE CADE RIDGE & MARSH CREATION PROJECT

TRANSECT "L-1" PLAN & PROFILE VIEW

STATE PROJECT NUMBER: TE-0138

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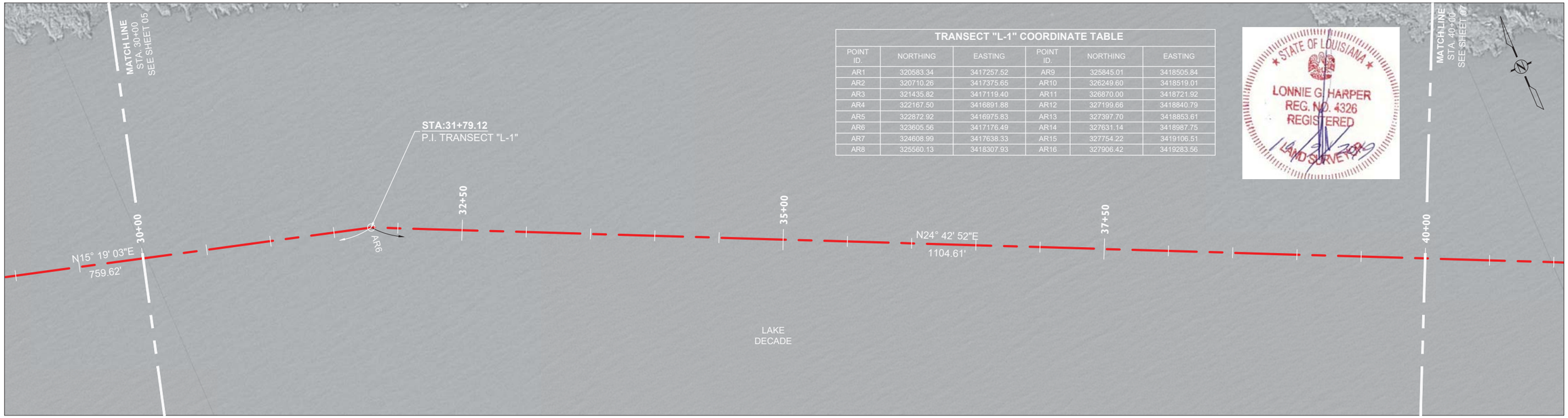
DATE: 07/24/2019

DRAWN BY: A.P.H. | DESIGNED BY: L.P.H. | APPROVED BY: L.G.H.



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STATE OF LOUISIANA
LONNIE G. HARPER
REG. NO. 4326
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LAND SURVEYOR
3/7/2019

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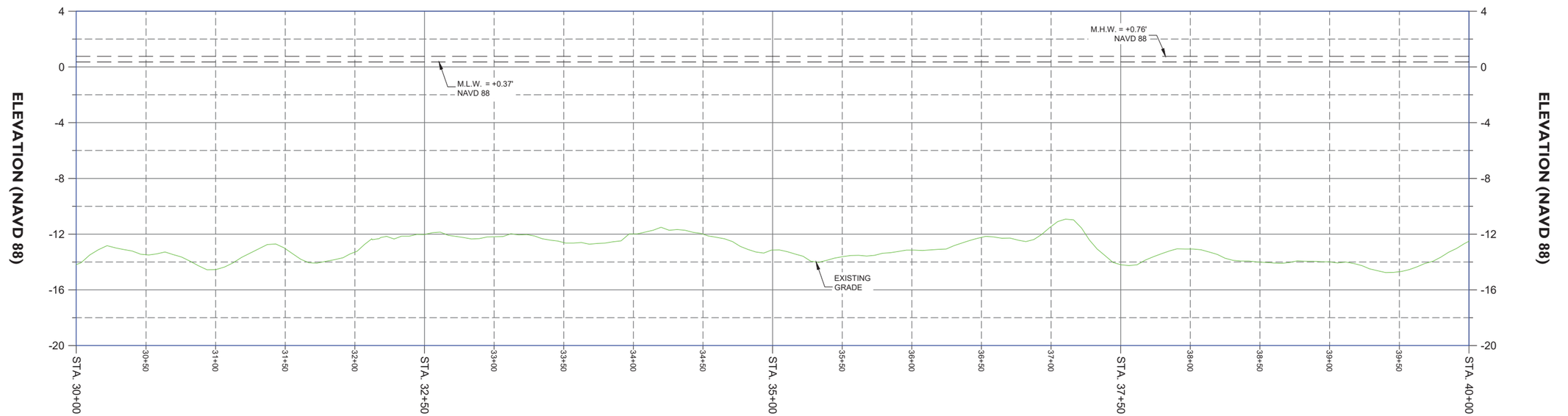

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VERTICAL SCALE :
8' 4' 0' 8' 16'

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TE-0138 BAYOU DE CADE RIDGE & MARSH CREATION PROJECT

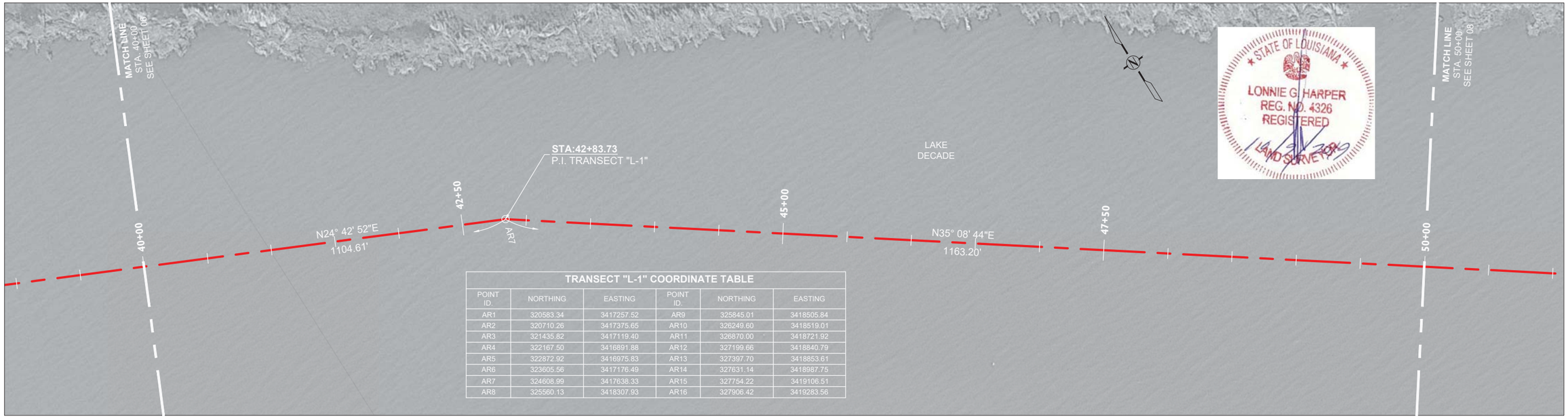
STATE PROJECT NUMBER: TE-0138

FEDERAL PROJECT NUMBER:

APPROVED BY: L.G.H.

TRANSECT "L-1"
PLAN & PROFILE VIEW

DATE: 07/24/2019



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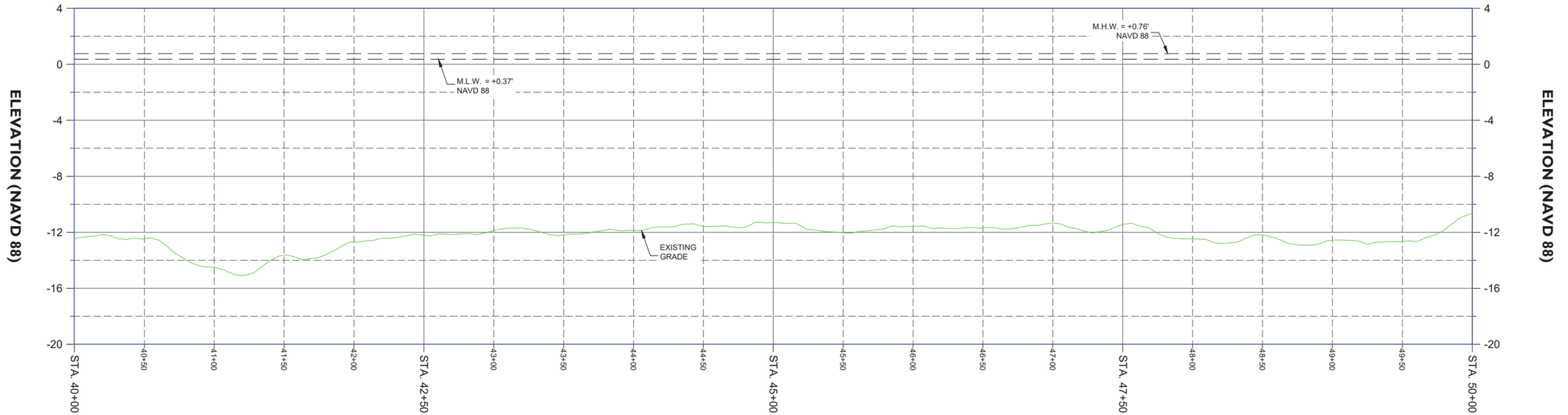

"L1-5" (PROFILE VIEW)

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VERTICAL SCALE :

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150 TERRACE AVENUE
BATON ROUGE, LOUISIANA 70802

TE-0138 BAYOU DE CADE RIDGE & MARSH CREATION PROJECT

TRANSECT "L-1" PLAN & PROFILE VIEW

STATE PROJECT NUMBER: TE-0138

FEDERAL PROJECT NUMBER:

DATE: 07/24/2019

DRAWN BY: A.P.H. | DESIGNED BY: L.P.H. | APPROVED BY: L.G.H.

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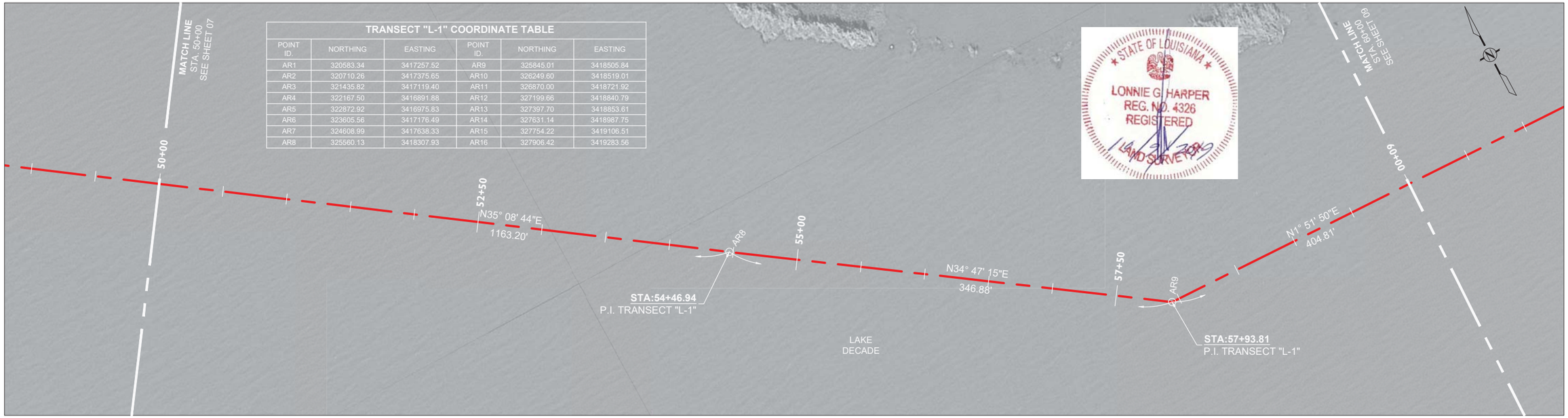
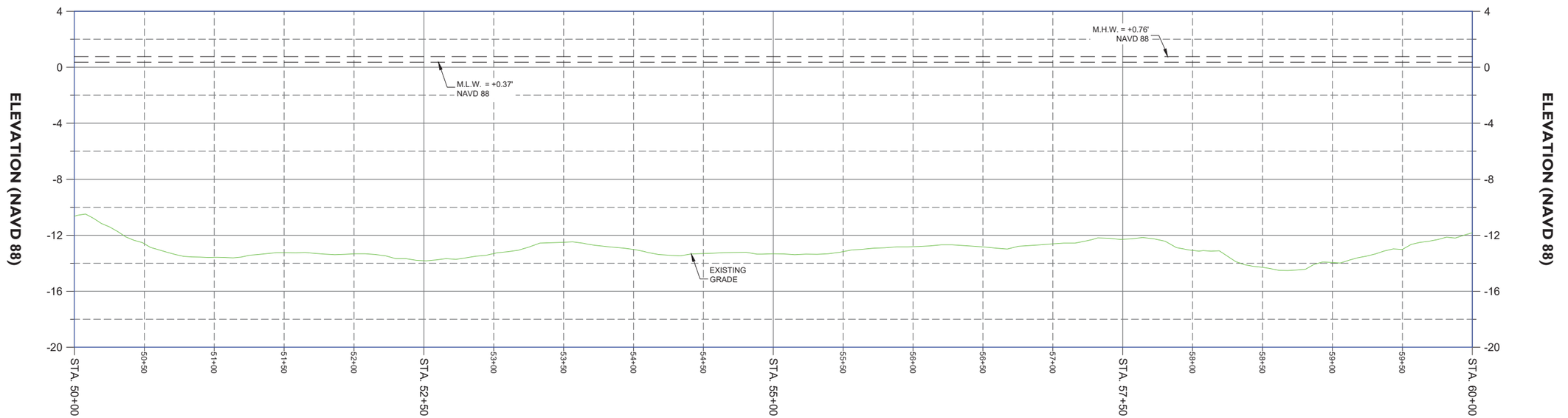


DETAIL "L1-6" (PLAN VIEW)



"L1-6" (PROFILE VIEW)

HORIZONTAL SCALE :

80' 40' 0' 80' 160'

VERTICAL SCALE :

8' 4' 0' 8' 16'

REV.	DATE	DESCRIPTION	BY

LONNIE G. HARPER & ASSOCIATES, INC.
CIVIL ENGINEERING & LAND SURVEYING
2746 HWY. NO. 384, BELL CITY, LOUISIANA 70630
PHONE: (337) 905-1079 FAX: (337) 905-1076

COASTAL PROTECTION AND RESTORATION AUTHORITY
150 TERRACE AVENUE
BATON ROUGE, LOUISIANA 70802

TE-0138 BAYOU DE CADE RIDGE & MARSH CREATION PROJECT

STATE PROJECT NUMBER: TE-0138

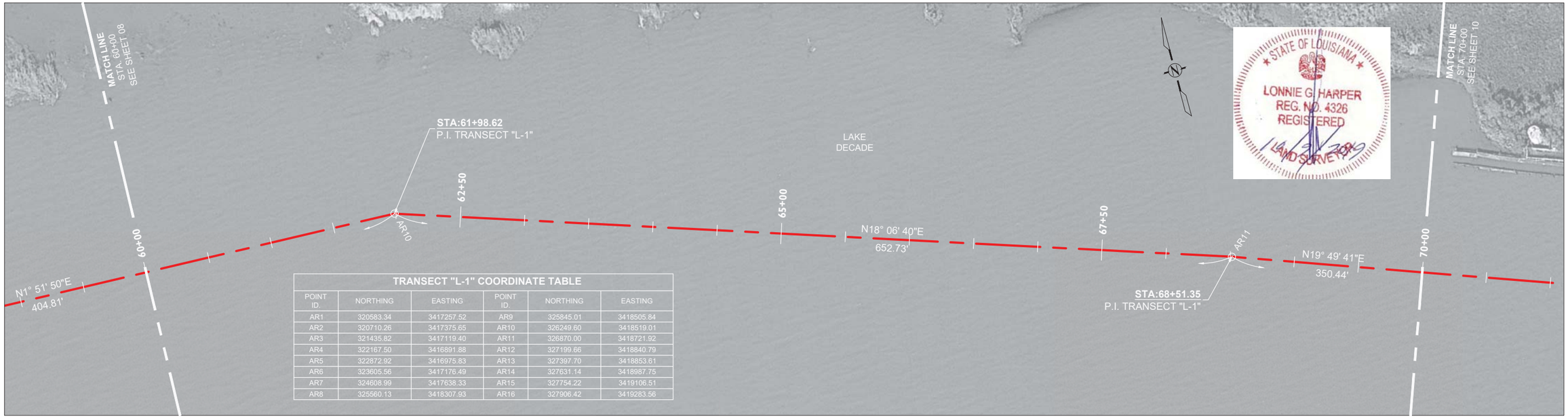
FEDERAL PROJECT NUMBER:

TRANSECT "L-1" PLAN & PROFILE VIEW

DRAWN BY: A.P.H. | DESIGNED BY: L.P.H.

APPROVED BY: L.G.H.

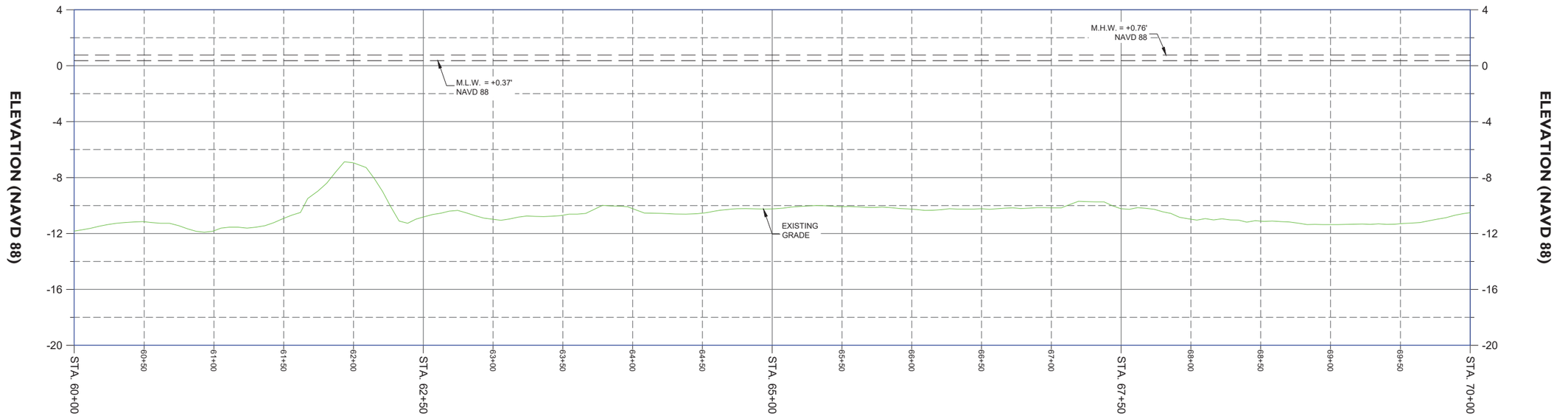
DATE: 07/24/2019



TRANSECT "L-1" COORDINATE TABLE

POINT ID.	NORTHING	EASTING	POINT ID.	NORTHING	EASTING
AR1	320583.34	3417257.52	AR9	325845.01	3418505.84
AR2	320710.26	3417375.65	AR10	326249.60	3418519.01
AR3	321435.82	3417119.40	AR11	326870.00	3418721.92
AR4	322167.50	3416891.88	AR12	327199.66	3418840.79
AR5	322872.92	3416975.83	AR13	327397.70	3418853.61
AR6	323605.56	3417176.49	AR14	327631.14	3418987.75
AR7	324608.99	3417638.33	AR15	327754.22	3419106.51
AR8	325560.13	3418307.93	AR16	327906.42	3419283.56

DETAIL "L1-7" (PLAN VIEW)



"L1-7" (PROFILE VIEW)

HORIZONTAL SCALE :

80' 40' 0' 80' 160'

VERTICAL SCALE :

8' 4' 0' 8' 16'

REV.	DATE	DESCRIPTION	BY

LONNIE G. HARPER & ASSOCIATES, INC.
CIVIL ENGINEERING & LAND SURVEYING
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TE-0138 BAYOU DE CADE RIDGE & MARSH CREATION PROJECT

STATE PROJECT NUMBER: TE-0138

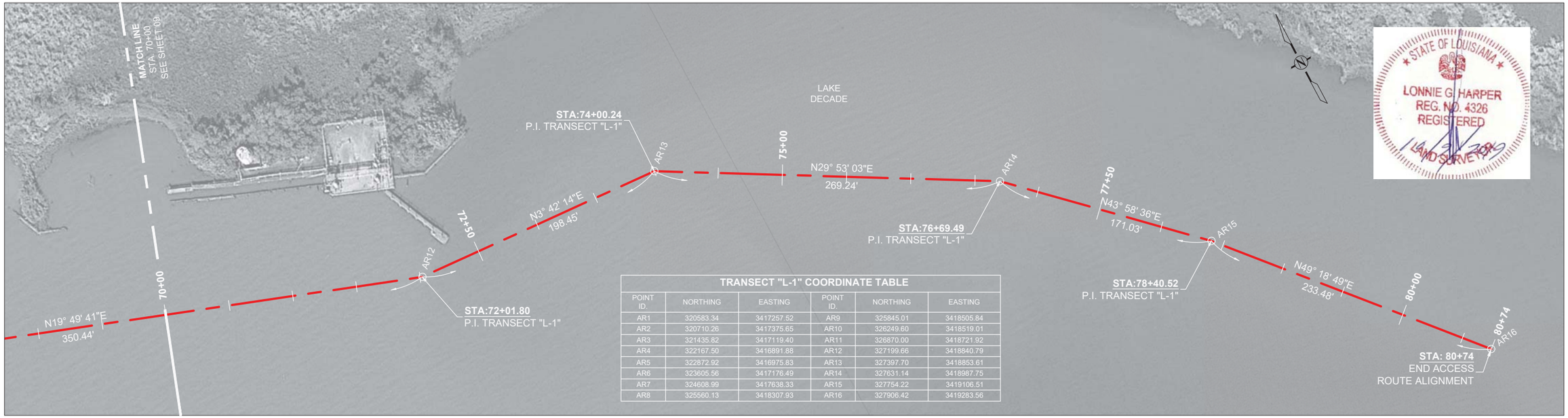
FEDERAL PROJECT NUMBER:

TRANSECT "L-1" PLAN & PROFILE VIEW

DRAWN BY: A.P.H. | DESIGNED BY: L.P.H.

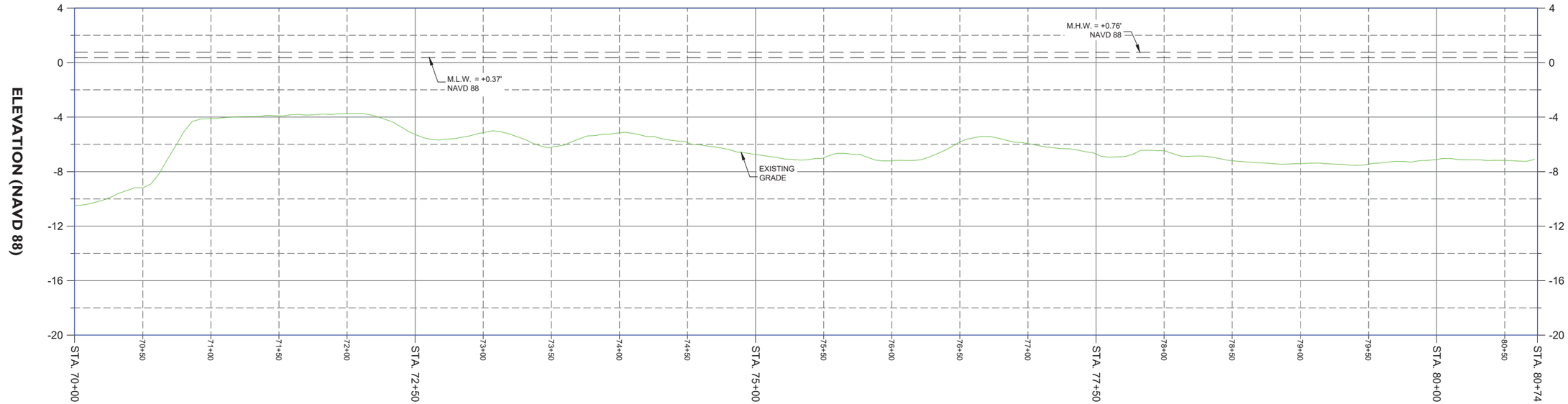
APPROVED BY: L.G.H.

DATE: 07/24/2019



TRANSECT "L-1" COORDINATE TABLE					
POINT ID.	NORTHING	EASTING	POINT ID.	NORTHING	EASTING
AR1	320583.34	3417257.52	AR9	325845.01	3418505.84
AR2	320710.26	3417375.65	AR10	326249.60	3418519.01
AR3	321435.82	3417119.40	AR11	326870.00	3418721.92
AR4	322167.50	3416891.88	AR12	327199.66	3418840.79
AR5	322872.92	3416975.83	AR13	327397.70	3418853.61
AR6	323605.56	3417176.49	AR14	327631.14	3418987.75
AR7	324608.99	3417638.33	AR15	327754.22	3419106.51
AR8	325560.13	3418307.93	AR16	327906.42	3419283.56

DETAIL "L1-8" (PLAN VIEW)



"L1-8" (PROFILE VIEW)

HORIZONTAL SCALE :
80' 40' 0' 80' 160'

VERTICAL SCALE :
8' 4' 0' 8' 16'

REV.	DATE	DESCRIPTION	BY

LONNIE G. HARPER & ASSOCIATES, INC.
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TE-0138 BAYOU DE CADE RIDGE & MARSH CREATION PROJECT

STATE PROJECT NUMBER: TE-0138

FEDERAL PROJECT NUMBER:

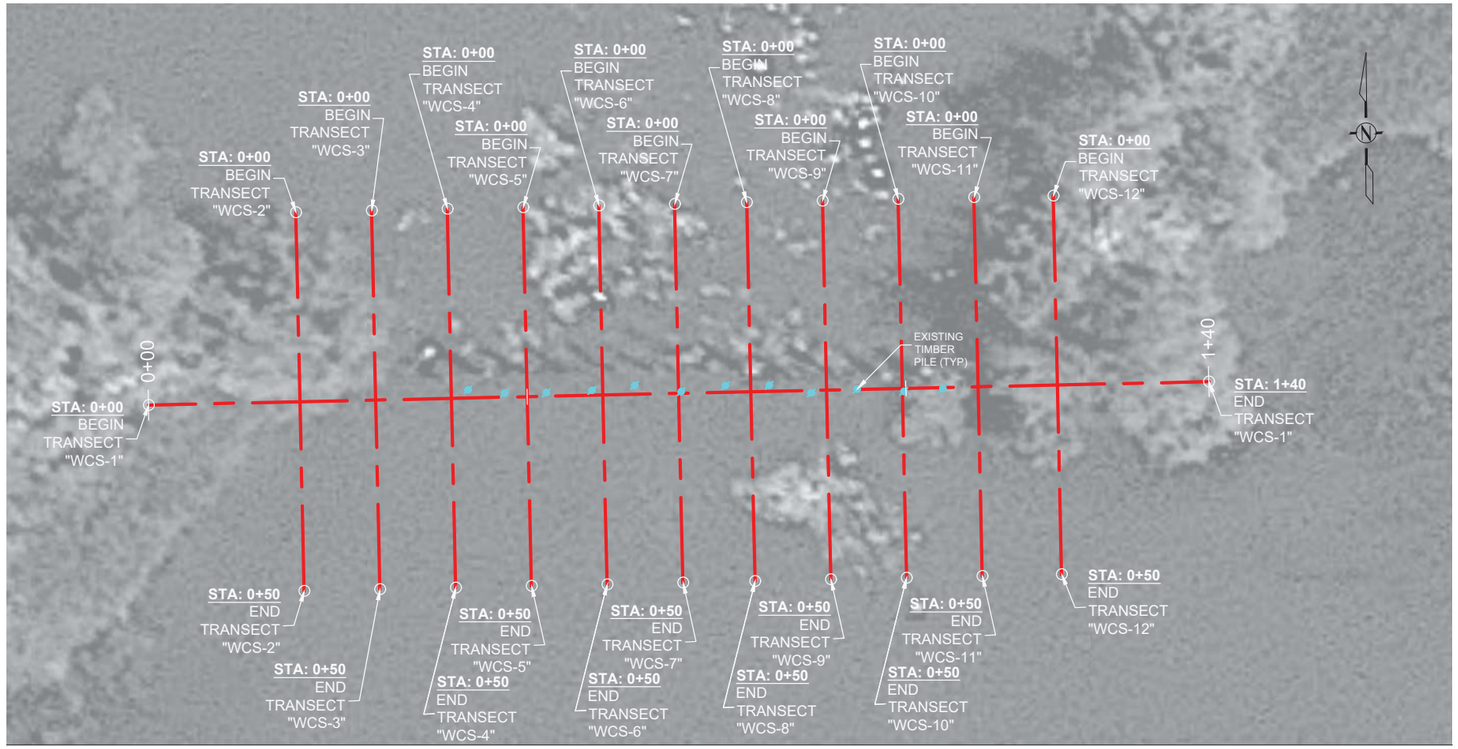
TRANSECT "L-1" PLAN & PROFILE VIEW

DRAWN BY: A.P.H. | DESIGNED BY: L.P.H.

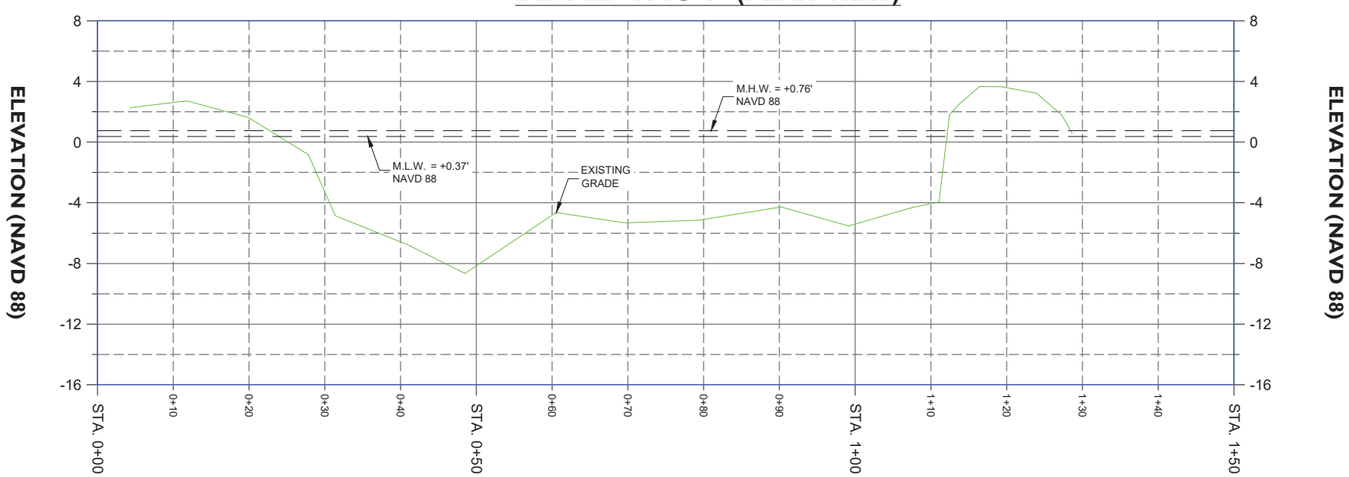
APPROVED BY: L.G.H.

DATE: 07/24/2019

SHEET 10 OF 19



DETAIL "WCS-1" (PLAN VIEW)



"TRANSECT WCS-1" (PROFILE VIEW)

STRUCTURE COORDINATE DATA TABLE					
POINT ID.	NORTHING	EASTING	POINT ID.	NORTHING	EASTING
WCS-1	321246.85	3414644.94	WCS-13	321273.39	3414714.37
WCS-2	321249.94	3414784.90	WCS-14	321223.40	3414715.47
WCS-3	321272.29	3414664.38	WCS-15	321273.60	3414723.90
WCS-4	321222.30	3414665.48	WCS-16	321223.61	3414725.00
WCS-5	321272.51	3414674.38	WCS-17	321273.82	3414733.90
WCS-6	321222.52	3414675.48	WCS-18	321223.83	3414735.00
WCS-7	321272.73	3414684.38	WCS-19	321274.04	3414743.89
WCS-8	321222.74	3414685.48	WCS-20	321224.05	3414744.99
WCS-9	321272.95	3414694.38	WCS-21	321274.26	3414753.89
WCS-10	321222.96	3414695.48	WCS-22	321224.27	3414754.99
WCS-11	321273.17	3414704.37	WCS-23	321274.49	3414764.36
WCS-12	321223.18	3414705.47	WCS-24	321224.50	3414765.46

HORIZONTAL SCALE :

20' 10' 0' 20' 40'

VERTICAL SCALE :

10' 5' 0' 10' 20'

REV.	DATE	DESCRIPTION	BY

LONNIE G. HARPER & ASSOCIATES, INC.
CIVIL ENGINEERING & LAND SURVEYING
2746 HWY. NO. 384, BELL CITY, LOUISIANA 70630
PHONE: (337) 905-1079 FAX: (337) 905-1076

COASTAL PROTECTION AND RESTORATION AUTHORITY
150 TERRACE AVENUE
BATON ROUGE, LOUISIANA 70802

TE-0138 BAYOU DE CADE RIDGE & MARSH CREATION PROJECT

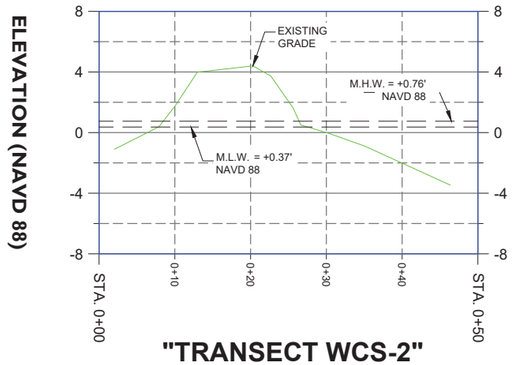
STATE PROJECT NUMBER: TE-0138

FEDERAL PROJECT NUMBER:

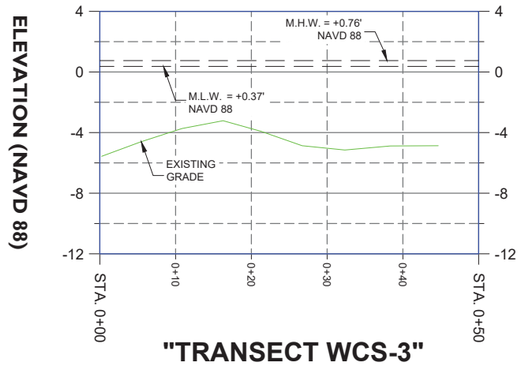
DETAIL "WCS-1" & TRANSECT "WCS-1"

DATE: 07/24/2019

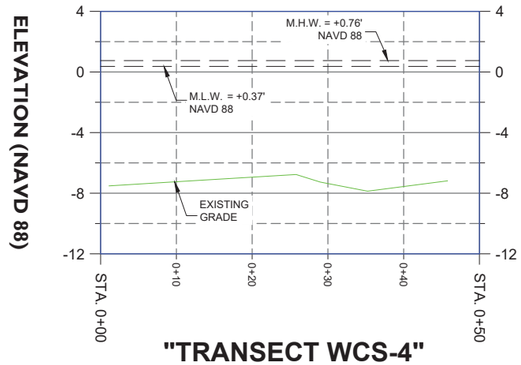
DRAWN BY: A.P.H. | DESIGNED BY: L.P.H. | APPROVED BY: L.G.H.



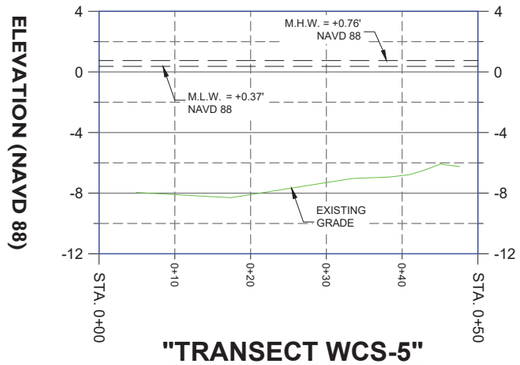
"TRANSECT WCS-2" (PROFILE VIEW)



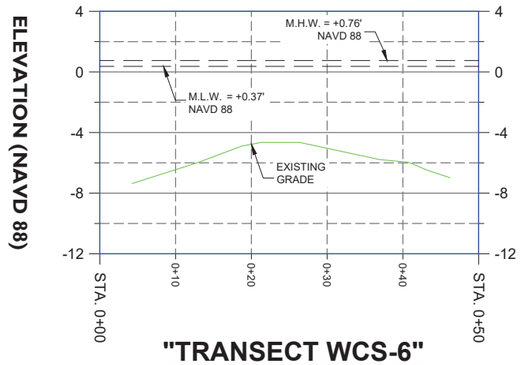
"TRANSECT WCS-3" (PROFILE VIEW)



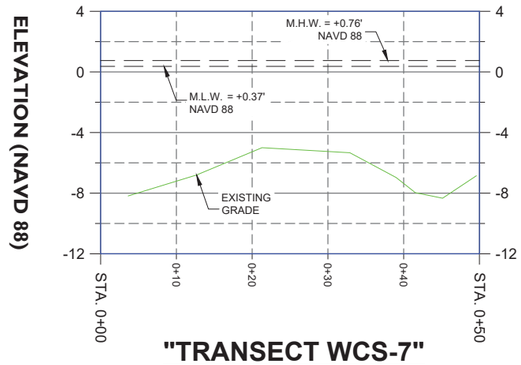
"TRANSECT WCS-4" (PROFILE VIEW)



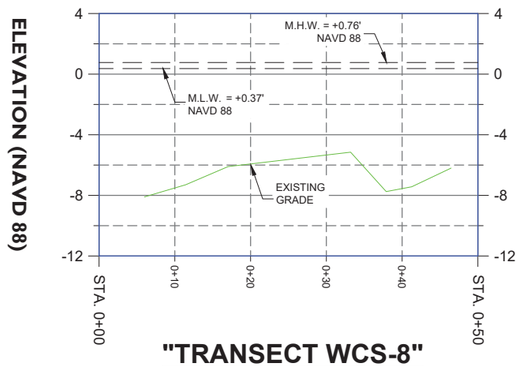
"TRANSECT WCS-5" (PROFILE VIEW)



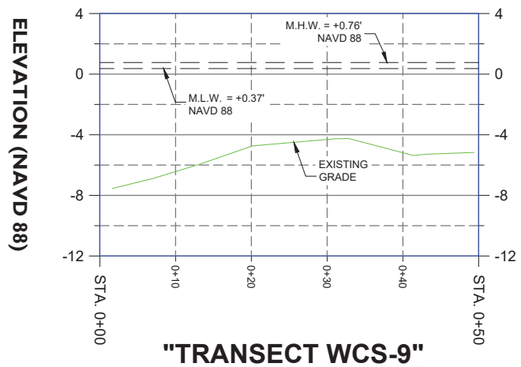
"TRANSECT WCS-6" (PROFILE VIEW)



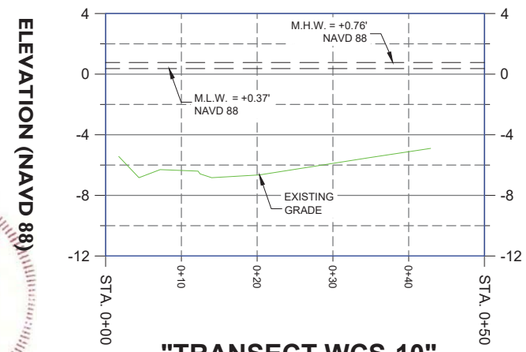
"TRANSECT WCS-7" (PROFILE VIEW)



"TRANSECT WCS-8" (PROFILE VIEW)



"TRANSECT WCS-9" (PROFILE VIEW)



"TRANSECT WCS-10" (PROFILE VIEW)

HORIZONTAL SCALE :

20' 10' 0' 20' 40'

VERTICAL SCALE :

10' 5' 0' 10' 20'

REV.	DATE	DESCRIPTION	BY

LONNIE G. HARPER & ASSOCIATES, INC.
CIVIL ENGINEERING & LAND SURVEYING
2746 HWY. NO. 384, BELL CITY, LOUISIANA 70630
PHONE: (337) 905-1079 FAX: (337) 905-1076

COASTAL PROTECTION AND RESTORATION AUTHORITY
150 TERRACE AVENUE
BATON ROUGE, LOUISIANA 70802

TE-0138 BAYOU DE CADE RIDGE & MARSH CREATION PROJECT

STATE PROJECT NUMBER: TE-0138

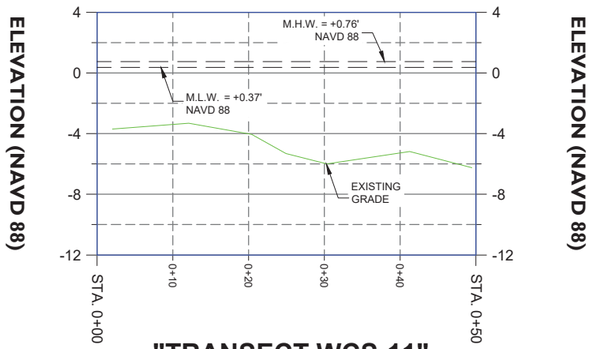
FEDERAL PROJECT NUMBER:

TRANSECT "WCS-2" -"WCS-10"

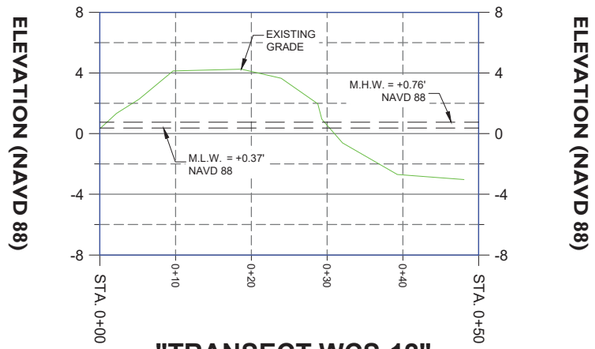
DRAWN BY: A.P.H. | DESIGNED BY: L.P.H. | APPROVED BY: L.G.H.

DATE: 07/24/2019

SHEET 12 OF 19



"TRANSECT WCS-11"
(PROFILE VIEW)



"TRANSECT WCS-12"
(PROFILE VIEW)

LONNIE G HARPER
REG. NO. 4326
REGISTERED
LAND SURVEYOR
STATE OF LOUISIANA
7/31/2019

HORIZONTAL SCALE :
20' 10' 0' 20' 40'

VERTICAL SCALE :
10' 5' 0' 10' 20'

REV.	DATE	DESCRIPTION	BY

LONNIE G. HARPER & ASSOCIATES, INC.
CIVIL ENGINEERING & LAND SURVEYING
2746 HWY. NO. 384, BELL CITY, LOUISIANA 70630
PHONE: (337) 905-1079 FAX: (337) 905-1076

COASTAL PROTECTION AND RESTORATION AUTHORITY
150 TERRACE AVENUE
BATON ROUGE, LOUISIANA 70802

TE-0138 BAYOU DE CADE RIDGE & MARSH CREATION PROJECT

STATE PROJECT NUMBER: TE-0138

FEDERAL PROJECT NUMBER:

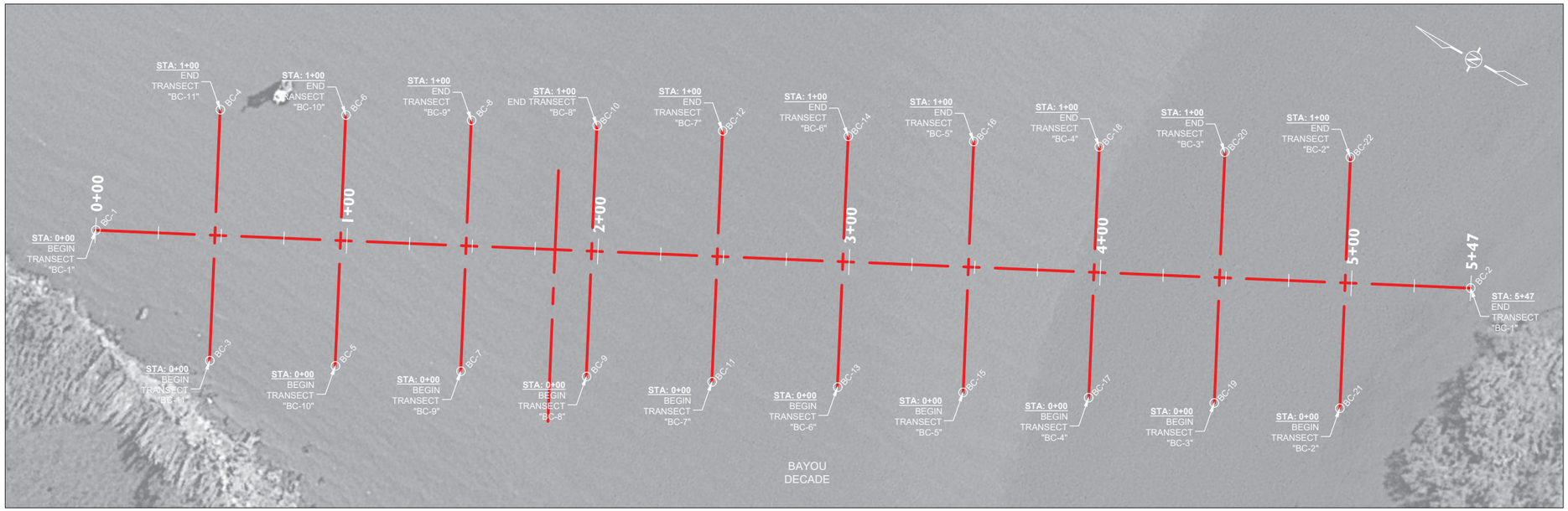
TRANSECT
"WCS-11" - "WCS-12"

DRAWN BY: A.P.H. | DESIGNED BY: L.P.H.

APPROVED BY: L.G.H.

DATE: 07/24/2019

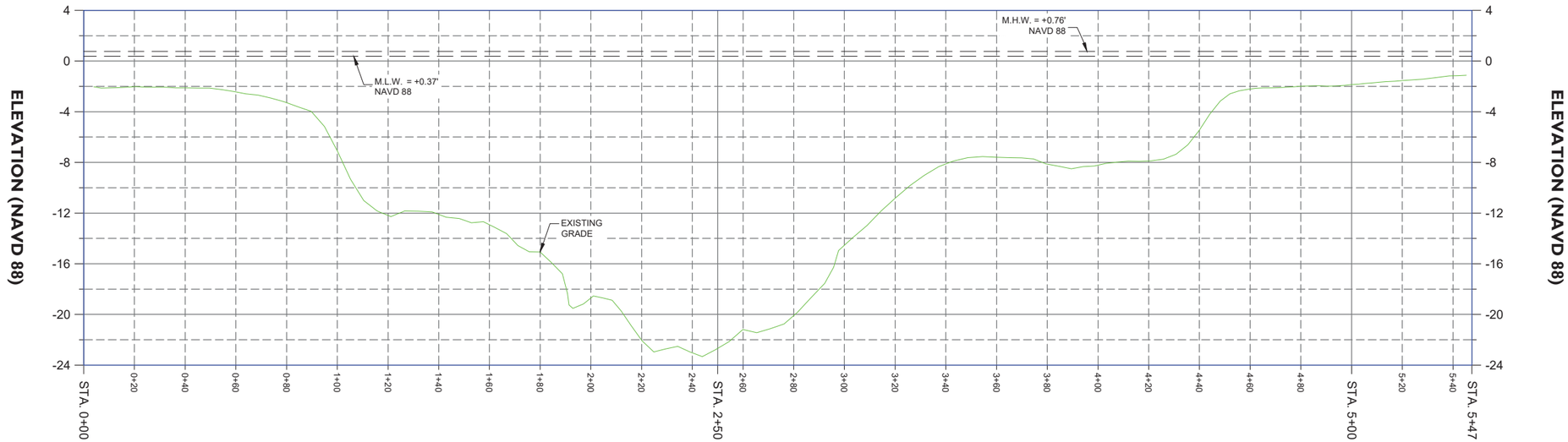
SHEET 13 OF 19



DETAIL "BC-1" (PLAN VIEW)

BAYOU DECADE COORDINATE DATA TABLE

POINT ID.	NORTHING	EASTING
BC-1	320602.75	3417247.38
BC-2	320117.49	3417500.89
BC-3	320537.51	3417225.06
BC-4	320583.81	3417313.69
BC-5	320493.19	3417248.21
BC-6	320539.49	3417336.84
BC-7	320448.87	3417271.36
BC-8	320495.18	3417359.99
BC-9	320404.56	3417294.51
BC-10	320450.86	3417383.15
BC-11	320360.24	3417317.66
BC-12	320406.54	3417406.29
BC-13	320315.92	3417340.82
BC-14	320362.23	3417429.45
BC-15	320271.61	3417363.97
BC-16	320317.91	3417452.60
BC-17	320227.29	3417387.12
BC-18	320273.59	3417475.75
BC-19	320182.97	3417410.27
BC-20	320229.28	3417498.91
BC-21	320138.66	3417433.43
BC-22	320184.96	3417522.06



"BC-1" (PROFILE VIEW)

HORIZONTAL SCALE :
50' 25' 0' 50' 100'

VERTICAL SCALE :
10' 5' 0' 10' 20'

REV.	DATE	DESCRIPTION	BY

LONNIE G. HARPER & ASSOCIATES, INC.
CIVIL ENGINEERING & LAND SURVEYING
2746 HWY. NO. 384, BELL CITY, LOUISIANA 70630
PHONE: (337) 905-1079 FAX: (337) 905-1076

COASTAL PROTECTION AND RESTORATION AUTHORITY
150 TERRACE AVENUE
BATON ROUGE, LOUISIANA 70802

DRAWN BY: A.P.H. | DESIGNED BY: L.P.H.

TE-0138 BAYOU DE CADE RIDGE & MARSH CREATION PROJECT

STATE PROJECT NUMBER: TE-0138

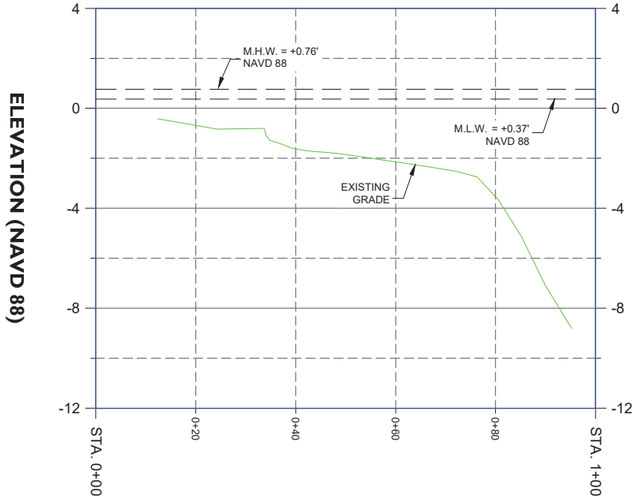
FEDERAL PROJECT NUMBER:

APPROVED BY: L.G.H.

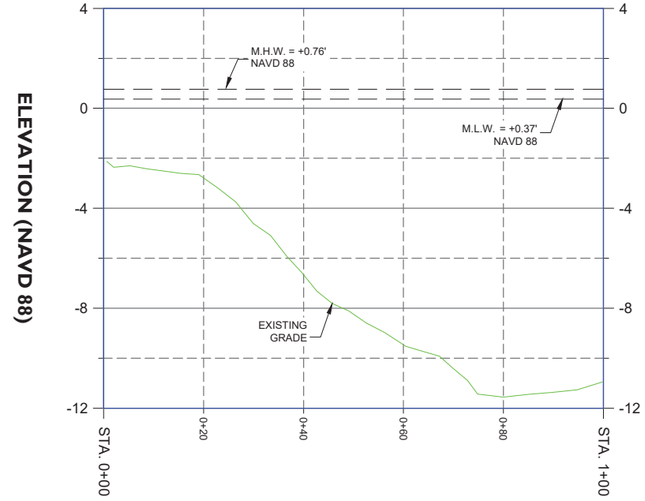
DETAIL "BC-1" & TRANSECT "BC-1"

DATE: 07/24/2019

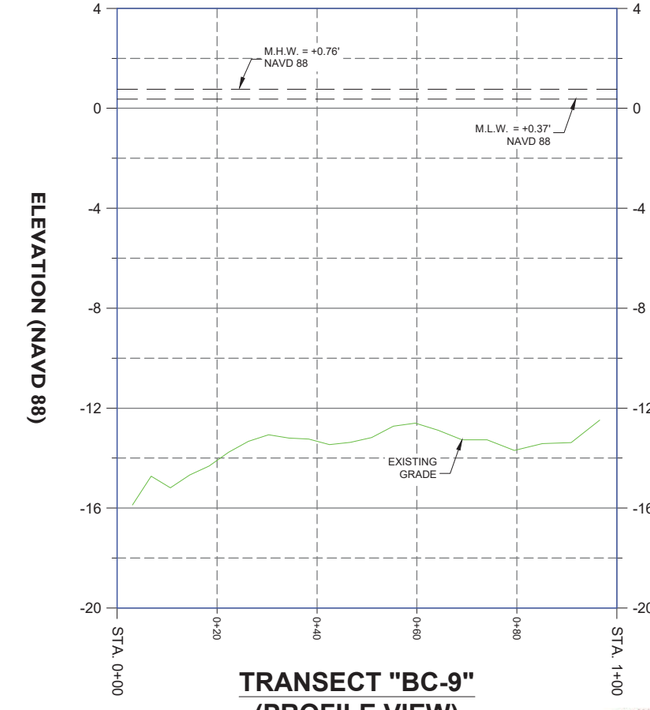
SHEET 14 OF 19



TRANSECT "BC-11"
(PROFILE VIEW)



TRANSECT "BC-10"
(PROFILE VIEW)



TRANSECT "BC-9"
(PROFILE VIEW)

HORIZONTAL SCALE :
30' 15' 0' 30' 60'

VERTICAL SCALE :
10' 5' 0' 10' 20'

REV.	DATE	DESCRIPTION	BY

LONNIE G. HARPER & ASSOCIATES, INC.
CIVIL ENGINEERING & LAND SURVEYING
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COASTAL PROTECTION AND RESTORATION AUTHORITY
150 TERRACE AVENUE
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DRAWN BY: A.P.H. | DESIGNED BY: L.P.H.

TE-0138 BAYOU DE CADE RIDGE & MARSH CREATION PROJECT

STATE PROJECT NUMBER: TE-0138

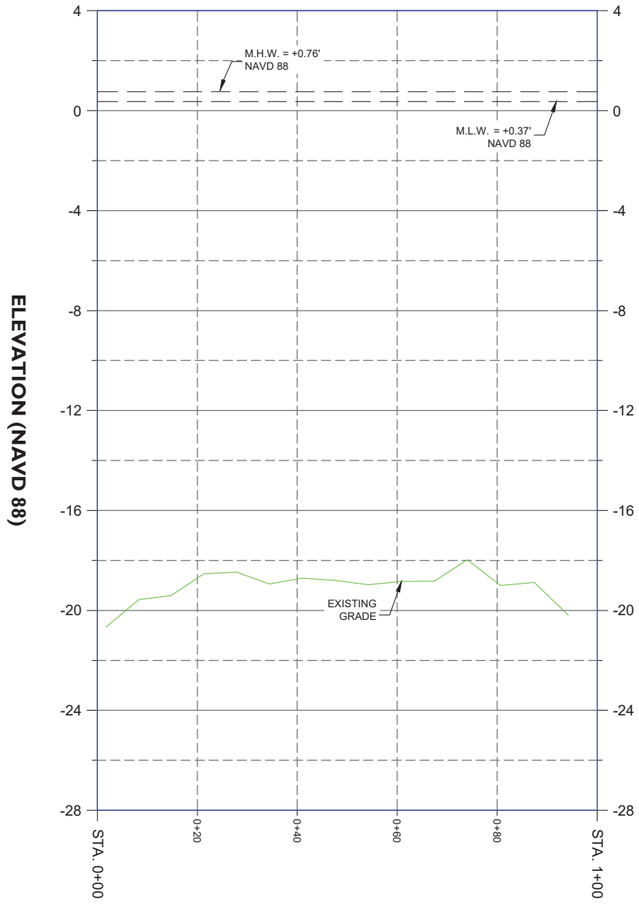
FEDERAL PROJECT NUMBER:

APPROVED BY: L.G.H.

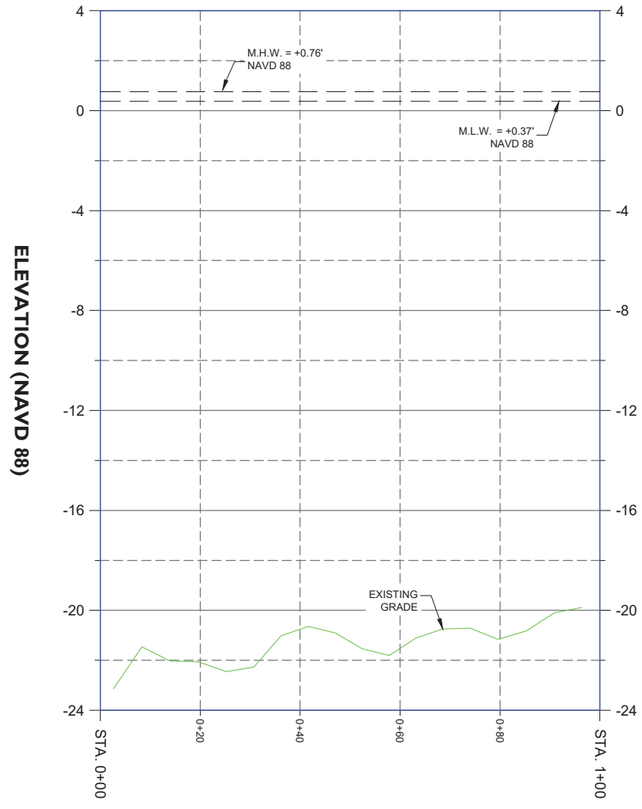
TRANSECT "BC-11" - "BC-9"

DATE: 07/24/2019

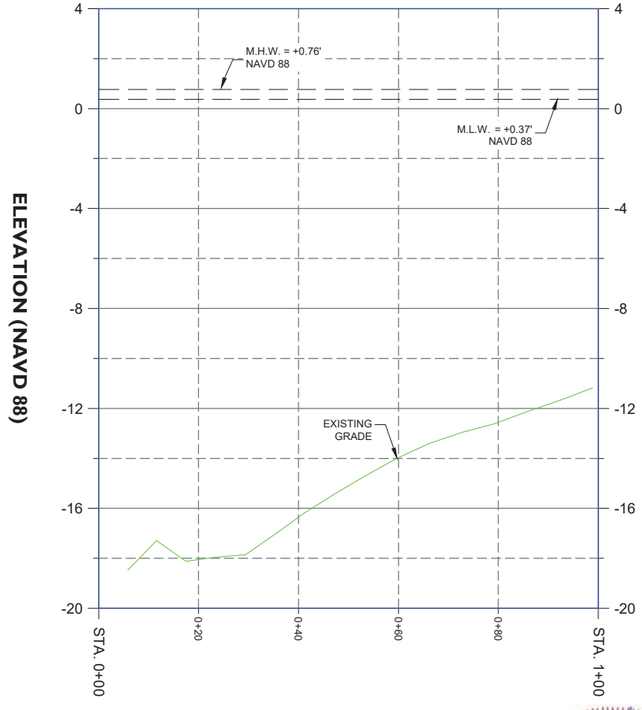
SHEET 15 OF 19



TRANSECT "BC-8"
(PROFILE VIEW)



TRANSECT "BC-7"
(PROFILE VIEW)



TRANSECT "BC-6"
(PROFILE VIEW)

STATE OF LOUISIANA
LONNIE G. HARPER
REG. NO. 4326
REGISTERED
LAND SURVEYOR

HORIZONTAL SCALE :
30' 15' 0' 30' 60'

VERTICAL SCALE :
10' 5' 0' 10' 20'

REV.	DATE	DESCRIPTION	BY

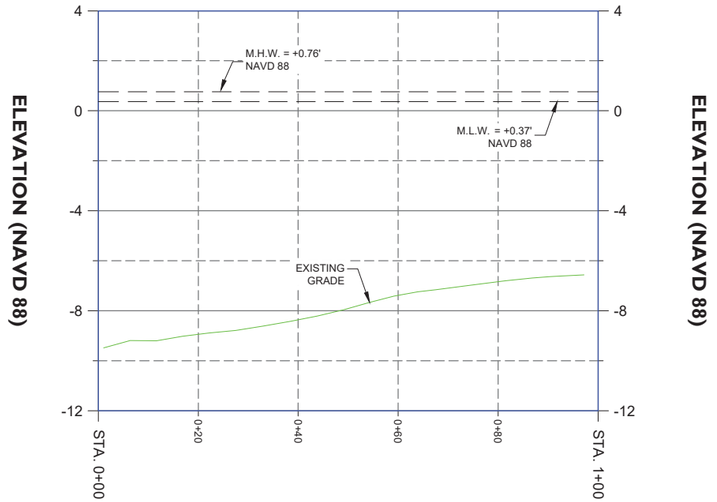
LONNIE G. HARPER & ASSOCIATES, INC.
CIVIL ENGINEERING & LAND SURVEYING
2746 HWY. NO. 384, BELL CITY, LOUISIANA 70630
PHONE: (337) 905-1079 FAX: (337) 905-1076

COASTAL PROTECTION AND RESTORATION AUTHORITY
150 TERRACE AVENUE
BATON ROUGE, LOUISIANA 70802

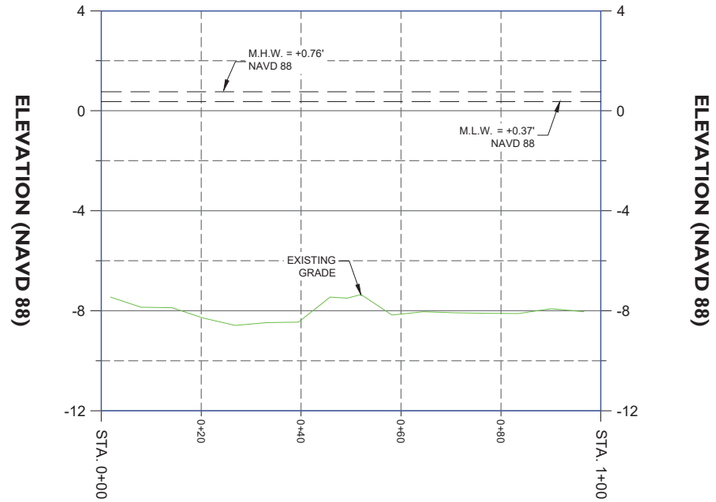
DRAWN BY: A.P.H.
DESIGNED BY: L.P.H.

TE-0138 BAYOU DE CADE RIDGE & MARSH CREATION PROJECT
STATE PROJECT NUMBER: TE-0138
FEDERAL PROJECT NUMBER:
APPROVED BY: L.G.H.

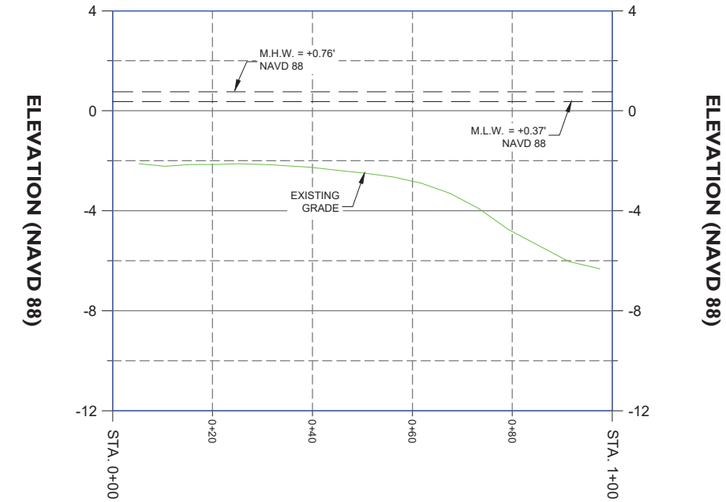
TRANSECT "BC-8" - "BC-6"
DATE: 07/24/2019
SHEET 16 OF 19



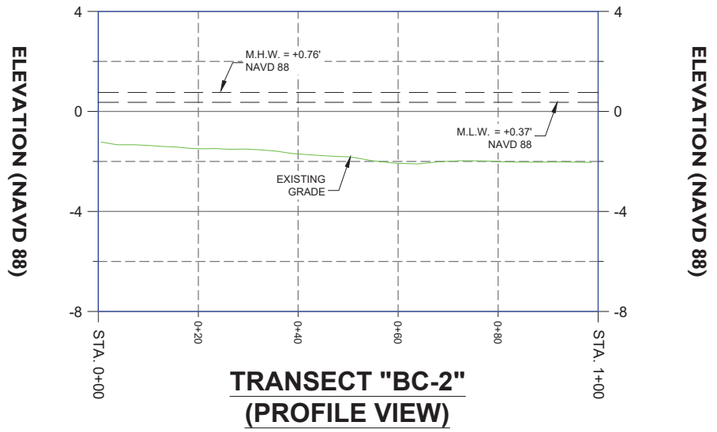
TRANSECT "BC-5"
(PROFILE VIEW)



TRANSECT "BC-4"
(PROFILE VIEW)



TRANSECT "BC-3"
(PROFILE VIEW)



TRANSECT "BC-2"
(PROFILE VIEW)

HORIZONTAL SCALE :

30' 15' 0' 30' 60'

VERTICAL SCALE :

10' 5' 0' 10' 20'

REV.	DATE	DESCRIPTION	BY

LONNIE G. HARPER & ASSOCIATES, INC.
CIVIL ENGINEERING & LAND SURVEYING
2746 HWY. NO. 384, BELL CITY, LOUISIANA 70630
PHONE: (337) 905-1079 FAX: (337) 905-1076

COASTAL PROTECTION AND RESTORATION AUTHORITY
150 TERRACE AVENUE
BATON ROUGE, LOUISIANA 70802

DRAWN BY: A.P.H. | DESIGNED BY: L.P.H.

TE-0138 BAYOU DE CADE RIDGE & MARSH CREATION PROJECT

STATE PROJECT NUMBER: TE-0138

FEDERAL PROJECT NUMBER:

APPROVED BY: L.G.H.

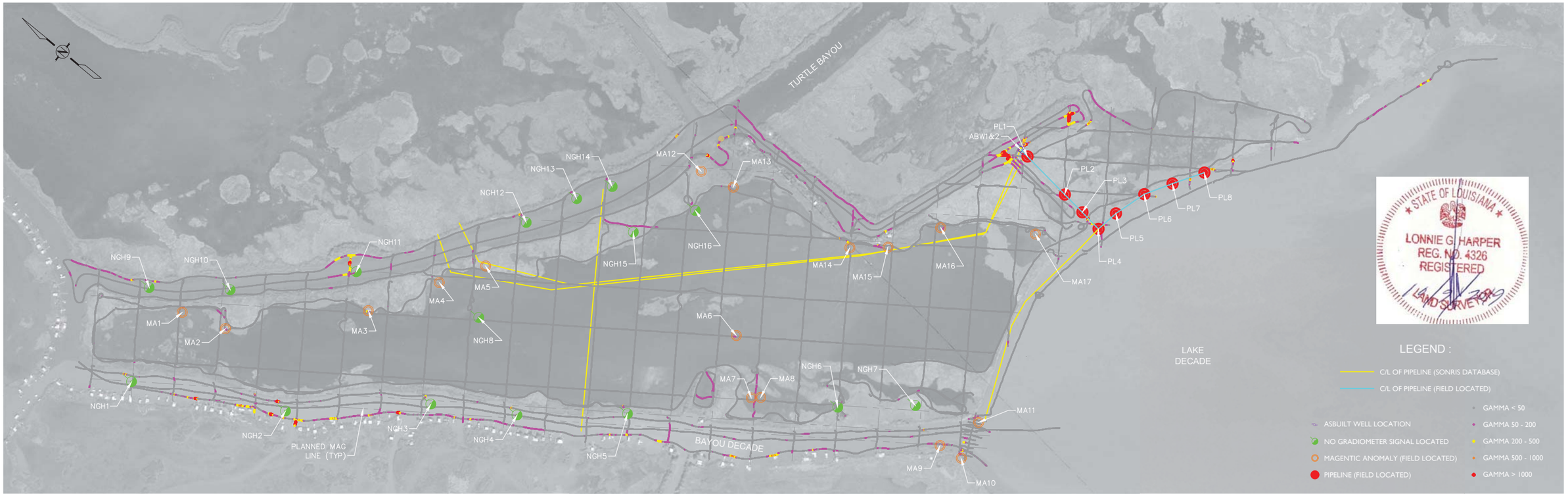
TRANSECT "BC-5" - "BC-2"

DATE: 07/24/2019

SHEET 17 OF 19

MAGNETIC ANOMALIES				
POINT ID.	NORTHING	EASTING	GAMMA	DESCRIPTION
ABW1	323404.67	3415610.38	-1329.66	TOP OF CASING
ABW2	323403.57	3415610.38	-1329.66	TOP OF CASING
MA1	315407.42	3409133.79	-55.74	DEBRIS ON WATER BOTTOM
MA2	315591.91	3409658.66	-56.24	REMAINS OF CAMP DOCK
MA3	316863.76	3410839.41	458.69	EXISTING WATER TANK ON WATER BOTTOM
MA4	317672.64	3411277.51	-72.22	WEAK GRADIOMETER SIGNAL TOO DEEP TO PROBE
MA5	318184.50	3411576.13	-60.85	EXISTING WATER HEATER ON MARSH
MA6	319484.03	3414428.73	-181.68	DEBRIS ON WATER BOTTOM
MA7	319025.80	3415049.19	-73.85	EXISTING NAV. BUOY IN MARSH
MA8	319102.49	3415130.44	-73.85	DEBRIS ON WATER BOTTOM
MA9	320047.89	3417160.20	-215.64	DEBRIS ON WATER BOTTOM
MA10	320096.17	3417452.51	362.19	EXISTING 18 ABOVE GROUND PILING
MA11	320562.36	3417336.94	209.02	EXISTING NAV. BUOY
MA12	320727.37	3412832.82	-1379.78	EXISTING CAMP FOUNDATION IN MARSH
MA13	320829.16	3413252.20	112.96	EXISTING NAV. BUOY ON WATER BOTTOM
MA14	321174.57	3414796.07	-386.13	DEBRIS ON WATER BOTTOM
MA15	321474.98	3415143.94	213.78	DEBRIS ON WATER BOTTOM
MA16	322062.14	3415479.54	-61.37	DEBRIS ON WATER BOTTOM

MAGNETIC ANOMALIES				
POINT ID.	NORTHING	EASTING	GAMMA	DESCRIPTION
MA17	322737.95	3416404.30	50.50	DEBRIS ON WATER BOTTOM
NGH1	314376.76	3409202.23	529.78	NO GRADIOMETER SIGNAL
NGH2	315297.36	3410850.63	-1475.39	NO GRADIOMETER SIGNAL
NGH3	316487.29	3412138.79	350.65	NO GRADIOMETER SIGNAL
NGH4	317053.30	3413019.79	-560.45	NO GRADIOMETER SIGNAL
NGH5	317922.05	3414028.01	-246.28	NO GRADIOMETER SIGNAL
NGH6	319611.11	3415919.28	-71.77	NO GRADIOMETER SIGNAL
NGH7	320226.18	3416623.79	127.66	NO GRADIOMETER SIGNAL
NGH8	317657.13	3411911.55	-52.66	NO GRADIOMETER SIGNAL
NGH9	315380.31	3408637.90	-379.69	NO GRADIOMETER SIGNAL
NGH10	315986.48	3409402.71	-76.80	NO GRADIOMETER SIGNAL
NGH11	317129.84	3410426.91	1103.24	NO GRADIOMETER SIGNAL
NGH12	318900.77	3411614.78	-694.13	NO GRADIOMETER SIGNAL
NGH13	319510.81	3411896.06	-88.54	NO GRADIOMETER SIGNAL
NGH14	319897.57	3412130.49	124.84	NO GRADIOMETER SIGNAL
NGH15	319641.71	3412676.38	96.57	NO GRADIOMETER SIGNAL
NGH16	320321.11	3413082.47	58.66	NO GRADIOMETER SIGNAL



HORIZONTAL SCALE :

1200' 600' 0' 1200' 2400'

REV.	DATE	DESCRIPTION	BY

LONNIE G. HARPER & ASSOCIATES, INC.
CIVIL ENGINEERING & LAND SURVEYING
2746 HWY. NO. 384, BELL CITY, LOUISIANA 70630
PHONE: (337) 905-1079 FAX: (337) 905-1076

COASTAL PROTECTION AND RESTORATION AUTHORITY
150 TERRACE AVENUE
BATON ROUGE, LOUISIANA 70802

TE-0138 BAYOU DE CADE RIDGE & MARSH CREATION PROJECT

MAGNETOMETER SURVEY & ANOMALY DATA

STATE PROJECT NUMBER: TE-0138

FEDERAL PROJECT NUMBER:

DATE: 07/24/2019

DRAWN BY: A.P.H. | DESIGNED BY: L.P.H. | APPROVED BY: L.G.H.

PIPELINE (FIELD LOCATED)						
POINT ID.	NORTHING	EASTING	GAMMA	TOP OF PIPE ELEVATION	MUDLINE ELEVATION	DESCRIPTION
PL1	323392.00	3415729.48	495.42	-3.21	1.51	TOP OF PIPELINE ELEVATION
PL2	323329.00	3416368.77	-1560.92	-3.07	1.58	TOP OF PIPELINE ELEVATION
PL3	323302.00	3416667.85	-1126.26	-3.10	-0.12	TOP OF PIPELINE ELEVATION
PL4	323272.43	3416945.65	-646.70	-4.42	-1.36	TOP OF PIPELINE ELEVATION
PL5	325550.62	3416987.39	-646.70	-5.44	-0.81	TOP OF PIPELINE ELEVATION
PL6	323947.34	3417100.23	1582.52	-5.65	-0.66	TOP OF PIPELINE ELEVATION
PL7	324264.72	3417278.37	970.28	-6.11	-0.74	TOP OF PIPELINE ELEVATION
PL8	324612.59	3417487.65	-834.73	-5.50	1.92	TOP OF PIPELINE ELEVATION

MAGNETIC ANOMALIES				
POINT ID.	NORTHING	EASTING	GAMMA	DESCRIPTION
ABW1	323404.67	3415610.38	-1329.66	TOP OF CASING
ABW2	323403.57	3415610.38	-1329.66	TOP OF CASING

STATE OF LOUISIANA
LONNIE G. HARPER
REG. NO. 4326
REGISTERED
LAND SURVEYOR
14 - 3 - 2019

LEGEND :

- C/L OF PIPELINE (SONRIS DATABASE)
- C/L OF PIPELINE (FIELD LOCATED)
- ASBUILT WELL LOCATION
- PIPELINE (FIELD LOCATED)

HORIZONTAL SCALE :

300' 150' 0' 300' 600'

REV.	DATE	DESCRIPTION	BY

LONNIE G. HARPER & ASSOCIATES, INC.
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COASTAL PROTECTION AND RESTORATION AUTHORITY
150 TERRACE AVENUE
BATON ROUGE, LOUISIANA 70802

TE-0138 BAYOU DE CADE RIDGE & MARSH CREATION PROJECT

PIPELINE DATA

STATE PROJECT NUMBER: TE-0138

FEDERAL PROJECT NUMBER:

DATE: 07/24/2019

DRAWN BY: A.P.H. | DESIGNED BY: L.P.H. | APPROVED BY: L.G.H.

APPENDIX 2

MONUMENT DATA SHEETS

BAYOU DE CADE RIDGE AND MARSH CREATION, (TE-138)

TERREBONNE PARISH, LOUISIANA

COASTAL PROTECTION AND RESTORATION AUTHORITY OF LOUISIANA

SEPTEMBER 2019

Prepared by:

Lonnie G. Harper and Associates, Inc.

2746 Hwy 384, Bell City, Louisiana 70630 337.905.1079

VICINITY MAP

0 1,200

1 inch = 1,000 feet

Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User

Station Name: "TE28-SM-A"

Location: From the boat launch on Falgout Canal in Theriot, Louisiana, by boat, proceed westerly and west-southwesterly in Falgout Canal to Lake De Cade, then in Lake De Cade west-southwesterly to Bayou De Cade, then in Bayou De Cade Westerly to Turtle Bayou on right. Turn right and proceed northeasterly in Turtle Bayou to Superior Canal on the left. Turn left and proceed northwesterly in Superioir Canal to slip canal on the left and the ,monument in the front yard of the camp.

Monument Description: NGS Style floating sleeve monument; 9/16" stainless steel rods driven 60 feet to refusal, set in sand filled 6" PVC pipe with access cover and set in concrete flush with ground.

Stamping: TE28-SM-A

Installation Date: May 2014 **Date of Survey:** December 2017

Monument Established By: JCLS

Monument Verified By: Oceaneering Inc.

For: Louisiana Department of Natural Resources, CRD

Adjusted NAD83 Geodetic Position

Lat: 29°23'29.6538" N

Long: 090°56'01.8481" W

Adjusted NAD83 Datum LSZ (1702) Ft

N= 324,457.88

E= 3,408,054.70

Adjusted UTM, NAD83 Datum LSZ (Zone 15) Meters

N= 3,253,144.271

E= 700,502.737

Adjusted NAVD88 Height (Geoid12A)

Elevation Geoid 12A= 1.53 feet (0.468 mtrs)

Elevation Geoid 99= 2.24 mtrs. (0.683 mtrs)

Ellipsoid Height = -24.304 mtrs.

Geoid12A Height = -24.772 mtrs.

Geoid99 Height = -24.987 mtrs.

Ellipsoid Height = -24.304 mtrs.

Adjusted Horizontal Position and Elevation Established originally by T. Baker Smith, LLC for the Coastal Protection & Restoration Authority of Louisiana and Confirmed by Oceaneering International., Inc.

VICINITY MAP

0 1,200

1 inch = 1,000 feet

Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User

Station Name: " TE34 SM 01"

Location: Located in Terrebonne Parish, Louisiana, approximately 11 miles southwesterly from the boat launch on Falgout Canal in Theriot. The monument is located on the north bank of Turtle Bayou immediately east of the intersection with Bayou DeCade. Permission is required for Right of entry from Apache Louisiana Minerals, Inc., POC Timothy Allen at (985) 879-3528.

Monument Description: NGS Style floating sleeve monument; 9/16" stainless steel rods driven 56 feet to refusal, set in a sand filled 6" PVC pipe with access cover set flush with the ground.

Stamping: TE34-SM-01

Installation Date: May 2004 **Date of Survey:** December 2017

Monument Established By: JCLS

Monument Adjusted By: Oceaneering International Inc.

For: CPRA, OCPR

Adjusted NAD83 Geodetic Position (NSRS2007)

Lat: 29°22'01.13868"N

Long: 90°55'55.39026"W

Adjusted NAD83 Datum LSZ (1702) Ft (NSRS2007)

N= 315518.71

E= 3408657.28

Adjusted NAVD88 Height (Geoid12A)

Elevation = 0.37 feet (0.114 mtrs)

Ellipsoid Height = -24.604 mtrs.

Geoid12A Height = -24.718 mtrs.

FOR REFERENCE ONLY

LCZ Adjusted NAVD88 Height (Geoid99)

Elevation = 1.24 feet (0.379 mtrs)

Adjusted Horizontal Position Established originally in June 2008 by John Chance Land Surveys, Inc. for the Coastal Protection & Restoration Authority of Louisiana and Confirmed by Oceaneering International., Inc. Adjusted Elevation confirmed by Oceaneering International., Inc.

APPENDIX 3

FIELD NOTES

BAYOU DE CADE RIDGE AND MARSH CREATION, (TE-138)

TERREBONNE PARISH, LOUISIANA

COASTAL PROTECTION AND RESTORATION AUTHORITY OF LOUISIANA

SEPTEMBER 2019

Prepared by:

Lonnie G. Harper and Associates, Inc.

2746 Hwy 384, Bell City, Louisiana 70630 337.905.1079

CPRA TE 138

5 man crew traveled from G.I. office to Houma to begin data collection.

Arrived @ Boat Launch then began traveling to job site.

Airboat radiator hose broke & turned back to launch

Crew got parts to repair airboat.

5- men 10 hrs (1 hr boat)
2- Trucks 240 miles each
1- RTK base 3 rovers
2- Sonarmites
2- mags
2- Differential GPS
2- Hypack laptops
1- Gradiometer
1- Airboat 4 gals
1- 1 gal total 2 gals

Houma
Hot + Clear
7-8-19

Aaron H
Lucas K
Chuck B
Matt R
Derek I

CPRA TE138

5 men traveled from hotel to job site to collect mag & sonarwrite Data.

Airboat crew collected mag data inside cell & gator tail crew collected mag data along southern flitch

Rental mag became problematic so crew switched to sonarwrite access Route.

5 men - 13 hrs (12 hours boat)
2 trucks - 50 miles each
1- RTK base / 3 Rovers
2- Sonarwrite
2- mags
2- differential GPS
2- Hypack PC
1- Radiometer
1- Airboat 70 gals
1- gator tail 8 gals

Houma

Hot & Clear

7-9-19

Aaron
Matt R
Chuck B
Lucas H
Derek Z

CPRA TE 138

5 men traveled to job site to retrieve mag, boom + boat because of approaching storm. Crew Repaired boat trailer + returned to grand lake to avoid storm.

5 men 10 hrs. (1 hr boat)
2 trucks 240 miles
1 - RTK base / 3 rovers
2 - Sonarmite
2 - mags
2 - differential GPS
2 - Hypack PC
1 - Gradiometer
1 - Airboat (10 gals)
1 - gatortail

Heat + Rainy

Houma 7-10-19

Aaron H
Lucas H
ChuckB
DerekF
MattR

CPRA TE 138

5 man crew got to office and loaded trucks to return to Houma. Crew traveled to Houma to begin collecting mag data.

2- Trucks 190 miles each
1- Airboat
1- gator tail
1- mag
1- dGPS
1- RTK Trade / 2 Rovers
1- Sonarmite
5- men 10 hrs.

Grand Lake Hot & Clear 7-16-19

Aaron H
matt R
Brad L
Lucas H
Chuck B

CPRA JE-138

5 man crew traveled from hotel to job site by truck & boat. Crew began snagging remaining lines + RTK'ed structure. Crew also sonamited access route

2 trucks 60 mls
1- Aircraft 90 gals
1- gatortail 6 gals
1- mag
1- diff GPS
1- Hypack PC
1- RTK base / 2 Rovers
1- sonamite
5 men 12 1/2 hrs (11 1/2 boat)

Hot & Clear

Houma 7-17-19

Aaron H
Chuck B
J Hebert
Dale Z
Matt R

CPRA TE 138

Smon crew traveled from Houma to Grand Lake. Crew left hotel @ 6:30 and arrived @ o/l @ 12:30. Crew unloaded & clean equipm

5 men (6 hrs)
2- Trucks 190 miles each
1- Airboat
1- gatortail
1- mag
1- diff gps
1- RTK base/2 Rovers
1- Sonarmite

Houma
Hart & Crew
7-18-19

Aaron H
matt R
Derek J
Chuck B
Jason H

TE-138

Crew traveled to Houma, Louisiana from Bell city, LA. Two trucks pulling LHA airboat and surface drive.

5 - personnel
2 - Trucks 190 - miles

BC - Houma, LA 8/4/2019 Hot & sunny

Matt R.
Aaron H
Lucas H
Derek L.
Lucas H.

TE-138

RTK / C4G

Base: TE34-SM-01 at 6.88sft

File: te13820110X0219

Start: 2883 ; 2895

END: 2894 ; 2921

Check: TE34-SM-A

DCSN: 2011

DCSN: 2008

File: TE13820080219

Start: 7630 ; 761 - Sonarmite 10000

END: 7650 ; 7661 ; 10718

check: TE34-SM-A

Five personnel collected Bathymetric data using RTK and sonarmite and located magnetic anomalies using gradiometer 5 probes Rain from 11:00 Am to 1:00 pm.

5-personnel	10.5 hrs
2-Trucks	40-miles
1- Sonarmite	2- RTK Rovers
1- RTK Base	2- gradiometers.
1- surface drive	8-boat hrs.
1-airboat	1-C4G

Hot & Rain / Thunderstorms

Houma / du Lac, LA 8/5/2019

Matt R.
Lucas H.
Chuck M.
Dirk C.
Aaron H.

TE-138

RTK

Base: TE34-SM-01 @ 6.88 sft

DC SN: 2011

File: te1382011080219

Start: 2922 ; Sonarwiz 25000 ; 5921

END: 2957 25009 ; 6111

Check: TC34-SM-A

DC SN: 2008

File: TE1382008080219

Start: 7668

END: 7682

Check: TE34-SM-A

Five personnel collected bathymetric data using Sonarwiz and magnetic anomalies were located.

Crew drove back to Bellcity office.

5- personnel

2- Trucks

1- Surface drive

1- airboat

1- Sonarwiz

2- RTK Rovers

1- RTK Base

13-hrs

210- miles

6 boat hours

Lake de Cade Hot & overcast

Houma / du Lac, LA 8/6/2019

matt R.
Chuck B.
aaron H
[illegible]
Charlie B.

APPENDIX 4

SURVEYING EQUIPMENT SPECIFICATIONS

BAYOU DE CADE RIDGE AND MARSH CREATION, (TE-138)

TERREBONNE PARISH, LOUISIANA

COASTAL PROTECTION AND RESTORATION AUTHORITY OF LOUISIANA

SEPTEMBER 2019

Prepared by:

Lonnie G. Harper and Associates, Inc.

2746 Hwy 384, Bell City, Louisiana 70630 337.905.1079

DATASHEET

Trimble TSC3 Controller

Key Features

Large, bright, high-resolution screen makes instrument control easy

Optimized for Trimble Access field software

Fully-integrated camera, GPS navigation, and communications

Improved collaboration and control through **constant connectivity**

The Trimble® TSC3 controller with Trimble Access™ software is a groundbreaking handheld field computing solution that streamlines the flow of everyday surveying work and the number of devices you need in the field.

A POWERFUL ENGINE FOR DRIVING TRIMBLE ACCESS SOFTWARE

Part of a trusted line of field controllers, the Trimble TSC3 controller is rugged and designed for surveyor's workflows. It performs Trimble Access operations fast and delivers ample power to run third-party applications on the Windows® platform.

Make Pictures an Essential Part of Your Workflow

With a built-in 5 MP Autofocus camera and LED flash, you can take digital photographs of your job site right from the controller. No extra devices, batteries, or file transfers are required, and images are automatically geotagged for easy identification.

Easily record the qualitative information that survey data alone can miss, such as site conditions or work progress. The benefits of including images as part of your workflow are almost limitless: from easy data handover to in-field quality assurance.

Communications that Bridge Field and Office in Real-Time

The TSC3 controller enables wireless Internet connectivity through an integrated GSM/GPRS/CDMA2 modem. This allows Trimble Access software to facilitate a constant flow of information between field and office, including real-time synchronization of field and office data with Trimble AccessSync software. You can download and upload important files any time and from anywhere, as needed. Data collection, processing, analysis, and delivery are faster and more efficient.

A wealth of communication options let you transfer critical information no matter the environment: Connect with VRS™ connections using the internal modem. Access your office network through 802.11 LAN, or USB and serial RS232 communication options.

For All of Your Surveying Applications

The rugged TSC3 controller is purpose-built to make both Integrated Surveying and Spatial Imaging jobs easier, more efficient, and more flexible:

Easy-to-Use Interface

Control your survey and verify your work on the large, bright, high-resolution LCD touchscreen. With the option of a QWERTY or conventional alpha-numeric keyboard, data entry is quick and easy.

An Internal Compass

Receive direction cues even when you are stationary or moving backwards.

Integrated GPS

Employ GPS Search on a conventional survey without an external GPS receiver. You can also navigate and find control points and other assets quickly.

Cables Eliminated

Bluetooth® wireless technology eliminates cables in surveying systems. An internal 2.4 GHz radio option is also ideal for controlling Trimble robotic systems.

Designed to Support Your Daily Workflows

Trimble Access field software available on the TSC3 controller offers numerous features and capabilities to streamline the flow of everyday surveying work. Streamlined workflows – such as Roads, Monitoring, Mines, and Tunnels —guide crews through common project types and allows crews to get the job done faster with less distractions.

Survey companies can also implement their unique workflows by taking advantage of the customization capabilities available in the Trimble Access Software Development Kit (SDK). The Trimble Access SDK provides software developers with the tools to customize and extend Trimble Access.

With a bright, daylight readable display, integrated communications, and integrated survey workflows, the fully integrated TSC3 controller will make your field work more efficient.

Trimble

Trimble TSC3 Controller

TECHNICAL SPECIFICATIONS

Standard software

Windows Embedded Handheld 6.5 Professional operating system, including:

- SMS Text Messaging Support
- Microsoft Office Mobile:
  - Word Mobile
  - Excel Mobile
  - PowerPoint Mobile
  - Outlook Mobile
- Internet Explorer Mobile
- Notes / Tasks
- Task Manager
- Calculator
- Microsoft Pictures and Videos
- Customized Camera and Flash control including geo-tagging through Microsoft Pictures & Videos software
- Flashlight mode control application
- Calendar / Contacts
- Windows Media Player
- Messenger
- Adobe Acrobat Reader
- Trimble SatViewer (GPS interface software application)

Operating system languages options (customer provisionable):
Simplified Chinese, English, French, German, Japanese, Spanish

Trimble Field Software Solutions

The Trimble TSC3 controller runs the Trimble Access field software. In addition, a number of regional solutions are available. For more information on the field software that's best for you, contact your local Trimble authorized distribution partner.

Standard Accessories (included)

- 28.9 Wh Li-Ion battery
- International AC power supply
- Hand strap
- USB cable (mini)
- Stylus tether
- Stylus with spring tip (pkg of 2)
- Screen protectors
- Audio port dust cover
- I/O port dust covers
- Standard soft case
- Quick start guide sheet
- Radio antenna for integrated 2.4 GHz radio modem (optional)

Optional Accessories

- Deluxe carry case
- Individual battery charger
- Range pole bracket
- 12 V vehicle charging kit
- Desk docking cradle with USB host, USB client, and 10/100 Mbps Ethernet connections

All standard accessories are also available to order separately.

HARDWARE

Physical Specifications

Size	141 mm x 278 mm x 64 mm (5.6 in x 10.9 in x 2.5 in) 80 mm (3.2 in) at handgrip
Weight	1.04 kg (2.3 lb) including rechargeable battery 1.10 kg (2.4 lb) including rechargeable battery and optional internal 2.4 GHz radio-modem
Housing	Polycarbonate (case), Hytrel® (overmold)

ENVIRONMENTAL SPECIFICATIONS

Meets or exceeds:

Operating Temperature	–30 °C to 60 °C (–22 °F to 140 °F)
Storage Temperature	–40 °C to 70 °C (–40 °F to 158 °F)
Temperature shock	–35 °C/65 °C (–31 °F/149 °F) MIL-STD-810G, Method 503.5, Procedure I
Humidity	90%RH temp cycle –20 °C/60 °C (–4 °F/140 °F) MIL-STD-810G, Method 507.5
Sand & dust	IP6x: 8 hours of operation with blowing talcum powder (IEC-529)
Water	IPx7: Immersed in 1 m of water for 30 minutes (IEC-529)
Drop	26 drops at room temperature from 1.22 m (4 ft) onto plywood over concrete MIL-STD-810G, Method 516.6, Procedure IV
Vibration	General Minimum Integrity and Loose Cargo test MIL-STD 810G, Method 514.6, Procedures I, II
Altitude	4,572 m (15,000 ft) at 23 °C (73 °F) and 12,192m (40,000 ft.) at –30 °C (–22 °F) MIL-STD-810G, Method 500.5, Procedures I, II, III

ELECTRICAL SPECIFICATIONS

- Processor: Texas Instrument Sitara™ 3715 series ARM® Cortex™–A8 Processor (800 MHz)
- Memory: 256 MB RAM
- Storage: 8 GB non-volatile NAND Flash onboard
- Expansion: SDHC memory slot, USB host internal embedded expansion slot (for future use)
- Batteries: 11.1 V, 2600 mAh, 28.9 Wh Li-Ion rechargeable pack
  - Battery life of 34 hours under normal operating conditions[1].
  - Full charge in 3.0 hours.
- Notification LEDs: 3 x tri-colored notification LEDs
- Display:
  - 4.2 in (107 mm) landscape VGA display, 640 x 480 pixels
  - Sunlight-readable color TFT with LED backlight, resistive touchscreen
- Keyboard:
  - Full QWERTY keypad with 10-key number pad, directional buttons, and 4 programmable buttons
  - "ABCD" style keypad option with 10-key number pad, directional buttons, and 4 programmable buttons available
- Audio: Integrated speaker and microphone with 3.5 mm stereo headset connection for audio system events, warnings, and notifications.
- I/O: USB Host (full speed), USB Client (high speed), DC power port, 9-pin serial RS-232
- Wireless:
  - Integrated Bluetooth 2.0+EDR, integrated Wi-Fi 802.11 b/g
  - Integrated quad-band GSM/GPRS/EDGE: 850/900/1800/1900 MHz
  - 2/6 Mbit/s 3G HSDPA GSM WWAN
  - Integrated 2.4 GHz frequency-hopping spread-spectrum radio modem (optional)
  - Dual band CDMA2000 in Bands BC0 and BC1 (800/900MHz)[2]
- Camera / GPS / Compass / Accelerometer:
  - 5 MP auto focus camera with dual white light LED flash, LED flashlight function
  - Integrated GPS (WAAS enabled)
  - Integrated compass
  - Integrated accelerometer

CERTIFICATIONS

Class B Part 15 FCC certification, CE Mark approval and C-tick approval. RoHS compliant. Bluetooth type approvals and regulations are country specific.
MIL-STD-810G, IP 67, MIL-STD-461, PTCRB, GCF compliant, Wi-Fi Alliance certified, AT&T Network Compatible.
Country type certifications: USA, Canada, EU, New Zealand, Australia, Brazil.
Pending certifications: Malaysia, China (PRC), India, Japan, Republic of Korea, Russia, Taiwan, Thailand, UAE

RECYCLING INFORMATION

For product recycling instructions and more information, please go to www.trimble.com/environment/summary.html.

Specifications subject to change without notice.

1 Unit is idle with backlight turned on, no radios turned on, moderate temperatures.
2 CDMA modem only supports the Verizon network (USA).

TRIMBLE AUTHORIZED DISTRIBUTION PARTNER

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SINGAPORE

Trimble

A325 GNSS Smart Antenna

Affordable, Portable Solution With Professional Accuracy

key features

- Athena™ RTK capable
- Long range RTK baselines of up to 50 km
- Very fast RTK fix and reacquisition times
- Strong multipath mitigation and interference rejection
- Wide operating voltage range, 7-36 V, high transient protection for any power source
- Supports NMEA 2000 over Controller Area Network (CAN) for ISO bus connections

Work smarter, not harder. The A325 GNSS smart antenna offers an affordable, portable solution with professional level accuracy for agricultural, marine, GIS mapping, and other applications.

Focus on the job at hand with fast start-up and reacquisition times, and an easy-to-see status indicator for power, GNSS, and Bluetooth. The durable enclosure houses both antenna and receiver. It can be powered through various sources, making the A325 smart antenna ideal for a variety of applications. Dual-serial, CAN, and pulse output options make this GNSS receiver compatible with almost any interface.

Athena RTK

The A325 GNSS smart antenna supports Athena, our new core GNSS engine. Athena offers significant improvements in the areas of initialization time, robustness in very difficult operating environments, performance over long baselines, and performance under scintillation.

Hemisphere®

precision@hgnss.com
www.hgnss.com

A325 GNSS Smart Antenna

GNSS Receiver Specifications

Receiver Type:	GNSS L1 & L2 RTK with carrier phase
Signals Received:	GPS and GLONASS
Channels:	114
GPS Sensitivity:	-142 dBm
SBAS Tracking:	3-channel, parallel tracking
Update Rate:	10 Hz standard, 20 Hz optional
Timing (1PPS) Accuracy:	20 ns
Cold Start:	< 60 s typical (no almanac or RTC)
Warm Start:	< 20 s typical (almanac and RTC)
Hot Start:	< 5 s typical (almanac, RTC and position)
Maximum Speed:	1,850 kph (999 kts)
Maximum Altitude:	18,288 m (60,000 ft)

Positioning Accuracy

	RMS (67%)	2DRMS (95%)
RTK: [2,3]	10 mm + 1 ppm	20 mm + 2 ppm
SBAS (WAAS): [2]	0.3 m	0.6 m
Autonomous, no SA: [2]	1.2 m	2.5 m

Communications

Serial Ports:	2 full-duplex RS-232, Bluetooth, CAN
Baud Rates:	4800 - 115200
Correction I/O Protocol:	Hemisphere GNSS proprietary, RTCM v2.3 (DGPS), RTCM v3 (RTK), CMR, CMR+[1]
Data I/O Protocol:	NMEA 0183, NMEA 2000, Hemisphere GPS binary, Bluetooth 2.0 (Class 2)
Timing Output:	1PPS, CMOS, active low, falling edge sync, 10 kΩ, 10 pF load
Event Marker Input:	CMOS, active low, falling edge sync, 10 kΩ, 10 pF load

Power

Input Voltage:	7-36 VDC with reverse polarity
operation	
Power Consumption:	< 4.6 W nominal GPS (L1/L2), GLONASS (L1/L2)
Current Consumption:	0.34 mA nominal GPS (L1/L2), GLONASS (L1/L2)
Power Isolation:	No
Reverse Polarity Protection:	Yes
Antenna Voltage:	Internal antenna

Environmental

Operating Temperature:	-40°C to +70°C (-40°F to +158°F)
Storage Temperature:	-40°C to +85°C (-40°F to +185°F)
Humidity:	95% non-condensing
Shock and Vibration:	Vibration: EP455 Section 5.15.1 Random Mechanical Shock: EP455 Section 5.14.1 Operational
EMC:	CE (ISO 14982 Emissions and Immunity) FCC Part 15, Subpart B CISPR 22
Enclosure:	IP67

Mechanical

Dimensions:	10.4 H x 14.5 D cm (4.1 H x 5.7 D in)
Weight:	< 0.56 kg (< 1.23 lbs)
Status Indications (LED):	Power, GNSS lock, Bluetooth
Serial Port Extension:	Bluetooth communication
Power/Data Connector:	12-pin male (metal)
Antenna Mounting:	1-14 UNS-2A female, 5/8-11 UNC-2B adapter and mag-mount available

[1] Receive only, does not transmit this format
[2] Depends on multipath environment, number of satellites in view, satellite geometry, and ionospheric activity
[3] Depends also on baseline length

Note: The Eclipse receiver technology is not designed or modified to use the GPS Y-Code

Authorized Distributor:

Rev. 09/15

Hemisphere

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Specifications

Trimble SPS461
Modular GPS Heading Receiver

Receiver Name	**SPS461 GPS Heading Receiver**
Configuration Option	**DGPS**
Type	Modular
Base and rover interchangeability	No, rover only
Base operation	NA
Rover operation	All models
Heading operation	All models[5]
Rover position update rate	1 Hz, 2 Hz, 5 Hz, 10 Hz, 20Hz
Rover maximum range from base	Unlimited
Rover operation within a VRS™ network	DGPS only
Factory options	Location RTK, OmniSTAR HP/XP, Precise Vertical, Precision RTK
General	
Keyboard and display	VFD display 16 characters by 2 rows On/Off key for one-button startup Escape and Enter keys for menu navigation 4 arrow keys (up, down, left, right) for option scrolls and data entry
Dimensions (L × W × D)	24 cm (9.4 in) × 12 cm (4.7 in) × 5 cm (1.9 in) including connectors
Weight	1.22 kg (2.70 lb) receiver only 1.37 kg (3.00 lb) receiver with internal radio
Antenna Options	
GA510	L1/L2 GPS, SBAS, and OmniSTAR (optimized for OmniSTAR)
GA530	L1/L2 GPS, MSK Beacon, SBAS, and OmniSTAR
L1/Beacon, DSM 232	Not supported
Zephyr™ Model 2	L1/L2 GPS, SBAS, and OmniSTAR
Zephyr Geodetic™ Model 2	L1/L2 GPS, SBAS, and OmniSTAR
Zephyr Model 2 Rugged	L1/L2 GPS, SBAS, and OmniSTAR
Zephyr, Zephyr Geodetic, Z-Plus, Micro-Centered™	Refer to antenna specification
Temperature	
Operating	–40 °C to +65 °C –40 °F to +149 °F)[1]
Storage	–40 °C to +80 °C (–40 °F to +176 °F)
Humidity	MIL-STD 810F, Method 507.4
Waterproof	IP67 for submersion to depth of 1 m (3.3 ft), dustproof
Shock and Vibration	
Drop	Designed to survive a 1 m (3.3 ft) pole drop onto a hard surface
Shock – Non-operating	To 75 g, 6 ms
Shock – Operating	To 40 g, 10 ms, saw-tooth
Vibration	Tested to Trimble ATV profile (4.5 g RMS): 10 Hz to 300 Hz: 0.04 g/Hz;[2] 300 Hz to 1,000 Hz; –6 dB/octave

Trimble

Specifications

Trimble SPS461
Modular GPS Heading Receiver

Measurements

Advanced Trimble Maxwell™ 5 Custom GPS chip
High-precision multiple correlator for L1/L2 pseudo-range measurements

Unfiltered, unsmoothed pseudo-range measurements data for low noise, low multipath error, low-time domain correlation, and high-dynamic response

Very low noise carrier phase measurements with <1 mm precision in a 1 Hz bandwidth
L1/L2 signal-to-noise ratios reported in dB-Hz
Proven Trimble low elevation tracking technology
72-channel L1 C/A code, L1/L2 Full Cycle Carrier

Trimble EVEREST™ multipath signal rejection
2-channel MSK Beacon (Optional)
4-channel SBAS (WAAS/EGNOS/MSAS)

Code Differential GPS Positioning[2]

Correction type	DGPS RTCM 2.x
Correction source	DGPS Base via radio or Internet
Horizontal accuracy	±(0.25m + 1 ppm) RMS ±(0.8 ft + 1 ppm)
Vertical accuracy	±(0.50m + 1 ppm) RMS ±(1.6 ft + 1 ppm)

SBAS (WAAS/EGNOS/MSAS) Positioning[3]

Horizontal accuracy	Typically <1 m (3.3 ft)
Vertical accuracy	Typically <5 m (16.4 ft)

OmniSTAR Positioning

VBS service accuracy	Horizontal <1 m (3.3 ft)
XP service accuracy	NA
HP service accuracy	NA

Location RTK Positioning[2]

Horizontal accuracy	NA
Vertical accuracy	NA

Precise Heading

Heading accuracy	
2 m antenna separation	0.09° RMS
10 m antenna separation	0.05° RMS

Power

Internal	NA
External	Power input on the 26-pin D-sub connector is optimized for lead acid batteries with a cut-off threshold of 11 V DC 11 V DC to 28 V DC external power input with over-voltage protection Receiver automatically turns on when connected to external power
Power over Ethernet (PoE)	44 V DC to 57 V DC, IEEE802.3af compliant device
Power consumption	6.0 W in rover mode with internal receive radio

Trimble

Specifications

Trimble SPS461
Modular GPS Heading Receiver

Operation Time on Internal Battery

Rover	NA
Base station	NA
450 MHz systems	

Regulatory Approvals

FCC: Part 15 Subpart B (Class B Device) and Subpart C, Part 90
Canadian ICES-003. Cet appareil numérique de la classe B est conforme à la norme NMB-003 du Canada.
Canadian RSS-310, RSS-210, and RSS-119.
Cet appareil est conforme à la norme CNR-310, CNR-210, et CNR-119 du Canada.
R&TTE Directive: EN 301 489-1/-5/-17, EN 300 440, EN 300 328, EN 300 113, EN 60950, EN 50371
ACMA: AS/NZS 4295 approval
CE mark compliance
C-tick mark compliance
RoHS compliant
WEEE compliant

Communications

Lemo (Serial)	NA
Modem 1 (Serial)	26-pin D-sub, Serial 2, Full 9-wire RS232, using adaptor cable
Modem 2 (Serial)	26-pin D-sub, Serial 3, 3 wire RS-232, using adaptor cable
1PPS (1 pulse-per-second)	Available
Ethernet	Through a multi-port adaptor
Bluetooth wireless technology	Fully-integrated, fully-sealed 2.4 GHz Bluetooth module[4]
Integrated radios (optional)	Fully-integrated, fully-sealed internal MSK Beacon and 450 MHz (UHF) Rx only, Internal MSK Beacon only or Internal 900 MHz Rx only
Channel spacing (450 MHz)	12.5 kHz or 25 kHz spacing available
450 MHz output power	NA
900 MHz output power	NA
Frequency approvals (900 MHz)	NA
External GSM/GPRS, cell phone support	Supported for direct-dial and Internet-based correction streams Cell phone or GSM/GPRS modem inside controller
Internal MSK Beacon receiver	If internal MSK Beacon Radio is installed[6] Frequency range 283.5–325.0 kHz Channel spacing 500 Hz MSK bit rate 50, 100, and 200 bps Demodulation minimum shift key (MSK)
Correction data input	RTCM 2.x
Correction data output	Repeat DGPS RTCM from MSK Beacon or OmniSTAR VBS source
Data outputs	NMEA, GSOF, 1PPS Time Tags

Trimble

Specifications

Trimble SPS461
Modular GPS Heading Receiver

Receiver Upgrades

Location RTK OmniSTAR, Location RTK PV, Precise RTK

Notes

1 Receiver will operate normally to –40 °C.

2 Accuracy and reliability may be subject to anomalies such as multipath, obstructions, satellite geometry, and atmospheric conditions. Always follow recommended practices.

3 Depends on SBAS system performance.

4 Bluetooth type approvals are country specific. For more information, contact your local Trimble office or representative.

5 Two of the supported antennas (See Antenna Options) must be connected for heading.

6 One of the antennas must be a GA530 for MSK Beacon signal reception.

Specifications subject to change without notice.

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Trimble Authorized Distribution Partner

Trimble

Trimble R8s

GNSS SYSTEM

One Receiver Configured for Today Scalable for Tomorrow

Rather than a pre-configured system, the Trimble® R8s GNSS system gives you just the features and benefits you need, in one flexible, scalable system. It's never been easier to build a system tailored to your job.

The Trimble R8s easily integrates with Trimble S-Series total stations and the innovative Trimble V10 imaging rover. Create a complete solution by combining the Trimble R8s receiver with a Trimble controller running Trimble Access™ field software, and Trimble Business Center office software.

Configure and Scale With Ease

With the Trimble R8s, it's easy and simple to build a receiver that is right for the job. Choose the configuration level that suits your needs best, whether it's post-processing, base, rover, or a combination of base and rover functionality. After you've selected a configuration level, additional individual options can be added to further extend the receiver functionality.

The Trimble R8s offers the ultimate in scalability. As your requirements change, the Trimble R8s can adapt. Simply add functionality whenever you need it.

Trimble 360 Technology

Each Trimble R8s comes integrated with powerful Trimble 360 tracking technology that supports signals from all existing and planned constellations, and augmentation systems. Trimble 360 technology can expand the reach of your GNSS rover to sites that were previously inaccessible due to moderate vegetation or other obstructions by taking advantage of the availability of additional satellite signals.

The Trimble R8s includes two integrated Maxwell™ 6 chips and 440 GNSS channels. Capable of tracking a full range of satellite systems, including GPS, GLONASS, Galileo, BeiDou and QZSS.

Communication Options and Remote Access Via Web UI

The Trimble R8s GNSS receiver provides data communication options including an integrated wide-band UHF radio or 3G cellular modem.

Trimble's exclusive Web UI eliminates the need to travel for routine monitoring of base station receivers.

The Complete Solution

Create an industry-leading field solution by pairing the Trimble R8s GNSS receiver with a powerful Trimble controller loaded with our easy-to-use Trimble Access field software.

Trimble Access field software offers the features and capabilities to simplify everyday work. Our streamlined workflow modules such as Roads, Monitoring, Mines, and Tunnels guide crews through common project types, enabling them to get the job done faster. Survey companies can also implement their unique workflows by taking advantage of the customization capabilities available in the Trimble Access Software Development Kit (SDK).

Once you're back in the office, Trimble Business Center enables you to check, process and adjust your data with confidence. No matter what Trimble solution you use in the field, you can trust that Trimble Business Center office software will help you generate industry leading deliverables.

Trimble Mobile App—A New Way to Quickly Collect GNSS Raw Data

The Trimble DL Android app provides a simple and easy to use mobile interface for collecting static GNSS raw data for post-processing purposes without the need of using a Trimble controller or Trimble Access field software. This free of charge app is available through the Google Play Store and operates on Android smart phones and tablets.

Key Features

- One configurable receiver that is scalable for future needs
- Available in post-processing, base only, rover only, or base & rover configurations
- Advanced satellite tracking with Trimble 360 receiver technology
- Includes Trimble Maxwell 6 chips with 440 channels
- Simple integration with Trimble S-Series Total Stations and the V10 Imaging Rover
- Intuitive Trimble Access Field Software and Trimble Business Center Office Software

Trimble R8s GNSS SYSTEM

PERFORMANCE SPECIFICATIONS[1]

Measurements

- Advanced Trimble Maxwell 6 Custom Survey GNSS chips with 440 channels
- Future-proof your investment with Trimble 360 tracking
- High precision multiple correlator for GNSS pseudorange measurements
- Unfiltered, un-smoothed pseudorange measurements data for low noise, low multipath error, low time domain correlation and high dynamic response
- Very low noise GNSS carrier phase measurements with <1 mm precision in a 1 Hz bandwidth
- Signal-to-Noise ratios reported in dB-Hz
- Proven Trimble low elevation tracking technology
- Satellite signals tracked simultaneously:
  - GPS: L1C/A, L1C, L2C, L2E, L5
  - GLONASS: L1C/A, L1P, L2C/A, L2P, L3
  - SBAS: L1C/A, L5 (for SBAS satellites that support L5)
  - Galileo: E1, E5A, E5B
  - BeiDou (COMPASS): B1, B2
- SBAS: QZSS, WAAS, EGNOS, GAGAN
- Positioning rates: 1 Hz, 2 Hz, 5 Hz, 10 Hz, and 20 Hz

POSITIONING PERFORMANCE[2]

Code differential GNSS positioning

Horizontal	0.25 m + 1 ppm RMS
Vertical	0.50 m + 1 ppm RMS
SBAS differential positioning accuracy[3]	typically <5 m 3DRMS

Static GNSS surveying

High-Precision Static	
Horizontal	3 mm + 0.1 ppm RMS
Vertical	3.5 mm + 0.4 ppm RMS
Static and Fast Static	
Horizontal	3 mm + 0.5 ppm RMS
Vertical	5 mm + 0.5 ppm RMS

Postprocessed Kinematic (PPK) GNSS surveying

Horizontal	8 mm + 1 ppm RMS
Vertical	15 mm + 1 ppm RMS

Real Time Kinematic surveying

Single Baseline <30 km	
Horizontal	8 mm + 1 ppm RMS
Vertical	15 mm + 1 ppm RMS
Network RTK[4]	
Horizontal	8 mm + 0.5 ppm RMS
Vertical	15 mm + 0.5 ppm RMS
Initialization time[5]	typically <8 seconds
Initialization reliability[5]	typically >99.9%

HARDWARE

Physical

Dimensions	19 cm x 10.4 cm (7.5 in x 4.1 in), including connectors
Weight	1.52 kg (3.35 lb) with internal battery, internal radio and antenna 3.81 kg (8.40 lb) items above plus range pole, controller & internal radio
Operating Temperature[6]	–40 °C to +65 °C (–40 °F to +149 °F)
Storage Temperature	–40 °C to +75 °C (–40 °F to +167°F)
Humidity	100%, condensing
Ingress Protection	IP67 dustproof, protected from temporary immersion to depth of 1 m (3.28 ft)
Shock and vibration	Tested and meets the following environmental standards:
Shock	Non-operating: Designed to survive a 2 m (6.6 ft) pole drop onto concrete. Operating: to 40 G, 10 msec, sawtooth
Vibration	MIL-STD-810F, FIG.514.5C-1

ELECTRICAL

- Power 10.5 V DC to 28 V DC external power input with over-voltage protection on Port 1 (7-pin Lemo)
- Rechargeable, removable 7.4 V, 2.8 Ah Lithium-ion smart battery
- Power consumption is <3.2 W in RTK rover mode with internal radio and Bluetooth™ in use[7]
- Operating times on internal battery[8]:
  - 450 MHz receive only option. . . . . 5.0 hours
  - 450 MHz receive/transmit option (0.5 W) . . . . . 2.5 hours
  - Cellular receive option. . . . . 4.0 hours

COMMUNICATIONS AND DATA STORAGE

- Serial: 3-wire serial (7-pin Lemo) on Port 1; full RS-232 serial (Dsub 9 pin) on Port 2
- Radio Modem[9]: fully Integrated, sealed 450 MHz wide band receiver/transmitter with frequency range of 403 MHz to 473 MHz, support of Trimble, Pacific Crest, and SATEL radio protocols:
  - Transmit power: 0.5 W
  - Range: 3–5 km typical / 10 km optimal[9]
- Cellular[1]: fully integrated, sealed internal GSM/GPRS/EDGE/UMTS/HSPA+ modem option. CSD (Circuit-Switched Data) and PSD (Packet-Switched Data) supported. Global Operation:
  - Penta-Band UMTS/HSPA+ (850/800, 900, 1900, and 2100 MHz)
  - Quad-Band GSM/CSD & GPRS/EDGE (850, 900, 1800, and 1900 MHz)
- Bluetooth: fully integrated, fully sealed 2.4 GHz communications port (Bluetooth)[10]
- External communication devices for corrections supported on Serial and Bluetooth ports
- Data storage: 56 MB internal memory, 960 hours of raw observables (approx. 1.4 MB/day), based on recording every 15 sec from an average of 14 satellites

Data Formats

- CMR, CMR+, CMRx, RTCM 2.1, RTCM 2.3, RTCM 3.0, RTCM 3.1, RTCM 3.2 inputs and outputs
- 23 NMEA outputs, GSOF, RT17 and RT27 outputs, supports BINEX and smoothed carrier

WebUI

- Offers simple configuration, operation, status, and data transfer
- Accessible via Serial and Bluetooth

Supported Trimble Controllers[1]

- Trimble TSC3, Trimble Slate, Trimble CU, Trimble Tablet Rugged PC

CERTIFICATIONS

IEC 60950-1 (Electrical Safety); FCC OET Bulletin 65 (RF Exposure Safety); FCC Part 15.105 (Class B), Part 15.247, Part 90; PTCRB (AT&T); Bluetooth SIG; IC ES-003 (Class B); Radio Equipment Directive 2014/53/EU, RoHS, WEEE; Australia & New Zealand RCM; Japan Radio and Telecom MIC

1 Based on Trimble R8s GNSS receiver configuration. Radio frequency settings are country specific.
2 Precision and reliability may be subject to anomalies due to multipath, obstructions, satellite geometry, and atmospheric conditions. The specifications stated recommend the use of stable mounts in an open sky view, EMI and multipath clean environment, optimal GNSS constellation configurations, along with the use of survey practices that are generally accepted for performing the highest-order surveys for the applicable application including occupation time appropriate for baseline length. Baselines longer than 30 km require precise ephemeris and occupations up to 24 hours may be required to achieve the high precision static specification.
3 Depends on SBAS system performance.
4 Network RTK PPM values are referenced to the closest physical reference station.
5 May be affected by atmospheric conditions, signal multipath, obstructions and satellite geometry. Initialization reliability is continuously monitored to ensure highest quality.
6 Receiver will operate normally to –40 °C, internal batteries are rated to –20 °C, optional internal cellular modem operates to –40 °C.
7 Tracking GPS, GLONASS and SBAS satellites.
8 Varies with temperature and wireless data rate. When using a receiver and internal radio in the transmit mode, it is recommended that an external 6 Ah or higher battery is used. The specified operating times on an internal battery for the cellular receive option are in GSM CSD (Circuit-Switched Data) or GPRS PSD (Packet-Switched Data) mode.
9 Varies with terrain and operating conditions.
10 Bluetooth type approvals are country specific.

Specifications subject to change without notice.

Contact your local Trimble Authorized Distribution Partner for more information

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Specifications

Trimble GA530 Antenna

	Trimble GA530 Antenna
Frequencies	L1/L2/OmniSTAR/Beacon/SBAS
Dimensions	dia 15.2 cm x 7.4 cm H (dia 6" x 2.9" H)
Weight	0.66 kgs (1.45 lbs)
Antenna cable connector	TNC. Sealed
Mounting	5/8"-11 UNC thread mount
Operation temperature	-40 °C to +70 °C (-40 °F to 158 °F)
Storage temperature	-55 °C to +85 °C (-67 °F to 185 °F)
Environmental	MIL-810-F Figure 514.5c-17 vibration levels on each axis Shock tested table MIL-810-F Table 516.5-I 2m drop, bouyant
Humidity	100% humidity proof, fully sealed
Feed	2 point
LNA(Low Noise Amplifier) input	5.5 V DC – 18 V DC (110 mA)
LNA(Low Noise Amplifier) gain	L1 45dB / L2 45dB
Antenna compliance	CE Mark, C-Tick, EN60945
Phase stability	< 5 mm

Specifications subject to change without notice.

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Trimble

Trimble R10

GNSS SYSTEM

A NEW LEVEL OF PRODUCTIVITY

Collect more accurate data faster and easier – no matter what the job or the environment, with the Trimble® R10 GNSS System. Built with powerful technologies integrated into a sleek design, this unique system provides Surveyors with a powerful way to increase productivity in every job, every day.

Trimble HD-GNSS Processing Engine

The advanced Trimble HD-GNSS processing engine provides markedly reduced convergence times as well as high position and precision reliability while reducing measurement occupation time. Transcending traditional fixed/float techniques, it provides a more accurate assessment of error estimates than traditional GNSS technology.

Trimble SurePoint

With Trimble SurePoint™ technology, advanced sensors onboard the Trimble R10 continuously stream pole tilt and heading information that is used to display an electronic level bubble on the Trimble controller screen, allowing surveyors to maintain focus where it matters most. Full tilt compensation allows the survey pole to be tilted up to 15° when measuring, allowing the Trimble R10 to capture points that would be inaccessible to other GNSS surveying systems.

Trimble 360 Receiver

Powerful Trimble 360 receiver technology in the Trimble R10 supports signals from all existing and planned GNSS constellations and augmentation systems. With two integrated Trimble Maxwell™ 6 chips, the Trimble R10 offers 440 GNSS channels.

Trimble CenterPoint RTX

Trimble CenterPoint® RTX delivers RTK level precision anywhere in the world without the use of a local base station or VRS network. Survey using satellite delivered, CenterPoint RTX corrections in areas where terrestrial based corrections are not available. When surveying over a great distance in a remote area, such as a pipeline or utility right of way, CenterPoint RTX eliminates the need to continuously move base stations or maintain connection to a cellular network.

Trimble xFill

Leveraging a worldwide network of Trimble GNSS reference stations and satellite datalinks, Trimble xFill® seamlessly fills in for gaps in your RTK or VRS connection stream. Maintain centimeter level accuracy beyond five minutes with a CenterPoint RTX subscription.

Smart, Versatile

A smart lithium-ion battery inside the Trimble R10 system delivers extended battery life and more reliable power. A built-in LED battery status indicator allows the user to quickly check remaining battery life.

The Trimble R10 system provides a number of communications options to support any workflow. Receive VRS corrections and connect to the Internet from the field with the integrated cellular modem. Using Wi-Fi, easily connect to the Trimble R10 system using a laptop or smartphone to configure the receiver without a Trimble controller.

The Complete Solution

Bring the power and speed of the Trimble R10 system together with trusted Trimble software solutions, including Trimble Access™ and Trimble Business Center.

Trimble Access field software provides specialized and customized workflows to make surveying tasks quicker and easier while enabling teams to communicate vital information between field and office in real time. Back in the office, users can seamlessly process data with Trimble Business Center software.

Key Features

- Cutting-edge Trimble HD-GNSS processing engine
- Precise position capture and full tilt compensation with Trimble SurePoint technology
- Trimble CenterPoint RTX provides RTK level precision anywhere without the need for a base station or VRS network
- Trimble xFill technology provides centimeter-level positioning during connection outages
- Advanced satellite tracking with Trimble 360 receiver technology
- Sleek ergonomic design for easier handling

PERFORMANCE SPECIFICATIONS		
MEASUREMENTS		
	Measuring points sooner and faster with Trimble HD-GNSS technology	
	Increased measurement productivity and traceability with Trimble SurePoint electronic tilt compensation	
	Worldwide centimeter level positioning using Trimble CenterPoint RTX satellite delivered corrections	
	Reduced downtime due to loss of radio signal with Trimble xFill technology	
	Advanced Trimble Maxwell 6 Custom Survey GNSS chips with 440 channels	
	Future-proof your investment with Trimble 360 GNSS tracking	
	Satellite signals tracked simultaneously:	GPS: L1C/A, L1C, L2C, L2E, L5 GLONASS: L1C/A, L1P, L2C/A, L2P, L3[1] SBAS: L1C/A, L5 (For SBAS satellites that support L5) Galileo: E1, E5A, E5B, E5 AltBOC BeiDou (COMPASS): B1, B2, B3[2]
	CenterPoint RTX, OmniSTAR® HP, XP, G2, VBS positioning	
	QZSS, WAAS, EGNOS, GAGAN, MSAS	
	Positioning Rates	1 Hz, 2 Hz, 5 Hz, 10 Hz, and 20 Hz
POSITIONING PERFORMANCE[3]		
CODE DIFFERENTIAL GNSS POSITIONING		
	Horizontal	0.25 m + 1 ppm RMS
	Vertical	0.50 m + 1 ppm RMS
	SBAS differential positioning accuracy[4]	typically <5 m 3DRMS
STATIC GNSS SURVEYING		
High-Precision Static		
	Horizontal	3 mm + 0.1 ppm RMS
	Vertical	3.5 mm + 0.4 ppm RMS
STATIC AND FAST STATIC		
	Horizontal	3 mm + 0.5 ppm RMS
	Vertical	5 mm + 0.5 ppm RMS
REAL TIME KINEMATIC SURVEYING		
Single Baseline <30 km		
	Horizontal	8 mm + 1 ppm RMS
	Vertical	15 mm + 1 ppm RMS
Network RTK[5]		
	Horizontal	8 mm + 0.5 ppm RMS
	Vertical	15 mm + 0.5 ppm RMS
RTK start-up time for specified precisions[6]		2 to 8 seconds
TRIMBLE RTX (SATELLITE AND CELLULAR/INTERNET (IP))		
CenterPoint RTX		
	Horizontal	4 cm RMS
	Vertical	9 cm RMS
	RTX convergence time for specific precisions[7]	< 30 min (typical)
	RTX QuickStart convergence time for specific precisions[7]	< 5 min (typical)
	Operating range (inland)	Nearly worldwide
CenterPoint RTX Fast		
	Horizontal	2 cm RMS
	Vertical	5 cm RMS
	RTX convergence time for specific precisions[7]	1-5 min (typical)
	Operating range (inland)	In select regions
TRIMBLE XFILL[8]		
	Horizontal	RTK[9] + 10 mm/minute RMS
	Vertical	RTK[9] + 20 mm/minute RMS

HARDWARE		
PHYSICAL		
Dimensions (W×H)	11.9 cm x 13.6 cm (4.6 in x 5.4 in)	
Weight	1.12 kg (2.49 lb) with internal battery, internal radio with UHF antenna, 3.57 kg (7.86 lb) items above plus range pole, controller & bracket	
Temperature[10]		
	Operating	−40° C to +65° C (−40° F to +149° F)
	Storage	−40° C to +75° C (−40° F to +167° F)
Humidity		100%, condensing
Ingress Protection		IP67 dustproof, protected from temporary immersion to depth of 1 m (3.28 ft)
Shock and vibration (Tested and meets the following environmental standards)		
	Shock	Non-operating: Designed to survive a 2 m (6.6 ft) pole drop onto concrete. Operating: to 40 G, 10 msec, sawtooth
	Vibration	MIL-STD-810F, FIG.514.5C-1
ELECTRICAL		
	Power 11 to 24 V DC external power input with over-voltage protection on Port 1 and Port 2 (7-pin Lemo)	
	Rechargeable, removable 7.4 V, 3.7 Ah Lithium-ion smart battery with LED status indicators	
	Power consumption is 5.1 W in RTK rover mode with internal radio[11]	
Operating times on internal battery[12]		
	450 MHz receive only option	5.5 hours
	450 MHz receive/transmit option (0.5 W)	4.5 hours
	450 MHz receive/transmit option (2.0 W)	3.7 hours
	Cellular receive option	5.0 hours
COMMUNICATIONS AND DATA STORAGE		
	Serial	3-wire serial (7-pin Lemo)
	USB v2.0	Supports data download and high speed communications
	Radio Modem	Fully Integrated, sealed 450 MHz wide band receiver/transmitter with frequency range of 403 MHz to 473 MHz, support of Trimble, Pacific Crest, and SATEL radio protocols:
		Transmit power: 2 W
		Range: 3–5 km typical / 10 km optimal[13]
	Cellular	Integrated, 3.5 G modem, HSDPA 7.2 Mbps (download), GPRS multi-slot class 12, EDGE multi-slot class 12, UMTS/HSDPA (WCDMA/FDD) 850/1900/2100MHz, Quad-band EGSM 850/900/1800/1900 MHz, GSM CSD, 3GPP LTE
	Bluetooth	Fully integrated, fully sealed 2.4 GHz communications port (Bluetooth®)[14]
	Wi-Fi	802.11 b,g, access point and client mode, WPA/WPA2/WEP64/WEP128 encryption
	USB v2.0	Supports data download and high speed communications
	External communication devices for corrections supported on	Serial, USB, TCP/IP and Bluetooth ports
	Data storage	4 GB internal memory; over seven years of raw observables (approx. 1.4 MB /day), based on recording every 15 seconds from an average of 14 satellites
	CMR+, CMRx, RTCM 2.1, RTCM 2.3, RTCM 3.0, RTCM 3.1, RTCM 3.2 input and output	
	24 NMEA outputs, GSOF, RT17 and RT27 outputs	

Trimble R10 GNSS SYSTEM

COMMUNICATIONS AND DATA STORAGE	
WEBUI	
	Offers simple configuration, operation, status, and data transfer
	Accessible via Wi-Fi, Serial, USB, and Bluetooth
SUPPORTED TRIMBLE CONTROLLERS	
	Trimble TSC3, Trimble Slate, Trimble CU, Trimble Tablet Rugged PC
CERTIFICATIONS	
	IEC 60950-1 (Electrical Safety); FCC OET Bulletin 65 (RF Exposure Safety); FCC Part 15.105 (Class B), Part 15.247, Part 90; PTCRB (AT&T); Bluetooth SIG; WFA IC ES-003 (Class B); Radio Equipment Directive 2014/53/EU, RoHS, WEEE; Australia & New Zealand RCM; Japan Radio and Telecom MIC

1 There is no public GLONASS L3 CDMA ICD. The current capability in the receivers is based on publicly available information. As such, Trimble cannot guarantee that these receivers will be fully compatible with a future generation of GLONASS satellites or signals.
2 Current BeiDou capability is based on publicly available information. The hardware of this product is designed for BeiDou B3 compatibility (trial version) and its firmware will be enhanced, where possible, to fully support such new signals as soon as the officially published signal interface control documentation (ICD) becomes available. As such, Trimble cannot guarantee full compatibility with future generations of BeiDou satellites or signals.
3 Precision and reliability may be subject to anomalies due to multipath, obstructions, satellite geometry, and atmospheric conditions. The specifications stated recommend the use of stable mounts in an open sky view, EMI and multipath clean environment, optimal GNSS constellation configurations, along with the use of survey practices that are generally accepted for performing the highest-order surveys for the applicable application including occupation times appropriate for baseline length. Baselines longer than 30 km require precise ephemeris and occupations up to 24 hours may be required to achieve the high precision static specification.
4 Depends on WAAS/EGNOS system performance.
5 Network RTK PPM values are referenced to the closest physical base station.
6 May be affected by atmospheric conditions, signal multipath, obstructions and satellite geometry. Initialization reliability is continuously monitored to ensure highest quality.
7 Receiver convergence time varies based on GNSS constellation health, level of multipath, and proximity to obstructions such as large trees and buildings. Convergences times decrease significantly when using a "RTX Quickstart" on a previously surveyed point or a known survey control point.
8 Precisions are dependent on GNSS satellite availability. xFill positioning without a RTX subscription ends after 5 minutes of radio downtime. xFill positioning with a RTX subscription will continue beyond 5 minutes providing RTX has converged, with typical precisions not exceeding 6 cm horizontal, 14 cm vertical. xFill is not available in all regions, check with your local sales representative for more information.
9 RTK refers to the last reported precision before the correction source was lost and xFill started.
10 Receiver will operate normally to –40° C, internal batteries are rated to –20° C.
11 Tracking GPS, GLONASS and SBAS satellites.
12 Varies with temperature and wireless data rate. When using a receiver and internal radio in the transmit mode, it is recommended that an external 6 Ah or higher battery is used.
13 Varies with terrain and operating conditions.
14 Bluetooth type approvals are country specific.

Specifications subject to change without notice.

Contact your local Trimble Authorized Distribution Partner for more information

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Singapore 449269
SINGAPORE

PN 022543-544I (08/17)

MUL-1 MAGNETIC UNDERWATER LOCATOR

KEY FEATURES

1. LCD Display
2. Connectors Pannel
3. Connectivity Cables
4. Control Pannel
5. Magnetic Underwater Locator
6. Audio Speakers

FEATURES

- Heavy-duty sensor cable acts as lanyard. 30', 50', 100' (non-standard lengths available)
- High-quality connectors and "Toilet Seat" cover over headset jack. "Seacon" connectors available.
- Alligator clips for 12-volt auxiliary power.
- Gel-cell auto-charges when auxiliary power connected.
- "Zero" to "Null" gradient.
- Permanent gel-cell battery-mounted under electronics panel.
- Bull-nosed and tapered sensor on BHG; longer sensor on MUL for diver or boat towing.
- 1 year warranty

Magnetic Underwater Sensor

- Durable detector finds metal immersed in 1,000+ feet of water
- Longer sensor, for diver or boat towing.

SPECIFICATIONS

CONTROLS
- On, Off
- Volume Up and Down
- Range setting (Gain or Sensitivity) Up and Down
- Zero, Plus and Minus
- Auto Zero - Automatic self-adjusting

OUTPUTS
- Audio Frequency Pitch (speaker and jack for headset)
- Visual LCD Display
- Bar Graph - range Gain setting - milligauss
- RS-232 PC connection (cable included)
- Control all keypad functions data log range, keypad and signal settings works with hyper terminal or equivalent

POWER OPTIONS
- Internal Battery: 12-volt, 7.2Ah sealed lead acid
- Battery Life: 72 hours continuous use, charges to full overnight
- External Power: 12 to 15-volt, cable included
- Internal battery charging circuit is enabled when external power or AC charging cable is connected

DIMENSIONS
- Electronics: 16.9"w x 10"h x 6.5"d
- Sensor: 1.625"d x 34.375"L (4.13cm x 87.3cm)

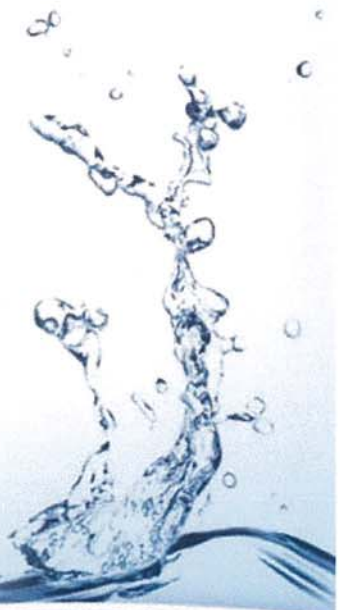
Includes:
- ABS custom case
- Connectivity cables
- Instruction manual

SubSurface Instruments, Inc. | 1230 Flightway Drive, De Pere, WI. 54115
toll free: 855.422.6346 | **Website:** www.ssilocators.com | **email:** info@ssilocators.com

ECHOTRAC™ CVM

MOBILE HYDROGRAPHIC SYSTEM

- Portable carry-on case style supports a dual frequency echo sounder with optional DGPS receiver, notebook PC and bundled data acquisition software.
- Features include Ethernet LAN interface, frequency agile configurable transceivers, standard serial interfaces for data acquisition systems, motion sensors and DGPS receivers.



TELEDYNE
ODOM HYDROGRAPHIC
A Teledyne Technologies Company

odom hydrographic.com

Odom Hydrographic Systems, Inc.
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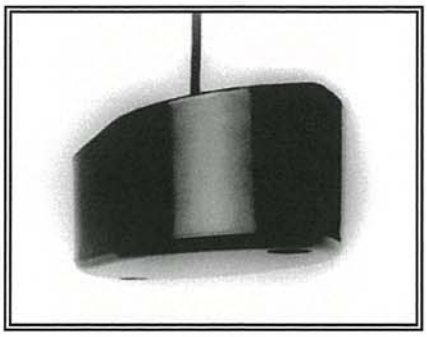
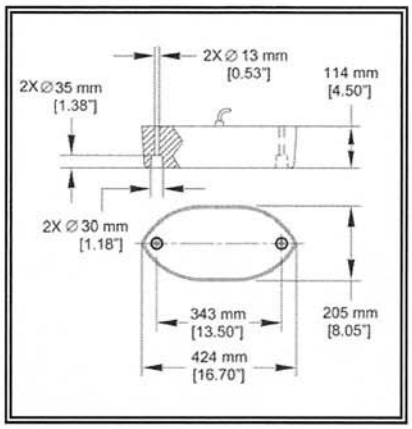
225.769.3051, Facsimile 225.766.5122

OTSBB200/24-4/20



Weight = 14.5Kg.



Performance Data

Frequency	200kHz	24kHz
Beam Width	4°	20°
Q (transmit)	4	7
Rated RMS Power	2KW	1.5KW
Balanced Impedance	ohms	
Peak Figure of Merit	-6db	-9db
Bandwidth		
Acoustic Window Material	Urethane	Urethane
Cable Type	C43 (2-14 AWG)	C43 (2-14 AWG)
Cable Size	10mm	10mm

The M42 houses Odom's best selling dual frequency transducer. Compatible with any hull material, its streamlined shape is designed for over-the-side or hull mounting, but it can be adapted to sea chest installation. Durable and reliable.

Seafloor

datasheet

SonarMite MILSpec[tm]

benefits

- rugged, field-proven survey grade echo sounder
- Bluetooth technology integrated with Windows Pocket PC devices
- proven "Smart" transducer design with QA output
- easily integrates with other modern software and GPS technology

multibeam survey image

specifications

frequency	200 KHz
beam width	4 degrees
ping rate	6 Hz
depth accuracy	1cm / 0.1% of depth
output formats	NMEA, ASCII
range	0.3m–75m
I/O	serial, Bluetooth
environmental	IP-65
power	rechargeable 12v battery

about

The SonarMite MILSpec[tm] echo sounder is the result of nearly two years' research and development to further extend the boundaries of shallow water hydrographic survey equipment. The introduction by Ohmex in 1997 of the SonarLite, the world's first truly portable echo sounder system has been a hard act to follow and it remains the portable instrument of choice in many survey companies around the world. The release of the SonarMite MILSPec instrument marks the next stage introducing a series of equipment designed around the WinSTRUMENT concept using the latest portable computer integrated with new measurement technologies.

options

- data collection software
- heave, pitch and roll measurements
- sound velocimeter
- portable mounting bracket
- rugged shipping case
- extended warranty

SonarMite MILSpec echo sounder with cable

Seafloor Systems, Incorporated
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(530) 677–1019 · info@seafloorsystems.com · www.seafloorsystems.com

Rev 07/13/2015

DMS

Dynamic Motion Sensors

Accurate motion measurement in all sea conditions

Subsea

Surface

The DMS range of motion sensors is designed specifically for the motion measurement needs of the marine industry. Whether it is achieving IHO standard survey from any size of vessel, or providing safety critical monitoring of offshore platforms, large vessels, helicopter landing decks, cranes and positioning systems, the DMS provides accurate motion measurement in all sea conditions.

Incorporating an enhanced external velocity and heading aiding algorithm for improved accuracy during dynamic manoeuvres, the solid state angular rate sensors offer reliability in the highest performing vertical reference units ever produced by TSS.

PRODUCT FEATURES AND BENEFITS

- Dynamic roll and pitch accuracy from 0.03° to 0.50° RMS
- Heave accuracy ±5cm or 5%
- Solid state solution available in surface or subsea housings
- Survey to Class 1 IHO standard
- High dynamic accuracy during vessel turns
- High reliability
- Power and data over Ethernet (surface units)
- Independently configurable serial outputs
- Complies with IEC 60945
- 24 hour, 365 days per year technical support
- Intuitive control software with user-configurable outputs
- Real-time digital and analogue outputs
- Compact and lightweight
- Low power, cost-effective solutions

TELEDYNE TSS
Everywhereyoulook™

DMS

Dynamic Motion Sensors

The DMS range of sensors is available in surface or subsea variants - the subsea unit is rated to 3000m as standard with 6000m available on request. As with all TSS systems, the DMS is certified to meet all current and anticipated European legislation for electromagnetic compatibility and electronic emissions.

The latest DMSView software programme is an intuitive Windows™ based programme enabling installation, set-up and integrity checking, and monitoring of the sensor. The user can select from a series of frequently used data protocols or configure a bespoke output from a selection of variables.

Product	Dynamic Accuracy	Depth Rating	Heave	Roll	Pitch
DMS-05	0.05°	✓	✓	✓	✓
DMS-10	0.10°	✓	✓	✓	✓
DMS-25	0.25°	✓	✓	✓	✓
DMS-RP25	0.25°	✓	x	✓	✓
DMS-RP30	0.30°	x	x	✓	✓
DMS-H	x	x	✓	x	x
DMS-525	0.25°	x	✓	✓	✓
DMS-525RP	0.25°	x	x	✓	✓
DMS-535RP	0.35°	x	x	✓	✓
DMS-550	0.50°	x	✓	✓	✓
DMS-550RP	0.50°	x	x	✓	✓
DMS-500H	x	x	✓	x	x

*Dynamic Accuracy at +/- 30°

No formal restrictions for most countries although heave products are subject to Export Licence.

Heave, Roll, Pitch

The DMS range of motion sensors is designed specifically for the motion measurement needs of the marine industry. Whether it is achieving IHO standard survey from any size of vessel, or providing safety critical monitoring of offshore platforms, large vessels, helicopter landing decks, cranes and positioning systems, the DMS provides accurate motion measurement in all sea conditions.

Incorporating an enhanced external velocity and heading aiding algorithm for improved accuracy during dynamic manoeuvres, the solid state angular rate sensors offer reliability in the highest performing vertical reference unit ever produced by TSS.

DMS-05
Subsea

PRODUCT FEATURES AND BENEFITS

- Dynamic roll and pitch accuracy to 0.03° (+/- 5°)
- Heave ±5cm
- Survey to Class 1 IHO standard
- High dynamic accuracy during vessel turns
- Surface and depth rated options available
- Real-time digital and analogue
- Compact and lightweight

Roll, Pitch

The DMS-RP sensors meet the requirements of the dynamic positioning industry for accurate vessel roll and pitch measurement. The units provide accurate motion measurement in all sea conditions.

Incorporating and enhanced external velocity and heading aiding algorithm for improved accuracy during dynamic manoeuvres, the solid state angular sensors offer reliability and a complimentary blending algorithm has proven that the DMS is the highest performance vertical reference unit ever produced by TSS.

The DMS-RP sensors are available in subsea and surface versions. The sensor can be supplied in various configurations for integration with towed vehicles and other bespoke applications.

DMS-RP25
Subsea

PRODUCT FEATURES AND BENEFITS

- Dynamic roll and pitch accuracy from 0.25° to 0.50° RMS
- Surface and subsea options available
- Independently configurable serial outputs
- Power and data over Ethernet (surface only)
- Survey to Class 1 IHO standard
- High dynamic accuracy during vessel turns
- DMSView intuitive control software
- User-configurable ouputs
- Real-time digital outputs
- Compact and lightweight

Heave

Whether in ports or harbours, offshore or as part of a hydrographic mapping programme, the need to measure ocean depths with the utmost accuracy is vital.

The DMS-500H heave sensor has been developed to work with a wide range of modern single beam echosounders. With their design, allowing acceptance of correction data from the DMS-500H, real-time heave compensation of the sounder data is achievable. Providing heave data in analogue and digital format, the outputs of the DMS-500H are easily configurable via a simple operator menu.

Compact, ruggedised and quick to install, the sensor is supplied with the cable connector necessary for interfacing and is accompanied by a comprehensive operation manual. In addition to echosounder compensation, the DMS-500H is ideally suited to a wide range of offshore applications including crane and winch control, wave radar and ship motion measurement.

DMS-500H
Surface

PRODUCT FEATURES AND BENEFITS

- Measurement to meet IHO standards
- Provides cost savings by increasing weather windows for survey
- Solid state accelerometers and rate sensors
- Removes vertical motion errors from survey data to eliminate the need for post-processing
- Suitable for a wide variety of vessels
- IP 65 Rated
- Designed to provide operators with the optimum cost benefit solution
- Freephone telephone support for life of product

DMS

Dynamic Motion Sensors

TECHNICAL SPECIFICATIONS

	DMS-05	DMS-10	DMS-25	DMS-RP25	DMS-RP30	DMS-H	DMS-525	DMS-525RP	DMS-535RP	DMS-550	DMS-550RP	DMS-500H
PERFORMANCE												
Roll & Pitch °RMS												
+/- 5° Dynamic	0.03	0.06	0.15	0.25	0.30	N/A	0.05	0.25	0.35	0.10	0.50	N/A
+/- 30° Dynamic	0.05	0.10	0.25	0.25	0.30	N/A	0.25	0.25	0.35	0.50	0.50	N/A
Heave	5 cm or 5%	5 cm or 5%	5cm or 5%	N/A	N/A	5cm or 5%	5cm or 5%	N/A	N/A	5cm or 5%	N/A	5cm or 5%
Maximum Calibrated Range	Heave ±10m, Roll & Pitch ±30°						Heave ±10m, Roll & Pitch ±30°					
Data Resolution	Heave 1cm, Roll & Pitch 0.01°						Heave 1cm, Roll & Pitch 0.01°					
DATA OUTPUT RATE												
Digital	Up to 100Hz						Up to 100Hz					
Analogue	Up to 500Hz (with optional DMS repeater)						N/A					
PHYSICAL CHARACTERISTICS												
Dimensions	99mm (d) x 172mm (h) (excluding connector)						160mm x 160mm x 160mm (240mm max at base)					
Weight in Air	2.3kg (3000m), 4.0kg (6000m)						4.0kg					
Weight in Water	1.0kg (3000m), 2.7kg (6000m)				N/A	N/A	N/A					
Depth Rating	3000m standard, 6000m on request				N/A	N/A	N/A					
Power Supply	12 - 36Vdc (2A supply)						12 - 36Vdc (2A supply)					
Power Requirement	<6.5W						<12W					
Power Over Ethernet	N/A						IEEE 802.3AF-2003					
Temperature Range	-15°C to +55°C operating, -20°C to +70°C storage						-15°C to +55°C operating, -20°C to +70°C storage					
Shock (survival)	30g peak (40ms half sine)						30g peak (40ms half sine)					
Vibration (operating)	IEC 60945						IEC 60945					
INTERFACE FORMATS												
Sensor Aiding Velocity	NMEA0183 (VTG & GLL or GGA)						NMEA0183 (VTG & GLL or GGA)					
Sensor Aiding Heading	NMEA0183, SGB, Robertson; Sperry LR40/60						NMEA0183 (DMS-550)					
Output Data Formats	Industry Standard formats						Industry Standard formats					
INTERFACE												
Digital	RS232 or RS422 (software selectable)						RS232 or RS422 (software selectable), Ethernet					
Analogue	Via optional DMS repeater						Via optional DMS repeater					
Ethernet	N/A						Dual redundant frequencies. Packet output via TCP, UDP or UDP multicast					
Application Software	DMSView for Windows™						DMS500View for Windows™					
SYSTEM												
MTBF	50,000 hours											
Warranty	24 months international warranty including parts and labour											
Export Compliance (ECCN)	7A103.a.2 for DMS-05, DMS-10, DMS-25, DMS-H											

COMPANY WITH MANAGEMENT SYSTEMS CERTIFIED BY DNV
= ISO 9001 =
= ISO 14001 =
= OHSAS 18001 =

CE

TELEDYNE TSS
Everywhereyoulook™

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G-882
Cesium Marine Magnetometer

GEOMETRICS
Innovation • Experience • Results

Geometrics offers a very high-resolution Cesium vapor marine magnetometer which is low in cost, small in size, and ready for professional surveys in shallow or deep water. The proven Cesium sensor is combined with our unique CM-221 Larmor counter and ruggedly packaged for small or large boat operation. Use your personal computer with our MagLog™ software to log, display and print GPS position and magnetic field data.

The G-882 offers flexibility for operation from shallow water surveys to deep-tow applications. The system directly interfaces to all major side-scan manufacturers for tandem tow configurations. Being small and lightweight, it is easily deployed and operated by one person. But add several streamlined weight collars and the system can quickly weigh more than 100 lb for deep tow applications.

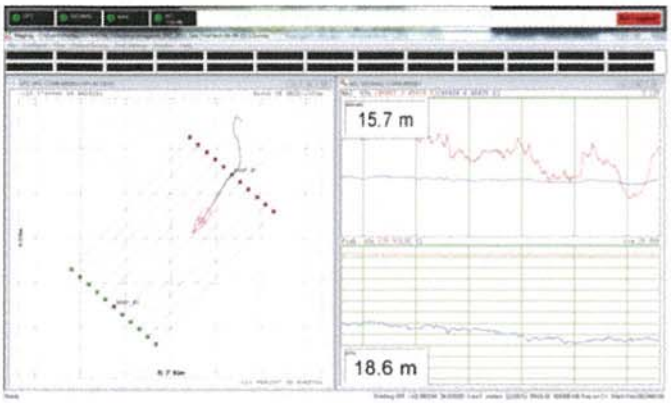
This marine magnetometer system is particularly well-suited for the detection and mapping of all sizes of ferrous objects. This includes anchors, chains, cables, pipelines, ballast stones and other scattered shipwreck debris, munitions of all sizes (UXO), aircraft, engines and any other object with a magnetic expression. The G-882 is also perfect for geological studies. Its high sensitivity and high sample rates are maintained for all applications.

Objects as small as a 5-inch screwdriver are readily detected provided that the sensor is close to the seafloor and within practical detection range (refer to table on back).

FEATURES & BENEFITS

- **Cesium Vapor High Performance** – Highest detection range and high probability of detecting all sized ferrous targets.
- **Streamlined Design for Tow Safety** – Low probability of fouling in fishing lines or rocks. Rugged fiber-wound fiberglass housing.
- **Quick Conversion from Nose Tow to CG Tow** – Simply remove an aluminum locking pin, move tow point and reinsert.
- **Sample at up to 20Hz** – Unparalleled data density while also covering larger areas per day.
- **Sensor can be rotated for optimal signal** – Can be used worldwide.
- **Easy Portability and Handling** – No winch required. Built-in easy-carry handle. Operable by a single man; only 44 lb with 200 ft cable.
- **Combine Multiple Systems for Increased Coverage** – Internal CM-221 Mini-counter provides multi-sensor sync and data concatenation, allowing side-by-side coverage which maximizes detection of small targets and reduces noise.
- **Export version available** – Use anywhere in the world without need for an export license (except embargoed countries). See specifications.

SPECIFICATIONS | G-882 Cesium Marine Magnetometer



MagLogLite™ Data Logging software is included with each magnetometer and allows recording and display of data and position with automatic anomaly detection. Additional software options include: MagLog Pro™, advanced logging software; MagMap™, a plotting and contouring package; and MagPick™ post-acquisition processing software.

MAGNETOMETER / ELECTRONICS

Operating Principle: Self-oscillating split-beam Cesium vapor (non-radioactive).

Operating Range: 20,000 to 100,000 nT.

Operating Zones: The earth's field vector should be at an angle greater than 10° from the sensor's equator and greater than 6° away from the sensor's long axis. Automatic hemisphere switching.

Noise: <0.004 nT/$\sqrt{Hz}_{rms}$. (SX (export) version: <0.02 nT/$\sqrt{Hz}_{rms}$).

Max Sample Rate: 20 Hz.

Heading Error: < 1 nT (over entire 360° spin).

Output: RS-232 at 1,200 to 19,200 Baud.

Power: 24 to 32 VDC, 0.75 A at power-on and 0.5 A thereafter.

MECHANICAL

Sensor Fish

DIA: 7 cm; L: 137 cm (2.75x54 in) (with fin assembly)
Weight: 18 kg (40 lb)

Includes sensor and electronics and 1 main weight. Additional collar weights are 6.4 kg (14 lb) each; total of 5 capable.

Tow Cable

DIA: 12 mm; L: 800 m (.48 in x 2,625 ft).
Weight: 7.7 kg (17 lb) with terminations.
Break strength: 1,630 kg (3,600 lb)
Bend diameter: 30 cm (12 in).

Typical Detection Range for Common Objects

1.	Ship: 1000 tons	0.5 to 1 nT at 800 ft (244 m)
2.	Anchor: 20 tons	0.8 to 1.25 nT at 400 ft (120 m)
3.	Automobile	1 to 2 nT at 100 ft (30 m)
4.	Light Aircraft	0.5 to 2 nT at 40 ft (12 m)
5.	Pipeline (12 inch)	1 to 2 nT at 200 ft (60 m)
6.	Pipeline (6 inch)	1 to 2 nT at 100 ft (30 m)
7.	Iron: 100 kg	1 to 2 nT at 50 ft (15 m)
8.	Iron: 100 lb	0.5 to 1 nT at 30 ft (9 m)
9.	Iron: 10 lb	0.5 to 1 nT at 20 ft (6 m)
10.	Iron: 1 lb	0.5 to 1 nT at 10 ft (3 m)
11.	Screwdriver: 5-inch	0.5 to 2 nT at 12 ft (4 m)
12.	Bomb: 1000 lb	1 to 5 nT at 100 ft (30 m)
13.	Bomb: 500 lb	0.5 to 5 nT at 50 ft (16 m)
14.	Grenade	0.5 to 2 nT at 10 ft (3 m)
15.	Shell: 20 mm	0.5 to 2 nT at 5 ft (1.8 m)

ENVIRONMENTAL

Operating Temperature: -35°C to +50°C (-30°F to +122°F).

Storage Temperature: -45°C to +70°C (-48°F to +158°F).

Altitude: 9,000 m (30,000 ft).

Depth: 2,700 m (8860 ft).

Water Tight: O-Ring sealed for up to 2,750 m (9,000 ft) depth operation.

ACCESSORIES

Standard: Operation manual, shipping/storage container, ship kit with tools and hardware, power supply, MagLogLite™.

Optional: Steel tow cable to 6,000 m (19,600 ft) with telemetry, longitudinal or transverse gradiometer, aluminum shipping case, MagLogPro™.

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