FLOOD INSURANCE STUDY

ST. BERNARD PARISH, LOUISIANA
(ALL JURISDICTIONS)

COMMUNITY NAME	COMMUNITY NUMBER
ST. BERNARD PARISH (UNINCORPORATED AREAS)	225204

REVISED PRELIMINARY

SEPTEMBER 29, 2015

EFFECTIVE:

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
22087CV000A

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program (NFIP) have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study (FIS) may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

Selected Flood Insurance Rate Map (FIRM) panels for the community contain information that was previously shown separately on the corresponding Flood Boundary and Floodway Map (FBFM) panels (e.g., floodways, cross sections). In addition, former flood hazard zone designations have been changed as follows:

Old Zone	New Zone
A1 through A30	AE
V1 through V30	VE
B	X
C	X

Part or all of this FIS may be revised and republished at any time. In addition, part of this FIS may be revised by the Letter of Map Revision (LOMR) process, which does not involve republication or redistribution of the FIS. It is, therefore, the responsibility of the user to consult with community officials and to check the community repository to obtain the most current FIS components.

Initial Parishwide FIS Effective Date:

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FLOOD INSURANCE STUDY
ST. BERNARD PARISH, LOUISIANA (ALL JURISDICTIONS)

1.0 INTRODUCTION

1.1 Purpose of Study

This parishwide FIS investigates the existence and severity of flood hazards in, or revises and updates previous FISs/FIRMs for the geographic area of St. Bernard Parish, Louisiana, including: the unincorporated areas of St. Bernard Parish (hereinafter referred to collectively as St. Bernard Parish).

This FIS aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This FIS has developed flood risk data for various areas of the parish that will be used to establish actuarial flood insurance rates. This information will also be used by St. Bernard Parish to update existing floodplain regulations as part of the Regular Phase of the National Flood Insurance Program (NFIP), and will also be used by local and regional planners to further promote sound land use and floodplain development. Minimum floodplain management requirements for participation in the NFIP are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some States or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the State (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this FIS are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

This FIS was prepared to include the unincorporated areas of, and incorporated communities within, St. Bernard Parish in a parishwide format. Information on the authority and acknowledgments for each jurisdiction included in this parishwide FIS, as compiled from their previously printed FIS reports, is shown below.

For the November 1, 1984 community-based FIS, the hydrologic and hydraulic analyses were performed by the New Orleans District, U.S. Army Corps of Engineers (USACE-MVN) for the Federal Emergency Agency (FEMA), under Interagency Agreement No. IAA-H-19-79, Project Order No. 22. The first part of this study was completed in December 1980. Wave height analyses for St. Bernard Parish were performed by Bernard Johnson Incorporated in 1984.

Basic data for the study were collected from various sources, such as the Type 5 FIS for the Louisiana Gulf Coast, and other pertinent studies and reports prepared by the USACE-MVN and FEMA. Maps contained in the Lake Pontchartrain and Vicinity

Hurricane Protection Project Restudy were utilized to develop the base map and work maps.

This parishwide FIS incorporates the Hurricane Storm Damage Risk Reduction System (HSDRRS) completed by the USACE. Revised hydrologic and hydraulic analyses for all revised flooding sources outside of the HSDRRS were prepared for FEMA by USACE-MVN under Interagency Agreement No. 05-06-A047S. This study was completed in April 2008.

The revised hydrologic and hydraulic analyses inside of the HSDRRS area were prepared for FEMA by Risk Assessment, Mapping, and Planning Partners (RAMPP) under contract number HSFEHQ-09-D-0369. This work was completed in April 2014.

Base map information shown on this FIRM was derived from multiple sources. Base map files were provided and/or extracted in digital format from the Louisiana Department of Transportation and Development (LaDOTD), U.S. Geological Survey (USGS), Northwest Louisiana Council of Governments (NLCOG), Louisiana Office of State Lands, St. Bernard Parish GIS Department, and the National Geodetic Survey (NGS).

The coordinate system used for the production of this FIRM is State Plane, Louisiana South, Federal Information Processing Standard (FIPS) Zone 1702. The horizontal datum is NAD 83, Geodetic Reference System 1980 (GRS80) spheroid. Corner coordinates shown on the FIRM are in latitude and longitude referenced to the State Plane projection, NAD 83. Differences in the datum and spheroid used in the production of FIRMs for adjacent counties may result in slight positional differences in map features at the parish boundaries. These differences do not affect the accuracy of information shown on the FIRM.

1.3 Coordination

Consultation Coordination Officer's (CCO) meetings may be held for each jurisdiction in this parishwide FIS. An initial CCO meeting is held typically with representatives of FEMA, the community, and the study contractor to explain the nature and purpose of a FIS, and to identify the streams to be studied by detailed methods. A final CCO meeting is held typically with representatives of FEMA, the community, and the study contractor to review the results of the study.

For the November 1, 1984 community-based FIS, the initial CCO meeting was held in St. Bernard Parish in January 1979 to discuss the study and to exchange pertinent information. Representatives of the community, FEMA, and the COE were in attendance. On April 13, 1983, the results of this study were reviewed at a final CCO meeting attended by representatives of the COE, FEMA, and St. Bernard Parish. The study was acceptable to the community.

For this parishwide FIS, the initial CCO meeting was held on March 2, 2005, and attended by representatives of FEMA and St. Bernard Parish.

Two intermediate CCO meetings were held on September 27, 2011 and December 5, 2012, and attended by representatives of FEMA, the community, and Risk Map and Planning Partners (RAMPP).

The results of this study were reviewed at the final CCO meeting held _____, _____. These meetings were attended by the FEMA Region VI Regional Service Center (RSC) and the community.

2.0 AREA STUDIED

2.1 Scope of Study

This FIS covers the geographic area of St. Bernard Parish, Louisiana. The areas studied by detailed methods were selected with priority given to all known flood hazards and areas of projected development or proposed construction.

The interior drainage analysis for areas protected by levees and pump stations was performed by the Interagency Performance Evaluation Task Force (IPET) (USACE, March 26, 2007).

Tidal flooding from the Gulf of Mexico, including wave action, was studied by detailed methods. This revision was carried out to incorporate an updated coastal surge analysis, implement coastal erosion regulations for frontal dunes, and incorporate an analysis of the effects of marsh grass on wave dissipation.

As part of this parishwide FIS, updated analyses were included for the areas of revision as described below:

The area of revision is within the limits of the HSDRRS situated in the Greater New Orleans metropolitan area, which includes portions of Orleans Parish. HSDRRS consists of a complex perimeter that includes levees (segments of Lake Pontchartrain & Vicinity levees, West Bank & Vicinity levees, and Mississippi River levees), floodwalls, drainage structures, locks, sector gates, and pumping stations all designed for elevation and stability to withstand a 1-percent probabilistic flooding event originating from river flow or hurricane surge. HSDRRS also includes a complex network of interior drainage features consisting of interior pump stations, box culverts, open channels, subsurface drainage systems, and interior floodwall/levee alignments (USACE, March 26, 2007).

All or portions of the flooding sources listed in Table 1, "Flooding Sources Studied by Detailed Methods," were studied by detailed methods. Limits of detailed study are indicated on the Flood Profiles (Exhibit 1) and on the FIRM (Exhibit 3).

TABLE 1 - FLOODING SOURCES STUDIED BY DETAILED METHODS

New Detailed Study

Lower 9th Ward and St. Bernard Polders

20 Arpent A3	Highway 46 Addition
40 Arpent A3	Intercept Canal
Bayou Ducros	Intercept 2
Bayou Villere	Intercept 3
Bluebird Extension	Intercept 4
Bluebird Lateral	Intracoastal Waterway (IWW)
Chalmette Loop	Meraux Canal
Chalmette Vista	Meraux Pump Station
Corrine Canal	Mississippi River Gulf Outlet (MRGO)
DeBouchel Canal	Pirates Ditch
DeLaRonde Canal	PS1 and 6
Docville Canal	PS2
East RR Ditch	Pump Station N
East Tunnel	Terre aux Boeufs A3
Eickes Canal	Tigertown Ditch
Florida Walk Canal	Toca Ditch A3
Fortification	Tweedy Bird A3
Forty Arpent	Violet Canal
Forty Arpent 2	Violet Ditch
Forty Arpent 3	Waterworks Ditch
Green Ave 3	West RR Ditch
Gueringer Canal	West Tunnel
Guichard Canal	WW Diversion
Highway 46 Ditch A3	Yscloskey
Inner Harbor Navigation Canal (IHNC)	

The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction.

All or portions of numerous flooding sources in the parish were studied by approximate methods. Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to, and agreed upon by, FEMA and St. Bernard Parish.

2.2 Community Description

St. Bernard Parish lies in southeastern Louisiana and is bounded by Lake Borgne and the Gulf of Mexico on the north and east, by Plaquemines Parish on the south, and by the Mississippi River and Orleans Parish on the west. The total land area within the parish limits is 377.5 square miles. According to U.S. Census Bureau

figures, the parish population decreased from 67,229 in 2000 to 35,897 in 2010 (US Census Bureau, 2010). Major transportation routes that traverse the parish include State Highways 47, 39, 46, 300 and 624, the Mississippi River, the MRGO and the Southern Pacific Railroad.

St. Bernard Parish is located in a part of the Mississippi River deltaic plain now occupied by the present course of the river. Principal physiographic features of the area are the river channel, natural levee ridges along its banks and along the banks of abandoned distributary channels, and low marshlands situated between and bordering the channels. Land elevations vary in St. Bernard Parish from approximately 10.0 feet North American Vertical Datum of 1988 (NAVD 88) near the Mississippi River to approximately 3 feet NAVD 88 below sea level in the coastal marsh area. The crest of the natural levee is the highest ground in the region. The coastal marsh area contains numerous bodies of shallow water.

St. Bernard Parish is located in a subtropical latitude. The climate is characterized by mild winters and hot, humid summers. During the summer, prevailing southerly winds produce conditions favorable for thunder showers. In the hurricane seasons, the area experiences frontal passages which produce squalls and sudden temperature drops. The mean annual temperature is about 70 degrees Fahrenheit (ºF). The average temperatures in the summer and winter are 91ºF and 63ºF, respectively. The average annual rainfall is 62 inches (St. Bernard Parish Health Profiles, 2005).

2.3 Principal Flood Problems

The past history of flooding within St. Bernard Parish indicates that flooding may occur during any season of the year.

The most severe flood in the study area occurred in August 2005 when Hurricane Katrina passed through the area. Although officially determined to be a Category 3 hurricane, Katrina produced a Category 5 surge and winds in excess of 125 mph when it made landfall in St. Bernard Parish. As the storm surge traveled across Lake Borgne and up the MRGO, it overtopped the levee along the northern edge of the urbanized area of St. Bernard Parish, and broke through the levee on the Industrial Canal in New Orleans' Lower 9th Ward. Water from both levee breaks flooded most of the parish inside the levees to depths of up to 14 feet. Flood waters remained for approximately three weeks. A flood-related breach of a tank at the Murphy Oil Company refinery released about a million gallons of crude oil, further damaging approximately 1,800 homes and polluting area canals. Fishing communities in the eastern areas of the parish outside of the levee system were destroyed.

On September 24, 2005, an eight-foot storm surge from Hurricane Rita breached recently-repaired levees and, combined with between 6 and 12 inches of rain, again caused widespread flooding in the parish.

In all, 127 St. Bernard Parish citizens died, about 68,000 people were displaced, and 100 percent of parish homes (over 25,000 units) were either destroyed or

damaged sufficiently to make them uninhabitable. All parish businesses and government buildings and most utility systems were similarly damaged or destroyed. Damaged levees, decimated wetlands, and the still-open MRGO have left the parish vulnerable to future storms (St. Bernard Parish-Disaster Impact Needs and Assessment, 2008).

In addition, research of historical rainfall and highwater stages has shown that significant floods occurred in 1909, 1915, 1947, 1956, 1965, 1969, 1978, and, to a lesser extent, in April of 1980 and 1992. Severe flood in the study area also occurred in September 1965 when Hurricane Betsy crossed the Louisiana coastline.

2.4 Flood Protection Measures

The most densely populated areas of St. Bernard Parish are protected from flooding by levees, drainage canals, and storm water pumps. The levees consist of three systems. The federally constructed Mississippi River and Tributaries Levee protects St. Bernard Parish from flooding due to stages in the Mississippi River. Another federal levee, Lake Pontchartrain and Hurricane Protection Levee (HPL), affords protection from hurricane surges from Lake Borgne and the direction of the MRGO. The locally maintained Chalmette Back Levee affords additional protection from storm surges.

The federally maintained Mississippi River and Tributaries Levee, in conjunction with the Old River Control Structure, Morganza Spillway and Bonnet Carré Spillway, provide protection from all anticipated flows in the Mississippi River up to and including the 0.2-percent annual chance flood.

The flood control facilities experienced damage of varying degrees throughout southeastern Louisiana as a result of Hurricanes Katrina and Rita, and the USACE-MVN is on an aggressive path to repair and improve the flood control system. The USACE-MVN had fully authorized levels of protection and improvements to the system completed in 2010 (St. Bernard Parish –Disaster Impact and Needs Assessment, 2008).

In 2011, the USACE built the Hurricane and Storm Damage Risk Reduction System (HSDRRS). The protection system consists of levees, floodwalls, floodgates, outfall canals, locks, surge barriers, and pump stations. A perimeter levee system protects the area from coastal surge and Mississippi River flooding. Pump stations are located along the perimeter levee to discharge local runoff into the exterior lakes or the Mississippi River. Local pump stations perform the same function along interior levees and discharge to marshy areas designated to collected flood water from developed areas. Two major closure complexes, the West Closure Structure Complex and the Inner Harbor Navigation Canal Complex, keep the surge from entering the major canals and navigation channels within the New Orleans area. The HSDRRS is designed to protect the Greater New Orleans area from the 1-percent annual chance flood.

FEMA specifies that all levees must have a minimum of 3 foot freeboard against 100-year flooding to be considered a safe flood protection structure. The HSDRRS perimeter levees meet the FEMA freeboard requirement.

Levees exist in the study area that provide the community with some degree of protection against flooding. However, it has been ascertained that some of these levees may not protect the community from rare events such as the 100-year flood. The criteria used to evaluate protection against the 100-year flood are 1) adequate design, including freeboard, 2) structural stability, and 3) proper operation and maintenance. Levees that do not protect against the 100-year flood are not considered in the hydraulic analysis of the 100-year floodplain.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the parish, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this FIS. Flood events of a magnitude which are expected to be equaled or exceeded once on average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10-, 2-, 1-, and 0.2-percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1-percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the Parish at the time of completion of this FIS. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for the flooding sources studied in detail affecting the parish.

November 1, 1984 FIS Analysis

St. Bernard Parish has had previously printed FIS reports. The hydrologic analyses described in those reports have been compiled and are summarized below.

The federally maintained Mississippi River and Tributaries Levee, in conjunction with the Old River Control Structure, Morganza Spillway and Bonnet Carré Spillway, provide protection from all anticipated flows in the Mississippi River up to and including the 0.2-percent annual chance flow.

Previous rainfall depth, frequency and duration data were obtained from the Rainfall Frequency Atlas of the United States, for hypothetical storms of 10-, 2-, 1-, and 0.2-percent annual chance recurrence intervals (National Weather Service, 1961).

No rainfall runoff monitoring is performed in St. Bernard Parish; therefore, synthetic unit hydrographs and rainfall were developed from unit hydrographs and runoff using a computerized model (Ven Te Chow, 1964 and USACE, 1961).

Previous stillwater surge elevations were determined by the USACE "Type 5, Flood Insurance Study, Louisiana Gulf Coast" (Brater and King, 1976). These elevations were computed using hurricane parameters such as forward speed, directional approach to coast, ratios to maximum winds and central pressure to compute synthetic hurricane surge peaks for hurricanes with different frequencies of occurrence. In addition, analytical frequencies of experienced stages were made and compared with synthetic frequencies. An appropriate elevation reduction was made inland from the surge reference line according to the methodology prescribed.

The determination of maximum wave crest elevations associated with the 10- and 1-percent annual chance events was approached by the method recommended by the National Academy of Sciences (NAS) (USACE, 1977).

This Parishwide FIS Analysis

Storage areas were modeled as subbasins in HEC-HMS Version 3.5 (USACE, 2010), and the 10-, 2-, 1-, and 0.2-percent annual chance event discharges for these recurrence intervals were directly input as flow hydrographs at corresponding locations in the hydraulic models.

Frequency-based synthetic rainfall was used for each subbasin within a polder. In the 2008 preliminary analysis, the precipitation depths for 10-, 2-, 1-, and 0.2-percent annual chance storm events were estimated using information obtained from National Weather Service's (NWS) Technical Memorandum HYDRO-35 (NOAA, 1977), and South-eastern Region Climatic Center (SRCC) Technical Report 97-1 (Rainfall Frequency/Magnitude Atlas, Date 4)

The storage area boundaries and identification numbers are shown in Figure 1, "Storage Area Index Map, Lower 9th Ward and St. Bernard Polder (St. Bernard Parish)."

As with the 2008 preliminary models, no routing was used within the HEC-HMS model and the storage areas included within the HEC-HMS model were not connected to each other. Routing was accomplished through the Hydrologic Engineering Center-River Analysis System (HEC-RAS) model where connections between storage areas and canals were taken into consideration.

The hydrologic analyses for this project used rainfall runoff modeling using HEC-HMS to develop flow hydrographs which were used in unsteady HEC-RAS models. The final hydrologic output was a flow hydrograph as opposed to a single flow value. Therefore, rather than provide a number of tables with the flow hydrograph information at various locations, the user is referred to the digital HEC-HMS model output that contains all the flow hydrograph discharges.

The stillwater elevations have been determined for the 10-, 2-, 1-, and 0.2-percent annual chance floods for the flooding sources studied by detailed methods and are summarized in Table 2, "Summary of Stillwater Elevations."

The 0.2-percent annual chance flood elevations shown for storage areas listed in Table 2 represent the highest flood elevation based on the following: 1) interior drainage calculation of 0.2-percent annual chance precipitation only and interior pump station capacity; or 2) the flood elevations provided by the USACE which represent the 0.2-percent annual chance water surface elevation that could occur from hurricanes, as applied to the HSDRRS system with no armoring in place, including potential overtopping or breaching of the HSDRRS and Mississippi River levees.

TABLE 2 - SUMMARY OF STILLWATER ELEVATIONS

FLOODING SOURCE AND LOCATION	ELEVATION (feet NAVD 88) 10-PERCENT ANNUAL CHANCE	2-PERCENT ANNUAL CHANCE	1-PERCENT[1] ANNUAL CHANCE	0.2-PERCENT ANNUAL CHANCE
LOWER 9TH WARD AND ST. BERNARD POLDER (list of storage areas below)				
1	5.2	5.5	6	12.0
42	2.9	3.3	4	12.0
43	3.0	3.4	4	12.0
45	-0.9	-0.7	-1	12.0
46	0.3	0.6	1	12.0
51	-1.1	-0.9	-1	12.0
56	7.5	7.7	8	12.0
63	-2.3	-1.6	-1	12.0
64	-2.7	-1.6	-1	12.0
65	0.3	0.7	1	12.0
66	0.7	1.1	1	12.0
67	-1.7	-1.4	-1	12.0
68	-2.2	-1.6	-1	12.0
87	-4.8	-3.9	-3	12.0
88	1.2	1.5	2	12.0
89	-2.0	-1.5	-1	12.0
340	1.1	1.3	2	12.0
341	0.9	1.2	1	12.0
343	0.6	1.0	1	12.0
344	1.0	1.5	2	12.0
345	2.2	2.8	3	12.0
346	5.3	5.4	5	12.0
347	2.4	2.6	3	12.0
349	0.6	1.0	1	12.0
350	0.8	1.0	1	12.0
351	2.6	2.8	3	12.0
352	2.1	2.2	2	12.0
353	3.1	3.1	3	12.0

[1] Represents the rounded BFE shown on the FIRM.

TABLE 2 - SUMMARY OF STILLWATER ELEVATIONS

FLOODING SOURCE AND LOCATION	ELEVATION (feet NAVD 88) 10-PERCENT ANNUAL CHANCE	2-PERCENT ANNUAL CHANCE	1-PERCENT[1] ANNUAL CHANCE	0.2-PERCENT ANNUAL CHANCE
LOWER 9TH WARD AND ST. BERNARD POLDER (list of storage areas below)				
354	2.3	2.6	3	12.0
355	1.6	2.2	2	12.0
852	-2.4	-1.5	-1	12.0
853	1.8	2.0	2	12.0
854	0.4	0.7	1	12.0
855	3.0	3.4	4	12.0
856	-1.0	-0.6	0	12.0
857	1.1	1.4	1	12.0
SA 1	5.0	5.3	5	12.0
SA 2	2.1	2.7	3	12.0
SA 3	2.8	3.0	3	12.0
SA 4	2.4	2.7	3	12.0
SA 5	2.8	3.0	3	12.0
SA 6	1.2	1.5	2	12.0
SA 7	3.1	3.3	3	12.0
SA 8	0.8	1.0	1	12.0
SA 9	-0.4	-0.1	0	12.0
SA 10	-0.6	-0.5	0	12.0
SA 11	-0.7	-0.6	-1	12.0
SA 12	-1.7	-1.7	-2	12.0
SA 13	-0.5	-0.3	0	12.0
SA 14	0.3	0.4	0	12.0
SA 15	-0.2	-0.1	0	12.0
SA 16	2.2	2.4	2	12.0
SA 17	-1.0	-0.9	-1	12.0
SA 18	-1.6	-1.5	-1	12.0
SA 19	-2.2	-2.0	-2	12.0
SA 20	-1.5	-1.4	-1	12.0
SA 21	-0.6	-0.5	0	12.0
SA 22	-2.3	-2.1	-2	12.0
SA 23	-1.5	-1.4	-1	12.0
SA 24	-3.2	-3.1	-3	12.0
SA 25	-1.6	-1.5	-1	12.0
SA 26	-3.3	-3.1	-3	12.0
SA 27	2.9	3.3	3	12.0
SA 28	1.3	1.4	2	12.0
SA 29	-1.6	-1.4	-1	12.0
SA 30	-1.0	-0.9	-1	12.0
SA Industry	5.0	5.3	5	12.0

[1] Represents the rounded BFE shown on the FIRM.

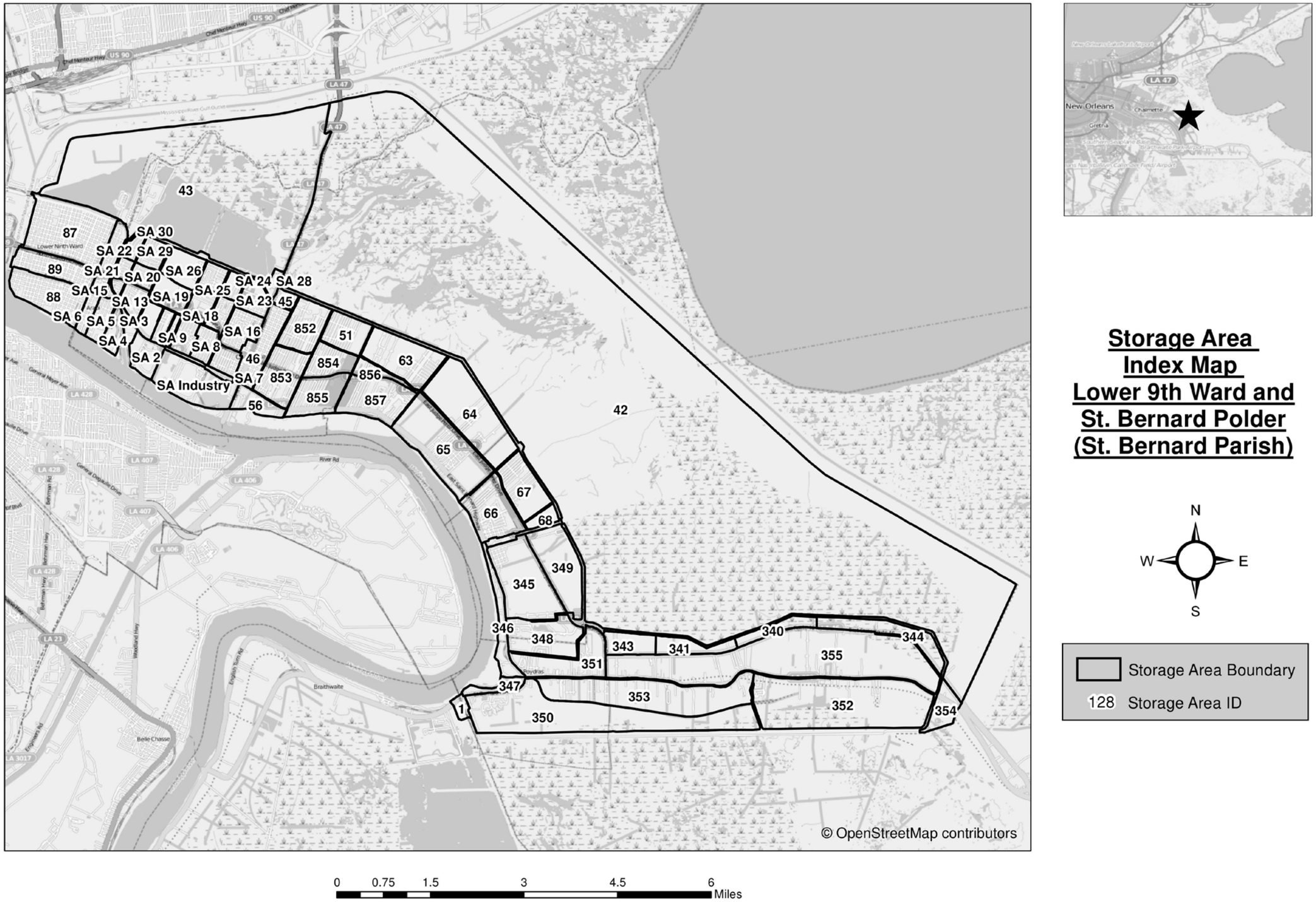

FIGURE 1 - STORAGE AREA INDEX MAP, LOWER 9TH WARD AND ST. BERNARD POLDER (ST. BERNARD PARISH)

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the source studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals. Users should be aware that flood elevations shown on the FIRM represent rounded whole-foot elevations and may not exactly reflect the elevations shown on the Flood Profiles or in the Floodway Data tables in the FIS report. For construction and/or floodplain management purposes, users are encouraged to use the flood elevation data presented in this FIS in conjunction with the data shown on the FIRM.

Cross sections were determined from topographic maps and field surveys. All bridges, dams, and culverts were field surveyed to obtain elevation data and structural geometry. All topographic mapping used to determine cross sections is referenced in Section 4.1.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles, where applicable (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross section locations are also shown on the FIRM (Exhibit 3).

The hydraulic analyses for this FIS were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

All qualifying bench marks within a given jurisdiction that are cataloged by the National Geodetic Survey (NGS) and entered into the National Spatial Reference System (NSRS) as First or Second Order Vertical and have a vertical stability classification of A, B, or C are shown and labeled on the FIRM with their 6-character NSRS Permanent Identifier.

Bench marks cataloged by the NGS and entered into the NSRS vary widely in vertical stability classification. NSRS vertical stability classifications are as follows:

- Stability A: Monuments of the most reliable nature, expected to hold position/elevation well (e.g., mounted in bedrock)
- Stability B: Monuments which generally hold their position/elevation well (e.g., concrete bridge abutment)
- Stability C: Monuments which may be affected by surface ground movements (e.g., concrete monument below frost line)
- Stability D: Mark of questionable or unknown vertical stability (e.g., concrete monument above frost line, or steel witness post)

In addition to NSRS bench marks, the FIRM may also show vertical control monuments established by a local jurisdiction; these monuments will be shown on

the FIRM with the appropriate designations. Local monuments will only be placed on the FIRM if the community has requested that they be included, and if the monuments meet the aforementioned NSRS inclusion criteria.

To obtain current elevation, description, and/or location information for bench marks shown on the FIRM for this jurisdiction, please contact the Information Services Branch of the NGS at (301) 713-3242, or visit their Web site at www.ngs.noaa.gov.

It is important to note that temporary vertical monuments are often established during the preparation of a flood hazard analysis for the purpose of establishing local vertical control. Although these monuments are not shown on the FIRM, they may be found in the Technical Support Data Notebook (TSDN) associated with this FIS and FIRM. Interested individuals may contact FEMA to access this data.

November 1, 1984 FIS Analysis

St. Bernard Parish (Unincorporated Areas) has had previously printed FIS reports. The hydraulic analyses described in those reports have been compiled and are summarized below.

Previous flood elevations were established by computing peak water storage volumes resulting from rainfall runoff and hurricane surge overtopping where appropriate. Storage volumes for rainfall runoff were computed by routing flood hydrographs through drainage structures and over roadways into the individual drainage units. Flood hydrographs were routed to outfall canal pumping stations and floodwaters were relieved by pumping. Pump stations in this historic study were operated at 75% of the capacity given, except for reaches 2 and 3 which were operated at 50%, since this capacity reflected historic operating conditions. Storage volumes from hurricane surge overtopping were obtained by computing cumulative volumes of weir flow over levees when stages exceed levee heights (Brater and King, 1976), and by computing cumulative volumes of wave overtopping over levees when stages are lower than levee heights (USACE, 1977). It should be noted that at the time of this analysis not all drainage areas were affected by hurricane surge overtopping and that hurricane surge overtopping did not occur during all flood events studied.

At the time of this analysis, federally built levees were considered to remain intact during the 1-percent annual chance storm event. The stability of non-federal levees were evaluated individually based upon observation of similar levees which have been overtopped and upon engineering judgment. Proper maintenance of levees is essential in maintaining the level of protection and the flood hazards shown on the FIRM. At the time of this analysis, as the levees consolidate and/or subside, the frequency and severity of surge overtopping could increase and create higher hazards in the areas.

This Parishwide FIS Analyses

Information on the methods used to determine peak discharge-frequency relationships for the streams restudied as part of this parishwide FIS is shown below.

On August 29, 2005, Hurricane Katrina made landfall, resulting in a compromise of the New Orleans Hurricane Protection System (HPS). As a result, the USACE-MVN formed IPET to determine the behavior and causes of damage to the HPS. The hydraulic analysis for this study is based on the IPET analyses.

This study area of the IPET analysis is drained by 9 pump stations, one in Orleans Parish operated by the Sewerage and Water Board (NOS&W) of New Orleans and the balance by the Lake Borgne Basin Levee District (LBBLD). All of the pump stations with the exception of St. Mary Pump Station 8 discharge into the Bayou Bienvenue and Bayou Dupre sump area between the MRGO HPL and the Forty Arpent Levee. The Bayou Bienvenue and Bayou Dupre sump area drains by gravity into Lake Borgne through two flood control gates. The St. Mary pump station discharges into the Lake Lery basin located south of the study area (USACE, March 26, 2007).

For streams, as well as ponding areas, water surface elevations for the 10-, 2-, 1-, and 0.2-percent annual chance floods were computed using HEC-RAS Versions 4.0 (USACE, 2008) and 4.1 (USACE, 2010) for the all polders in the parish. All hydraulic models were performed using unsteady-state condition simulation.

Stage-storage relationship curves were established from the 2012 USACE Light Detection and Ranging (LiDAR) (USACE, 2012). Storage volumes for rainfall runoff were computed by routing flood hydrographs through drainage structures and over roadways into the individual drainage units. Flood hydrographs were routed to outfall canals and drainage ditches. It should be noted that a pumping capacity of 90% was assumed at each pump station for this study. The pumps used for this analysis are listed in Table 3.

TABLE 3 – PUMP CAPACITY DATA

Pump Station	No. Pumps	Capacity (cfs)
#1 & #6	6	2,099
#2	4	740
#3	3	535
#4	3	1,146
#5	4	1,872
#5, EJ Gore	6	613
#7	3	953
#8	3	761
TOTAL	32	8,791

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations on the FIRM are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

Roughness coefficients were estimated based on field inspection of stream channels and floodplain areas. Table 4 shows the Manning's "n" ranges for the streams studied by detailed methods in this study:

TABLE 4 - SUMMARY OF ROUGHNESS COEFFICIENTS

Stream	Channel "n"	Overbank "n"
All Channels in Lower 9th Ward	0.015 – 0.05	0.04 – 0.05

3.3 Coastal Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of flood elevations for selected recurrence intervals. Users should be aware that flood elevations shown on the FIRM represent rounded whole-foot elevations and may not exactly reflect the elevations shown in the coastal data tables and flood profiles in the FIS report. For construction and/or floodplain management purposes, users are encouraged to use the flood elevation data present in this FIS in conjunction with the data shown on the FIRM.

3.3.1 Storm Surge Analysis and Modeling

For areas subject to tidal inundation, the 10-, 2-, 1-, and 0.2-percent annual chance stillwater elevations and delineations were taken directly from a detailed storm surge study documented in the TSDN for this new Louisiana coastal flood hazard study.

The Advanced Circulation model for Coastal Ocean Hydrodynamics (ADCIRC) developed by the USACE-MVN, was applied to predict the stillwater elevations or storm surge levels for coastal Louisiana. The ADCIRC model uses an unstructured grid and is a finite-element long wave model. It has the capability to simulate tidal circulation and storm surge propagation over large areas and is able to provide highly detailed resolution in the areas of interest including shorelines, open coasts and inland bays. It solves the three dimensional equations of motion, including tidal potential, Coriolis acceleration, and nonlinear terms of the governing equations. The model is formulated from the depth averaged shallow water equations for conservation of mass and momentum which result in the generalized wave continuity equation.

Nearshore waves are required to calculate wave runup and overtopping on structures, and the wave momentum (radiation stress) contribution to elevated water levels (wave setup). The numerical model Steady State Spectral WAVE (STWAVE) was used to generate and transform waves to the shore. STWAVE is a finite-difference model that calculates wave spectra on a rectangular grid. The model outputs zero-moment wave height, peak wave period (T_p), and mean wave

direction at all grid points and two-dimensional spectra at selected grid points. STWAVE includes an option to input spatially variable wind and surge field. The surge significantly alters the wave transformation and generation for the hurricane simulations in shallow areas flooded.

The STWAVE model was applied on several grids for the southern Louisiana area. The input for each grid includes the bathymetry (interpolated from the ADCIRC domain), surge fields (interpolated from ADCIRC surge fields), and wind (interpolated from the ADCIRC wind fields, which apply land effects to the wind fields input to the surge model). The wind applied in the STWAVE is spatially and temporally variable for all domains. The STWAVE model was run at 30-minute intervals.

An existing ADCIRC grid mesh developed by the USACE-MVN was refined along the shoreline of Louisiana and surrounding areas using bathymetric and topographic data from various sources. Bathymetric data consisted of ETOPO5 and Digital Nautical chart databases in the offshore regions. In the nearshore areas, bathymetric data came from regional bathymetric surveys conducted by the USACE-MVN. The topographic portion of the ADCIRC mesh was populated with topographic LiDAR from several sources. In addition, subgrid sized features such as roads and levees were captured in the grid and modeled as weirs. Additional details about the terrain data and how it was processed can be found in the TSDN.

The completed ADCIRC grid mesh forming the finite element model has over 2,200,000 grid nodes. The National Oceanic and Atmospheric Administration (NOAA) high definition vector shoreline was used to define the change between water and land elements. The grid includes other features, such as islands, roads, bridges, open water, bays, and rivers. Field reconnaissance detailed the significant drainage and road features, and documentation of coastal structures in the form of seawalls, bulkheads, and harbors. The National Land Cover Dataset was used to define Manning's n values for bottom roughness coefficients input at each node to the mesh. A directional surface wind roughness value was also applied. Further details about the ADCIRC mesh creation and grid development process can be found in the TSDN.

Predicted tidal cycles were used to calibrate the ADCIRC model and refine the grid. Tidal boundary conditions were obtained from a total of 40 NOAA tide gauges. Seven tidal constituents were used (K1, O1, Q1, M2, S2, N2, and K2). The simulated water-surface elevation time series was compared to measured tides from tide gauge stations for over a 30-day period. Model validation, which tests its ability to reproduce historical events, was performed against Hurricanes Katrina (2005), Rita (2005), and Andrew (1992). Simulated water levels for each event were compared to observed water levels from NOAA tidal gauges, as well as available high water marks. Further details about the model calibration and validation can be found in the TSDN.

Production runs were carried out with STWAVE and ADCIRC on a set of hypothetical storm tracks and storm parameters in order to obtain the maximum

water levels for input to the statistical analysis. The hypothetical (synthetic) population of storms was divided into two groups, one for hurricanes of Saffir-Simpson Hurricane Scale Category 3 and 4 strength or "greater storms" and another set for hurricanes of Category 2 strength or "lesser storms." A total of 304 individual storms with different tracks and various combinations of the storm parameters were chosen for the production runs of synthetic hurricane simulations. Each storm was run for at least 3 days of simulation and did not include tidal forcing. Wind and pressure fields obtained from the Planetary Boundary Layer model and wave radiation stress from the STWAVE model were input into the ADCIRC model for each production storm. All stillwater results for this study include the effects of wave setup. The maximum water-surface elevation was output at every wetted ADCIRC grid point in a specific storm. This resulted in more than 1,000,000 locations where statistical methods were applied to obtain return periods of the stillwater elevation. A Triangular Irregular Network (TIN) was created to represent the stillwater surface based on the density of the output points from the ADCIRC. Further details about the production run process can be found in the TSDN.

3.3.2 Statistical Analysis

The Joint Probability Method (JPM) was used to develop the stillwater frequency curves for the 10-, 2-, 1-, and 0.2-percent annual chance stillwater elevations. The JPM approach is a simulation methodology that relies on the development of statistical distributions of key hurricane input variables such as central pressure, radius to maximum wind speed, maximum wind speed, translation speed, track heading, etc., and sampling from these distributions to develop model hurricanes. The resulting simulation results in a family of modeled storms that preserve the relationships between the various input model components, but provides a means to model the effects and probabilities of storms that historically have not occurred. The JPM approach was modified for this coastal study based on updated statistical methods developed by FEMA and the USACE-MVN for Mississippi and Louisiana.

Due to the excessive number of simulations required for the traditional JPM method, the Joint Probability Method-Optimum Sampling (JPM-OS) was utilized to determine the stillwater elevations associated with tropical events. JPM-OS is a modification of the JPM method developed cooperatively by FEMA and the USACE-MVN for Mississippi and Louisiana coastal flood studies that were being performed simultaneously, and is intended to minimize the number of synthetic storms that are needed as input to the ADCIRC model. The methodology entails sampling from a distribution of model storm parameters (e.g., central pressure, radius to maximum wind speed, maximum wind speed, translation speed, and track heading) whose statistical properties are consistent with historical storms impacting the region, but whose detailed tracks differ. The methodology inherently assumes that the hurricane climatology over the past 60 to 65 years (back to 1940) is representative of the past and future hurricanes likely to occur along the Louisiana coast.

3.3.3 Stillwater Elevation

The results of the ADCIRC model, as described above, provided stillwater elevations, including wave setup effects that are statistically analyzed to produce probability curves. The JPM-OS is applied to obtain the return periods associated with tropical storm events. The approach involves assigning statistical weights to each of the simulated storms and generating the flood hazard curves using these statistical weights. The statistical weights are chosen so that the effective probability distributions associated with the selected greater and lesser storm populations reproduced the modeled statistical distributions derived from all historical storms.

Stillwater elevations for each Louisiana coastal parish, obtained using the ADCIRC and JPM-OS models, are provided for JPM and ADCIRC grid node locations for the 10-, 2-, 1-, and 0.2-percent annual chance return period stillwater elevations in the TSDN.

3.3.4 Wave Height Analysis

Areas of coastline subject to significant wave attack are referred to as coastal high hazard zones. The USACE-MVN has established the 3-foot breaking wave as the criterion for identifying the limit of coastal high hazard zones (USACE Coastal & Hydraulics Laboratory, 2006). The 3-foot wave has been established as the minimum size wave capable of causing major damage to conventional wood frame and brick veneer structures.

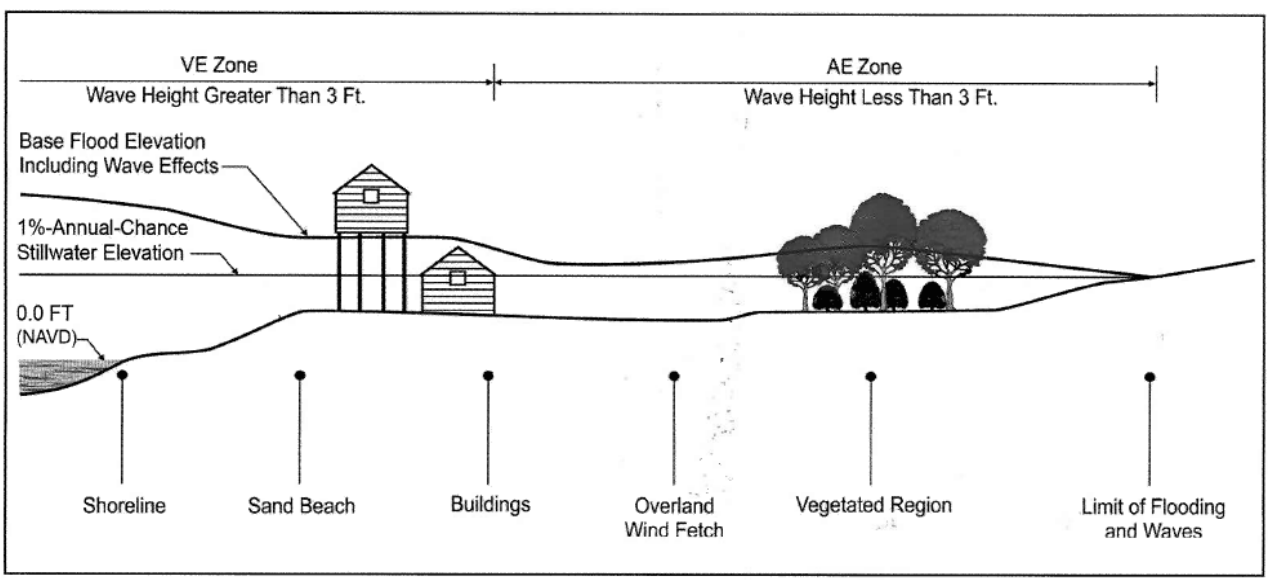

FIGURE 2 – TRANSECT SCHEMATIC

Figure 2 shows a profile for a typical transect and illustrates the effects of energy dissipation and regeneration of wave as it moves inland. This figure shows the wave crest elevations being decreased by obstructions, such as buildings, vegetation, and rising ground elevations, and being increased by open, unobstructed wind fetches. Figure 2 also illustrates the relationship between the local stillwater elevations, the ground profile, and the location of the VE/AE boundary. This inland limit of the coastal high hazard area is delineated to ensure that adequate insurance rates apply and appropriate construction standards are imposed, should local agencies permit building in this coastal high hazard area.

For St. Bernard Parish, there are two potential flood sources: The Gulf of Mexico and Lake Borgne. Transects 1 through 13 are located between Lake Borgne and the Mississippi River Levee. Transects 14 through 22 are located between Lake Borgne and the Gulf of Mexico. Transects 23 through 27 are oriented in a northwest-southeast direction from the Gulf of Mexico to the HPL to Lake Borgne. For areas subject to both flood sources, Wave Height Analyses for Flood Insurance Studies (WHAFIS) runs were performed from both directions, and the higher water level was mapped. The WHAFIS analyses for the portion of St. Bernard Parish protected by the hurricane protection levee system near the Chalmette area were limited to the 0.2-percent annual chance flood event since wave height analyses for the 1-percent annual chance flood event were performed as part of the IPET analyses. The initial wave heights representing 1- and 0.2-percent annual chance flood events were determined based on depth-limited breaker heights, which is 78% of the stillwater depth under the corresponding surge conditions. Wave periods were extracted from STWAVE modeling results.

The wave transects listed in Table 5 “Coastal Data Table” for this study were developed considering the physical and cultural characteristics of the land so that they would closely represent physical conditions in their locality. Transects were spaced dense enough to represent the hydraulic conditions and to capture hydraulic changes. In areas having more uniform characteristics, transects were spaced at relatively larger intervals. Transects are also located in areas where unique flooding existed and in areas where computed wave heights varied significantly between adjacent transects. Transects are shown on the respective FIRM panels for the parish.

The topographic information applied to transect profiles was based on ADCIRC grid bathymetry and LiDAR data collected by the State of Louisiana and FEMA between 2003 and 2005. The vertical datum for topographic/bathymetry data is the NAVD 88.

The Louisiana Gap Analysis Program (GAP) Project, developed by the USGS, served as the primary source for the spatial distribution of vegetative cover. Aerial imagery and field reconnaissance were performed to verify the Louisiana GAP Project data. Aerial photos and images downloaded from http://atlas.lsu.edu/ were applied to verify features such as buildings, levees, forested vegetation, and marsh grass for input to the wave height models (FEMA, 1988).

No storm-induced erosion analysis was performed. Primary frontal dune erosion was not applicable for this parish.

Wave height calculation used in this study follows the methodology described in Appendix D of the October 2006 FEMA Guidelines and Specifications for Flood Hazard Mapping Partners. WHAFIS 4.0 was applied to calculate overland wave height propagation and establish base flood elevations. In addition to the 1-percent annual chance event, the 0.2-percent annual chance event was also modeled with WHAFIS 4.0. The 0.2-percent annual chance wave height results are not included on the FIRMs but are provided in wave transect profiles in the FIS.

Stillwater elevations are applied to each ground station along each transect and input to WHAFIS. The stillwater elevations were obtained from the ADCIRC storm surge study, using the stillwater TIN generated by the USACE-MVN. Wave setup was not calculated separately because wave setup was included in the base stillwater elevations from the storm surge analysis. Levees and embankment structures not meeting the freeboard requirements of Title 44 Code of Federal Regulations, 65.10 were removed in the WHAFIS wave height analyses. The only exception is the St. Bernard HPL system near the Chalmette area. This levee system was assumed to remain intact under the 1-percent annual chance event. For the remaining levees, if there is high ground in front of those levees and the surge did not reach those levees, then no wave runup analysis is performed. Otherwise, the van der Meer Method described in the 2003 version of the Coastal Engineering Manual (CEM) was used in calculating wave runup over sloped levees. Wave characteristics were obtained from the WHAFIS wave height analyses. Stillwater elevations were extracted from the USACE-MVN's storm surge analyses with the ADCIRC model, which included the wave setup. The wave setup was deducted from the surge elevations to avoid double counting in the wave runup analyses since the wave runup analysis formulas include the wave runup.

The FIRM panel shows a Base Flood Elevation (BFE) along the levee that includes wave runup.

TABLE 5 - COASTAL DATA TABLE

Community Name	Transect	Description	Latitude at Start of Transect	Longitude WHAFIS (NAD 83)	Starting Stillwater Elevations (FT. NAVD 88) Range of Stillwater Elevations (FT. NAVD88)				Zone Designation and BFE (FT. NAVD 88)
					10% Annual	2% Annual	1% Annual	0.2% Annual	
Flood from Lake Borgne									
St. Bernard	1	Begins at in Lake Borgne and ends at HSDRRS levee Parallels MRGO in Bayou Ville area traversing east to west	30.00453	89.85975	9.4 Range Not Available	13.8 Range Not Available	16.3 10.6-17.5	19.3 19.3-20.4	VE 21-24
St. Bernard	2	Located to the south of Transect 1 Traversing east to west.	29.98857	89.85400	9.3	13.6	16 13.4-17.1	19.0 19.0-20.7	VE 19-24
St. Bernard	3	Located to the south of Transect 2 Traversing east to west.	29.96642	89.84850	9.1	13.4	15.7 13.1-16.4	18.8 18.8-19.6	VE 19-22
St. Bernard	4	Located to the south of Transect 3 Traversing east to west.	29.95424	89.84454	9	13.3	15.6 15.6-16.0	17.1 17.1-18.0	VE 19-22
St. Bernard	5	Located to the south of Transect 4 traversing east to west	29.93534	89.82545	8.8	12.9	15 14.4-15.2	18.7 18.7-19.1	VE 18-22
St. Bernard	6	Located to the south of Transect 5 traversing east to west	29.93496	89.78442	8.5	12.1	14.0 14.0-15.2	18.1 18.1-20.3	AE 16 VE 17-19
St. Bernard	7	Located to the south of Transect 6 traversing northeast to southwest	29.94229	89.75897	8.3	11.6	13.5 13.2-18.0	16.6 16.6-22.5	AE 16 VE 17-19
St. Bernard	8	Located to the south of Transect 7 traversing northeast to southwest	29.95372	89.72704	8.0	11.3	13.1 13.1-17.1	16.4 16.4-21.2	AE 16-19 VE 17-20
St. Bernard	9	Located to the southwest of Transect 8 traversing northeast to southwest	29.90198	89.74439	8.1	11.5	13.5 13.5-17.1	16.7 16.7-20.5	AE 16-19 VE 16-20
St. Bernard	10	Located to the southwest of Transect 9 traversing northeast to southwest	29.89634	89.73581	8.0	11.3	13.4 13.4-17.1	16.5 16.5-20.7	AE 17-18 VE 16-20

TABLE 5 - COASTAL DATA TABLE (continued)

Community Name	Transect	Description	Latitude at Start of Transect	Longitude WHAFIS (NAD 83)	Starting Stillwater Elevations (FT. NAVD 88) Range of Stillwater Elevations (FT. NAVD88)				Zone Designation and BFE (FT. NAVD 88)
					10% Annual	2% Annual	1% Annual	0.2% Annual	
Flood from Lake Borgne									
St. Bernard	11	Located to the southwest of Transect 10 traversing northeast to southwest	29.89162	89.72653	7.9	11.2	13.2 10.8-16.4	16.4 16.4-20.1	AE 17-18 VE 16-19
St. Bernard	12	Located to the southwest of Transect 11 traversing northeast to southwest	29.88551	89.71795	7.9	11.2	13.1 6.5-16.0	16.3 16.3-19.5	AE 17 VE 16-19
St. Bernard	13	Located to the west of Transect 12 traversing northeast to southwest	29.87099	89.69842	7.8	11.1	12.9 10.8-16.9	16.2 16.2-20.0	AE 17 VE 16-19
St. Bernard	14A	Located to the southwest of Transect 13 traversing north to south	29.86842	89.67951	7.7	11.0	12.8 12.8-15.8	16.0 16.2-19.0	AE 17 VE 16-19
St. Bernard	15A	Located to the west of Transect 14A traversing north to south	29.86429	89.66679	7.6	11.0	12.7 12.7-15.1	15.9 15.9-18.6	AE 17 VE 16-22
St. Bernard	16A	Located to the west of Transect 15A traversing north to south	29.86220	89.65553	7.6	10.9	12.7 12.7-15.0	15.9 15.9-18.6	AE 17 VE 16-23
St. Bernard	17A	Located to the west of Transect 16A traversing north to south	29.86009	89.62591	7.6	11.0	12.7 12.8-15.0	15.9 15.9-18.6	VE 17-22
St. Bernard	18A	Located to the northwest of Transect 17A traversing north to south	29.87376	89.59119	7.6	11.0	12.8 12.8-15.6	15.9 15.9-17.8	AE 16-18 VE 17-19
St. Bernard	19A	Located to the northwest of Transect 18A traversing northwest to southeast	29.91844	89.58792	7.7	10.9	12.7 12.7-15.2	15.8 15.8-16.6	AE 19 VE 17-20
St. Bernard	20A	Located to the north of Transect 19A traversing west to east	29.95923	89.57307	7.7	11.8	13.7 13.7-14.8	16.0 15.6-16.0	AE 19 VE 17-19

TABLE 5 - COASTAL DATA TABLE (continued)

Community Name	Transect	Description	Latitude at Start of Transect	Longitude WHAFIS (NAD 83)	Starting Stillwater Elevations (FT. NAVD 88) Range of Stillwater Elevations (FT. NAVD88)				Zone Designation and BFE (FT. NAVD 88)
					10% Annual	2% Annual	1% Annual	0.2% Annual	
Flood from Lake Borgne									
St. Bernard	21A	Located to the north of Transect 20A traversing west to east	29.99093	89.57150	7.8	12.0	14.4 14.4-14.9	16.1 15.6-16.1	VE 17-19
St. Bernard	22A	Located to the north of Transect 21A traversing west to east	30.03062	89.49122	7.7	13.0	15.1 15.0-15.2	16.3 16.1-16.3	VE 18-19
Flood from Gulf of Mexico									
St. Bernard	14B	Starts at Gulf of Mexico shoreline near Garden Island Bay and ends at Lake Borgne traversing from south to north	29.61452	89.70039	9.7	13.5	15.7 12.8-15.8	18.9 16.0-18.9	AE 17 VE 16-19
St. Bernard	15B	Located to the west of Transect 14B traversing from south to north	29.67219	89.60621	9.2	12.5	14.7 12.7-15.1	18.0 15.9-18.6	AE 17 VE 16-22
St. Bernard	16B	Located to the west of Transect 15B traversing from south to north	29.65238	89.53002	8.6	11.9	14.2 12.7-15.0	17.4 15.9-18.6	AE 17 VE 16-23
St. Bernard	17B	Located to the west of Transect 16B traversing from southeast to northwest	29.68060	89.43114	8.2	12.1	14.4 12.7-15.0	17.6 15.9-18.6	VE 17-22
St. Bernard	18B	Located to the northwest of Transect 17B traversing from southeast to northwest	29.78151	89.33213	7.7	12.3	14.6 12.7-15.6	16.4 15.7-17.8	AE 16-18 VE 17-19
St. Bernard	19B	Located to the north of Transect 18B traversing from east to west	29.85916	89.35573	8	13.0	15.1 12.7-15.2	16.5 15.8-16.6	AE 19 VE 17-20
St. Bernard	20B	Located to the north of Transect 19B traversing from east to west	29.93689	89.37991	7.5	12.7	14.7 13.6-14.8	15.6 15.6-16.0	AE 16 VE 17-19
St. Bernard	21B	Located to the north of Transect 20B traversing from east to west	29.98915	89.44066	7.6	12.8	14.8 13.9-14.9	15.7 15.7-16.2	VE 17-19

TABLE 5 - COASTAL DATA TABLE (continued)

Community Name	Transect	Description	Latitude at Start of Transect	Longitude WHAFIS (NAD 83)	Starting Stillwater Elevations (FT. NAVD 88) Range of Stillwater Elevations (FT. NAVD88)				Zone Designation and BFE (FT. NAVD 88)
					10% Annual	2% Annual	1% Annual	0.2% Annual	
Flood from Gulf of Mexico									
St. Bernard	22B	Located to the north of Transect 21B Traversing from east to west	30.04530	89.38321	7.6	12.9	15.0 15.0-15.2	16.1 16.1-16.4	VE 18-19
St. Bernard	23	Starts at Gulf of Mexico shoreline near Raccoon Island parallels the Mississippi River and parish border between Plaquemines and St. Bernard Parishes traversing from southeast to northwest.	29.73892	89.65362	8.7	12.0	15.1 8.4-17.2	18.6 18.3-20.5	AE 17-19 VE 18-22
St. Bernard	24	Located to the northeast of Transect 23 traversing from southeast to northwest	29.75000	89.64461	9.5	13.0	15.2 13.8-16.8	18.7 18.3-20.5	AE 17-18 VE 18-22
St. Bernard	25	Located to the northeast of Transect 24 traversing from southeast to northwest	29.75029	89.62476	9.5	13.0	15.1 15.0-16.4	18.6 17.8-18.8	AE 17 VE 18-22
St. Bernard	26	Located to the northeast of Transect 25 traversing from southeast to northwest	29.74777	89.59882	9.4	12.9	15 14.5-15.4	18.6 17.3-18.6	AE 17 VE 18-22
St. Bernard	27	Located to the northeast of Transect 26 traversing from southeast to northwest	29.74739	89.55014	9.2	12.8	14.7 13.1-14.9	18.4 16.3-18.6	AE 16-17 VE 16-20

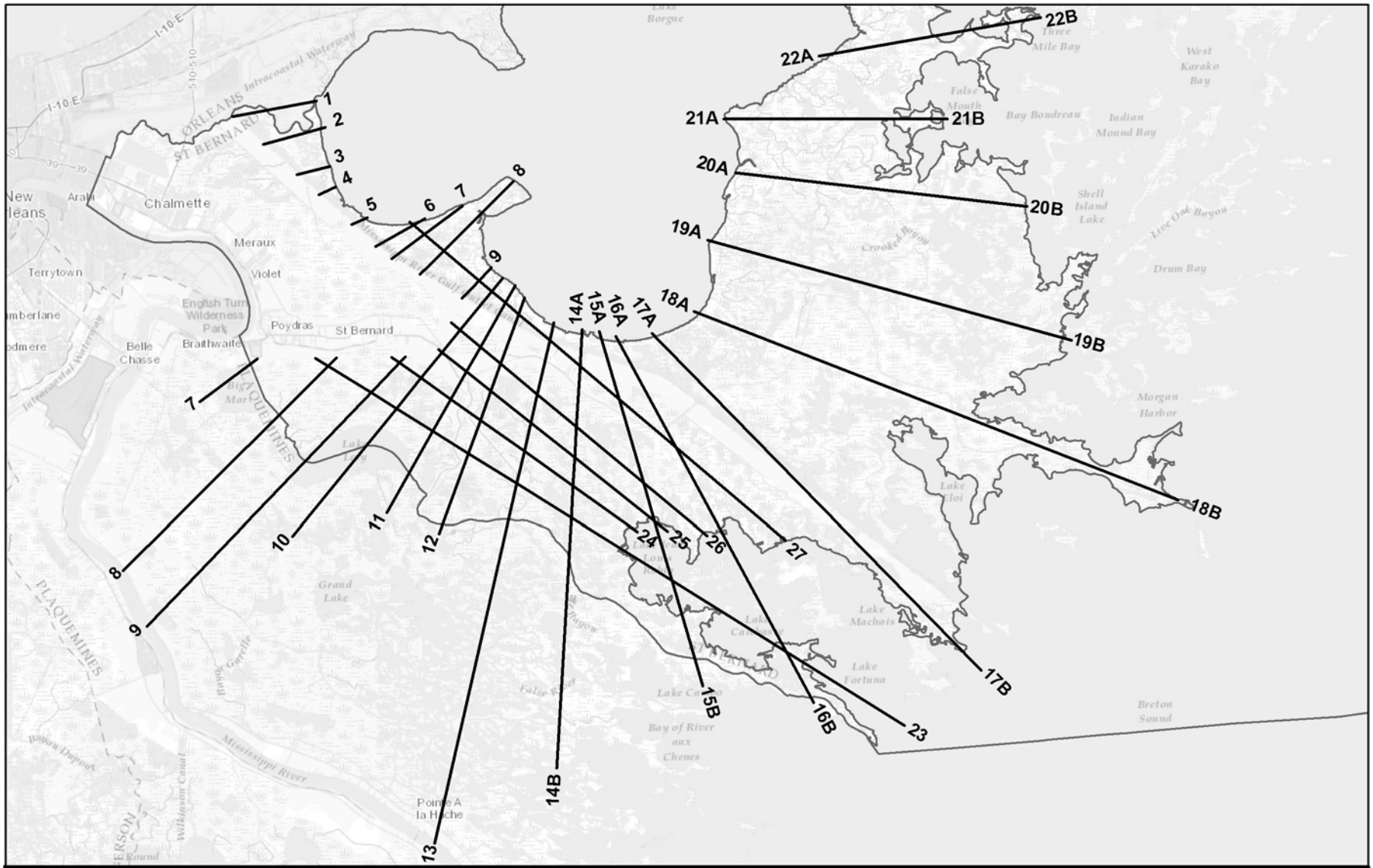

Figure 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. BERNARD PARISH, LOUISIANA

Approximate Scale

0 20,000 40,000 80,000 Feet

TRANSECT LOCATION MAP

3.4 Vertical Datum

All FISs and FIRMs are referenced to a specific vertical datum. The vertical datum provides a starting point against which flood, ground, and structure elevations can be referenced and compared. Until recently, the standard vertical datum in use for newly created or revised FISs and FIRMs was the National Geodetic Vertical Datum of 1929 (NGVD 29). With the finalization of the NAVD 88, many FIS reports and FIRMs are being prepared using NAVD 88 as the referenced vertical datum.

All flood elevations shown in this FIS report and on the FIRM are referenced to the NAVD 88. Structure and ground elevations in the community must, therefore, be referenced to NAVD 88. It is important to note that adjacent communities may be referenced to NGVD 29. This may result in differences in base flood elevations across the corporate limits between communities.

Prior versions of this FIS report and FIRM were referenced to NGVD 29. When a datum conversion is effected for FIR report and FIRM, the Flood Profiles, BFEs, and Elevation Reference Marks (ERMs) reflect the new datum values. To compare structure and ground elevations to 1-percent annual chance elevations shown in the FIS and FIRM, the subject structure and ground elevations must be referenced to the new datum values.

Some of the data used in this revision were taken from the prior effective FIS reports and FIRMs and adjusted to NAVD 88. Ground, structure, and flood elevations may be compared and/or referenced to NGVD 29 by applying a standard conversion factor. The datum conversion factor to NGVD 29 from NAVD 88 in St. Bernard Parish is -0.03 foot.

The BFEs on the FIRM represent whole-foot values. For example, a BFE of 102.4 ft will appear as 102 ft on the FIRM and 102.6 ft will appear as 103 ft. Therefore, users that wish to convert the elevations in this FIS to NGVD 29 should apply the stated conversion factor to elevations shown on the Flood Profiles and supporting data tables in the FIS report, which are shown at a minimum to the nearest 0.1 foot.

For additional information regarding conversion between the NGVD 29 and NAVD 88, visit the NGS website at www.ngs.noaa.gov, or contact the NGS at the following address:

NGS Information Services
NOAA, N/NGS12
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

3.5 Land Subsidence

The prevalence of land subsidence in the study area complicates the determination of the expected depth of flooding at a property. This information should always be obtained by direct comparison of the current property elevation with the official base flood elevation at the property as shown on the FIRM.

Local officials should be aware of the subsidence problem and should require the use of the most up-to-date and accurate property elevation data in compensating for land subsidence; however, base flood elevations should not be adjusted, but rather obtained directly from the FIRM.

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound floodplain management programs. To assist in this endeavor, each FIS provides 1-percent annual chance floodplain data, which may include a combination of the following: 10-, 2-, 1-, and 0.2-percent annual chance flood elevations; delineations of the 1- and 0.2-percent annual chance floodplains; and 1-percent annual chance floodway. This information is presented on the FIRM and in many components of the FIS, including Flood Profiles, Floodway Data tables, and Summary of Stillwater Elevation tables. Users should reference the data presented in the FIS as well as additional information that may be available at the local community map repository before making flood elevation and/or floodplain boundary determinations.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1-percent annual chance flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent annual chance flood is employed to indicate additional areas of flood risk in the parish. For the streams studied in detail, the 1- and 0.2-percent annual chance floodplain boundaries have been delineated using the flood elevations determined at each cross section.

For the 2008 preliminary parishwide FIS the 1-percent annual chance flood boundaries for detailed study streams outside the HSDRRS were delineated. These boundaries were interpreted between cross sections using topographic maps at a scale of 1:6000 with a contour interval of 2 feet (Louisiana Statewide Atlas, 2008).

For this revised preliminary parishwide FIS the 1- and 0.2-percent annual chance floodplain boundaries for areas inside the HSDRRS were delineated. These boundaries were delineated by detailed methods using the LiDAR data obtained from the USACE (USACE, 2012). This LiDAR data was used to create a Digital Elevation Model (DEM) and Digital Terrain Model (DTM)/ESRI Terrain.

The 1- and 0.2-percent annual chance floodplain boundaries are shown on the FIRM (Exhibit 3). On this map, the 1-percent annual chance floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones AE, V and VE), and the 0.2-percent annual chance floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 1- and 0.2-percent

annual chance floodplain boundaries are close together, only the 1-percent annual chance floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

For the streams studied by approximate methods, only the 1-percent annual chance floodplain boundary is shown on the FIRM (Exhibit 3).

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the NFIP, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 1-percent annual chance floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the 1-percent annual chance flood can be carried without substantial increases in flood heights. Minimum federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this FIS are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

The area between the floodway and 1-percent annual chance floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water-surface elevation of the 1-percent annual chance flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 4.

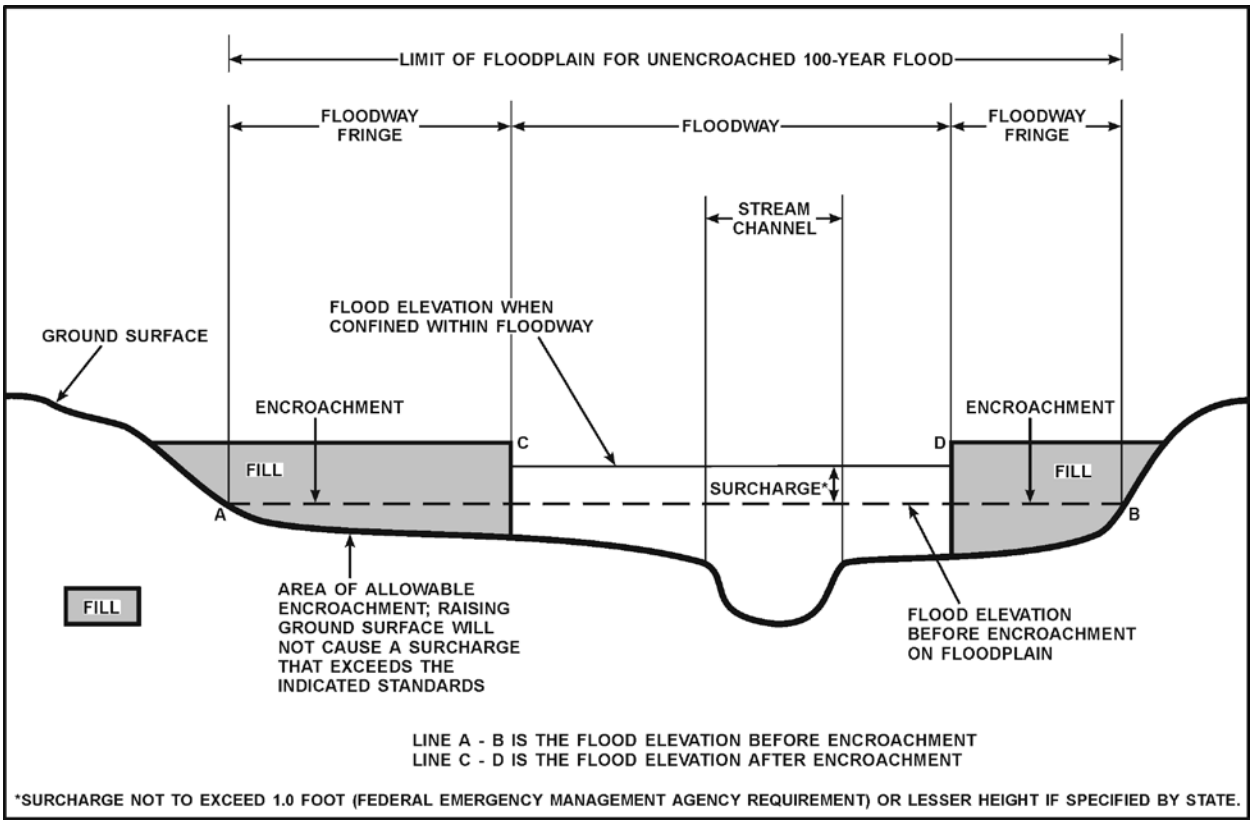

FIGURE 4 - FLOODWAY SCHEMATIC

No floodways were computed for the St. Bernard Parish parishwide study because all the studied channels are defined by the berms between the storage areas.

5.0 INSURANCE APPLICATIONS

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. The zones are as follows:

Zone A

Zone A is the flood insurance rate zone that corresponds to the 1-percent annual chance floodplains that are determined in the FIS by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no base flood elevations or depths are shown within this zone.

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 1-percent annual chance floodplains that are determined in the FIS by detailed methods. In most instances, whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AH

Zone AH is the flood insurance rate zone that corresponds to the areas of 1-percent annual chance shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AO

Zone AO is the flood insurance rate zone that corresponds to the areas of 1-percent annual chance shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-foot depths derived from the detailed hydraulic analyses are shown within this zone.

Zone AR

Area of special flood hazard formerly protected from the 1-percent annual chance flood event by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1-percent annual chance or greater flood event.

Zone A99

Zone A99 is the flood insurance rate zone that corresponds to areas of the 1-percent annual chance floodplain that will be protected by a Federal flood protection system where construction has reached specified statutory milestones. No base flood elevations or depths are shown within this zone.

Zone V

Zone V is the flood insurance rate zone that corresponds to the 1-percent annual chance coastal floodplains that have additional hazards associated with storm waves. Because approximate hydraulic analyses are performed for such areas, no base flood elevations are shown within this zone.

Zone VE

Zone VE is the flood insurance rate zone that corresponds to the 1-percent annual chance coastal floodplains that have additional hazards associated with storm waves. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 0.2-percent annual chance floodplain, areas within the 0.2-percent annual chance floodplain, and to areas of 1-percent annual chance flooding where average depths are less than 1 foot, areas of 1-percent annual chance flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 1-

percent annual chance flood by levees. No base flood elevations or depths are shown within this zone.

Zone D

Zone D is the flood insurance rate zone that corresponds to unstudied areas where flood hazards are undetermined, but possible.

6.0 FLOOD INSURANCE RATE MAP

The FIRM is designed for flood insurance and floodplain management applications.

For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0 and, in the 1-percent annual chance floodplains that were studied by detailed methods, shows selected whole-foot base flood elevations or average depths. Insurance agents use the zones and base flood elevations in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols, the 1- and 0.2-percent annual chance floodplains. Floodways and the locations of selected cross sections used in the hydraulic analyses and floodway computations are shown where applicable.

The current FIRM presents flooding information for the entire geographic area of St. Bernard Parish. Previously, separate Flood Hazard Boundary Maps and/or FIRMs were prepared for each identified flood-prone incorporated community and the unincorporated areas of the parish. This parishwide FIRM also includes flood hazard information that was presented separately on FBFMs, where applicable. Historical data relating to the maps prepared for each community, prior to this parishwide FIS, are presented in Table 6, "Community Map History."

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISION DATE(S)	FLOOD INSURANCE RATE MAP EFFECTIVE DATE	FLOOD INSURANCE RATE MAP REVISION DATE(S)
St. Bernard Parish	March 13, 1970	None	August 31, 1973	July 1, 1974 February 6, 1975 May 1, 1985 March 4, 1987

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. BERNARD PARISH, LA

COMMUNITY MAP HISTORY

7.0 OTHER STUDIES

Flood Insurance Studies are on-going for the adjacent Orleans and Plaquemines Parishes. The results of this study are in complete agreement with those studies.

Information pertaining to revised and unrevised flood hazards for each jurisdiction within St. Bernard Parish has been compiled into this FIS. Therefore, this FIS supersedes all previously printed FIS Reports, FHBMs, FBFMs, and FIRMs for all jurisdictions within St. Bernard Parish (FEMA, November 1984.).

8.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting FEMA Region VI, Federal Insurance and Mitigation Division, 800 North Loop 288, Denton, Texas 76209.

9.0 BIBLIOGRAPHY AND REFERENCES

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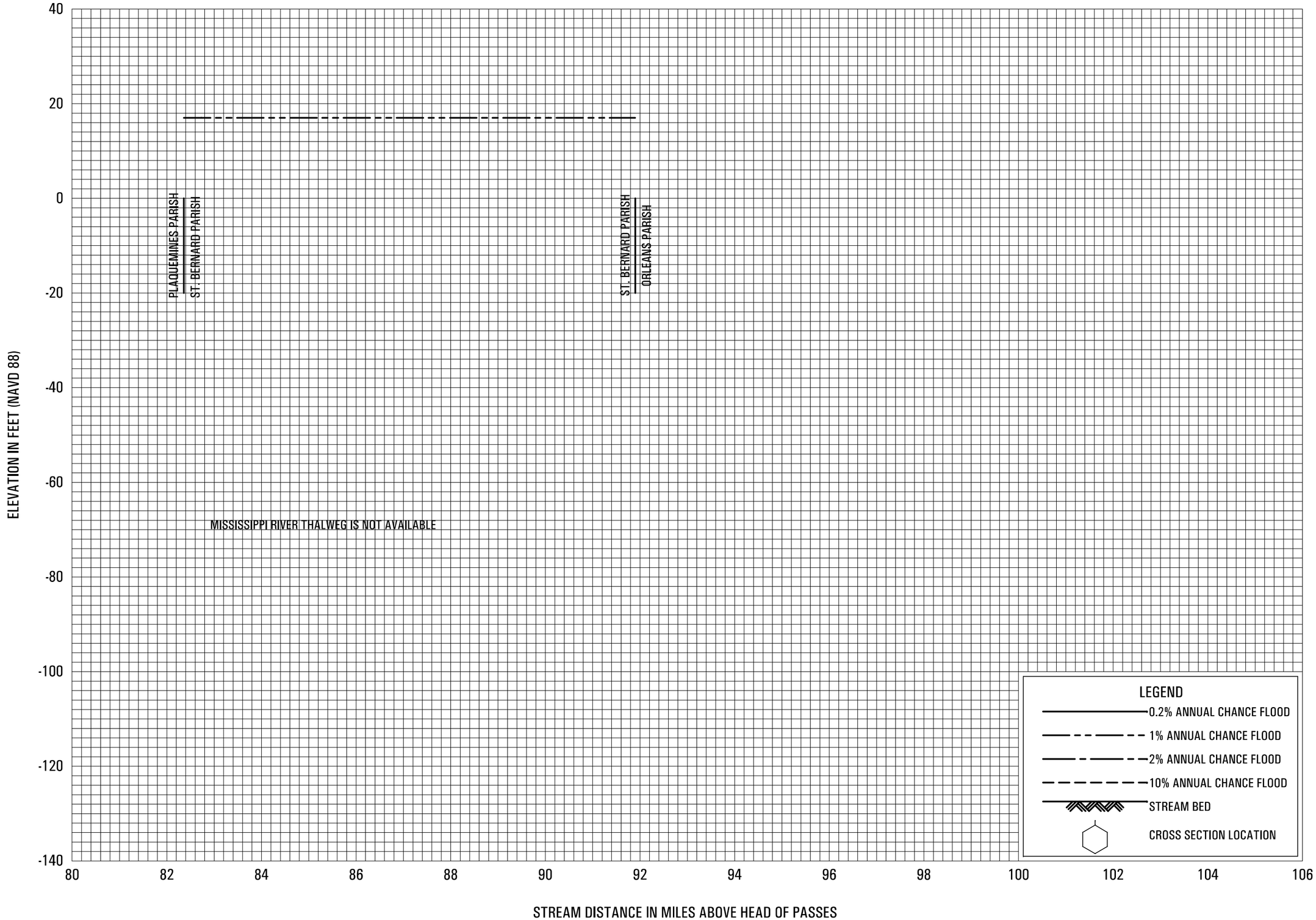


FLOOD PROFILES

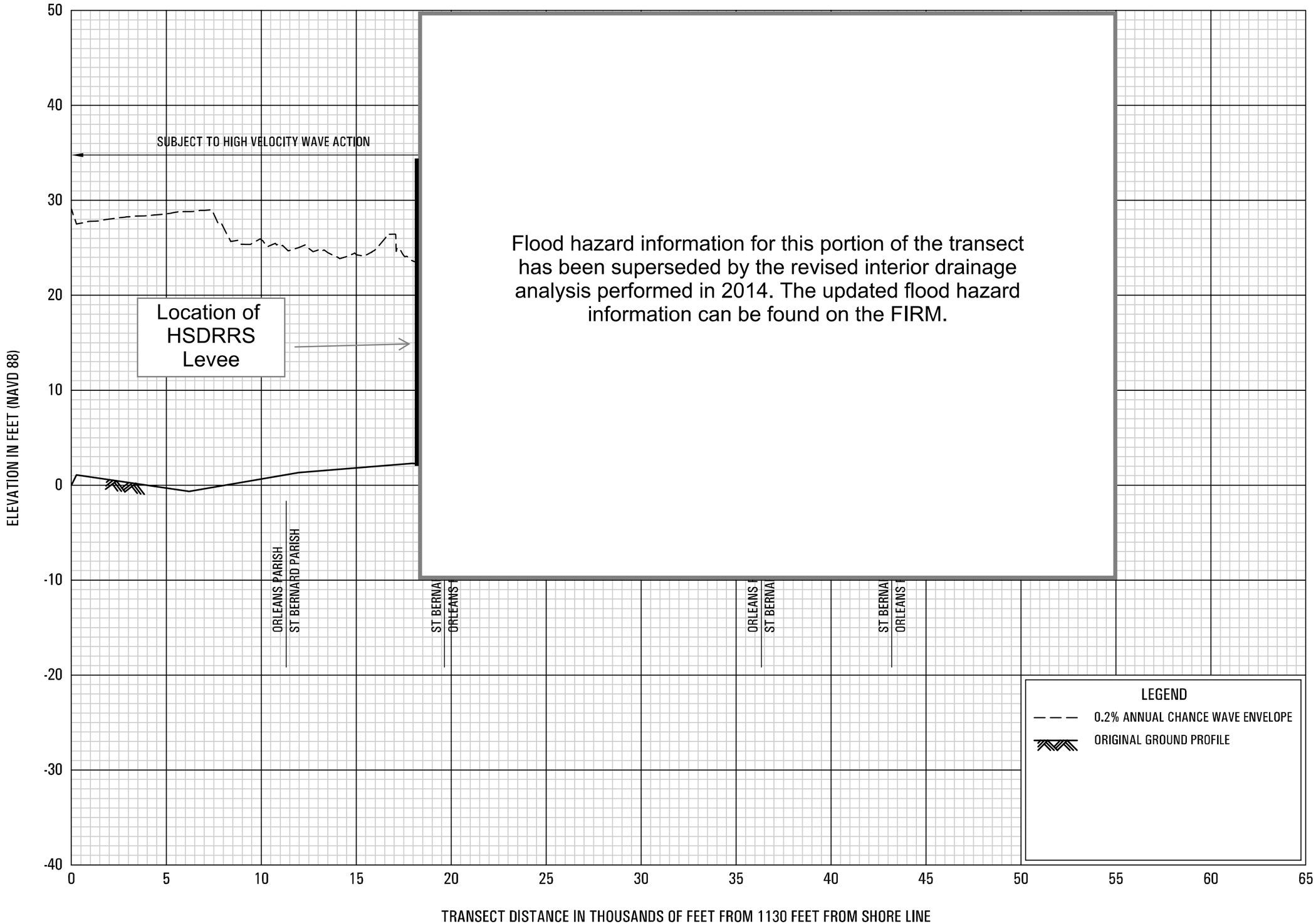
MISSISSIPPI RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. BERNARD PARISH, LA

AND INCORPORATED AREAS

01P



0.2% ANNUAL CHANCE WAVE ENVELOPE

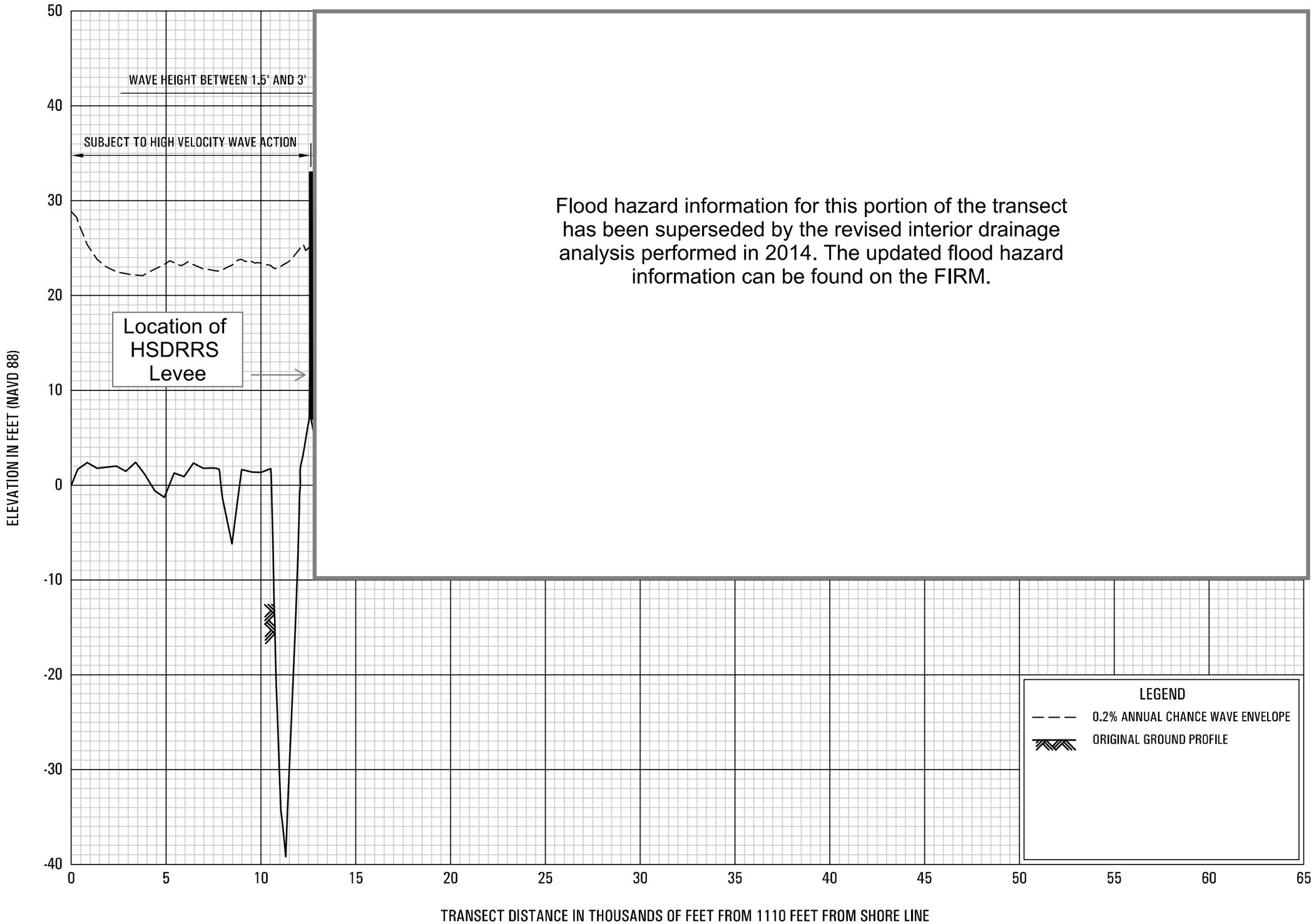
TRANSECT 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. BERNARD PARISH, LA

(ALL JURISDICTIONS)

01P



0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. BERNARD PARISH, LA

(ALL JURISDICTIONS)

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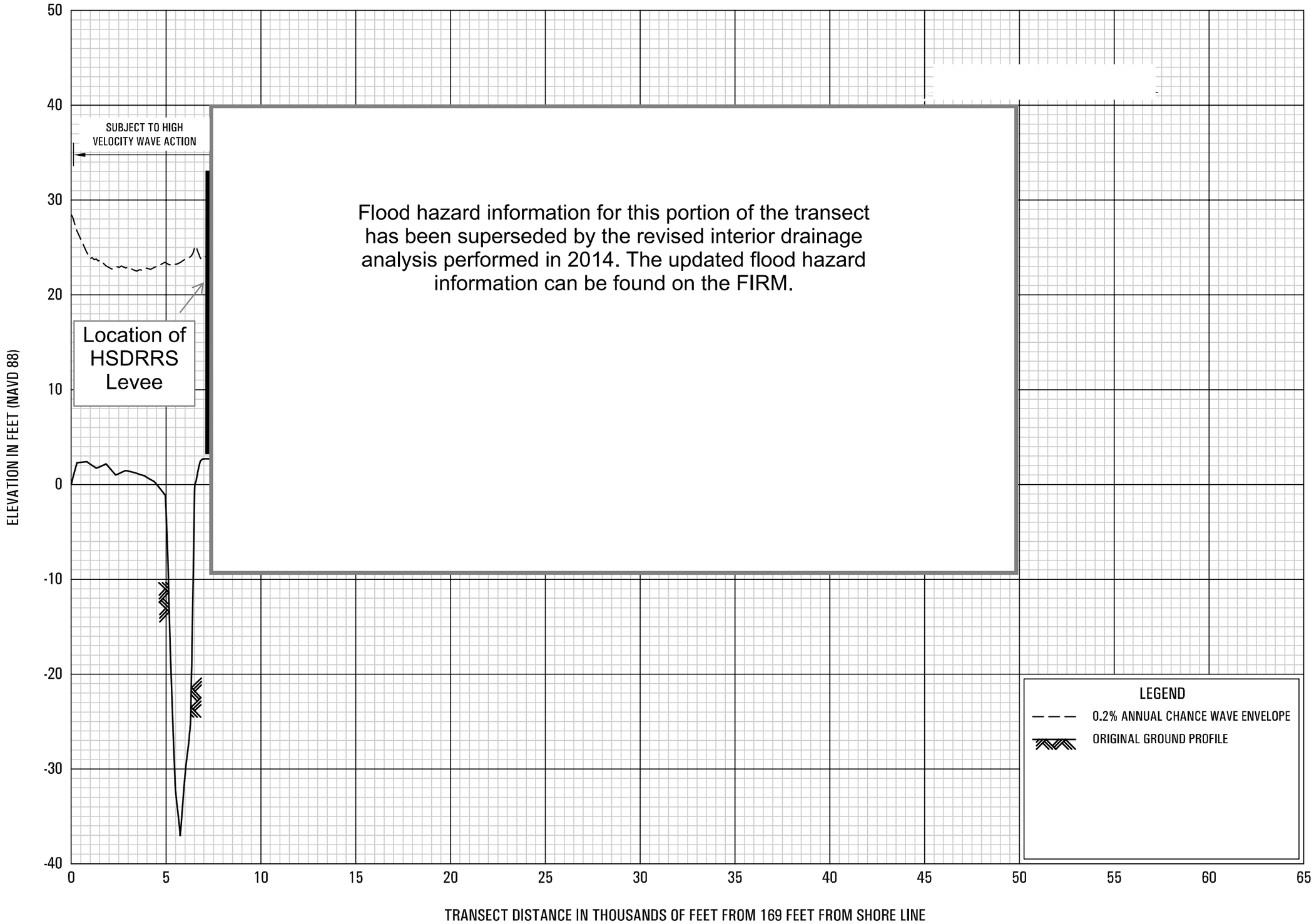

0.2% ANNUAL CHANCE WAVE ENVELOPE

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FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. BERNARD PARISH, LA

(ALL JURISDICTIONS)

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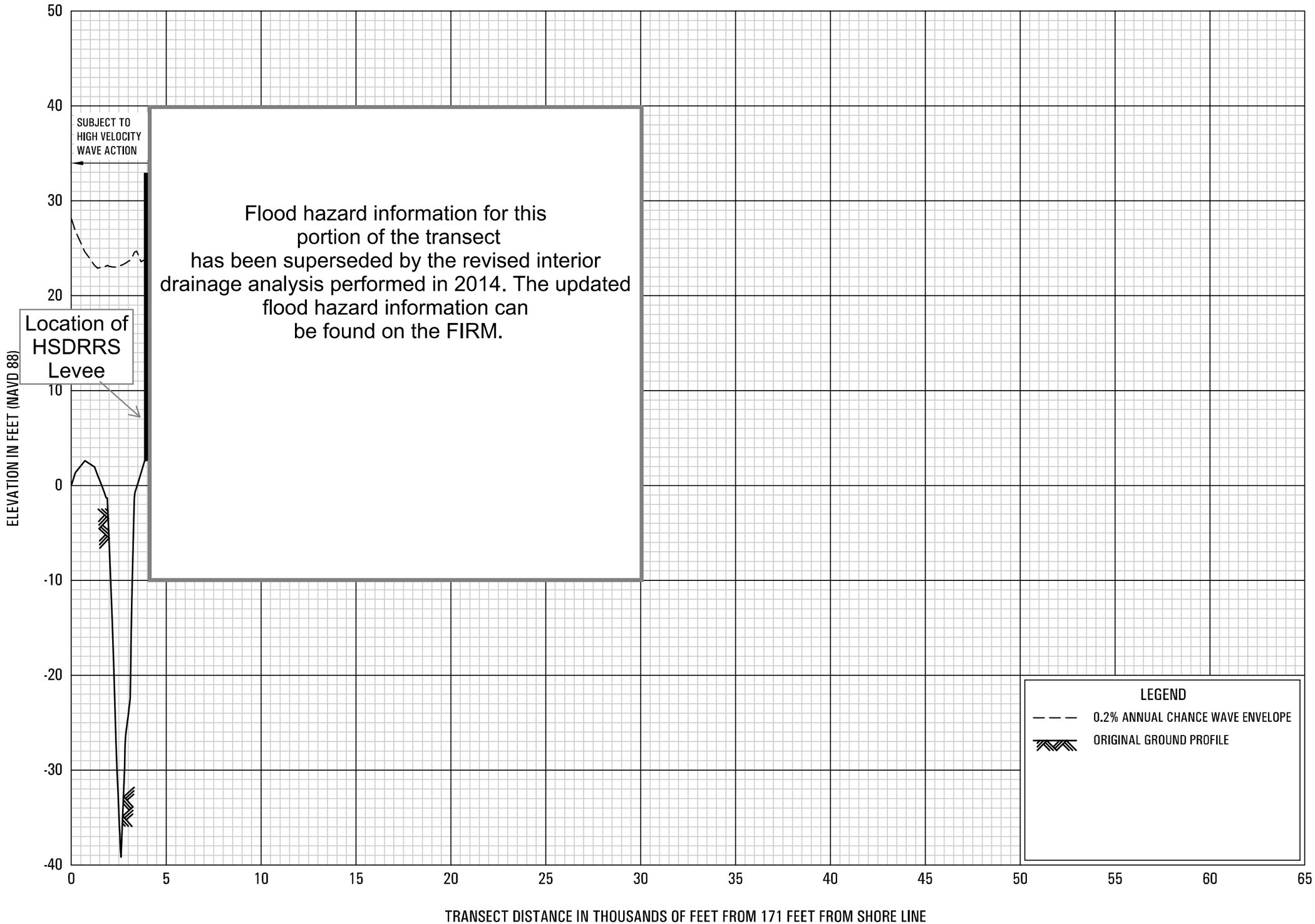


0.2% ANNUAL CHANCE WAVE ENVELOPE

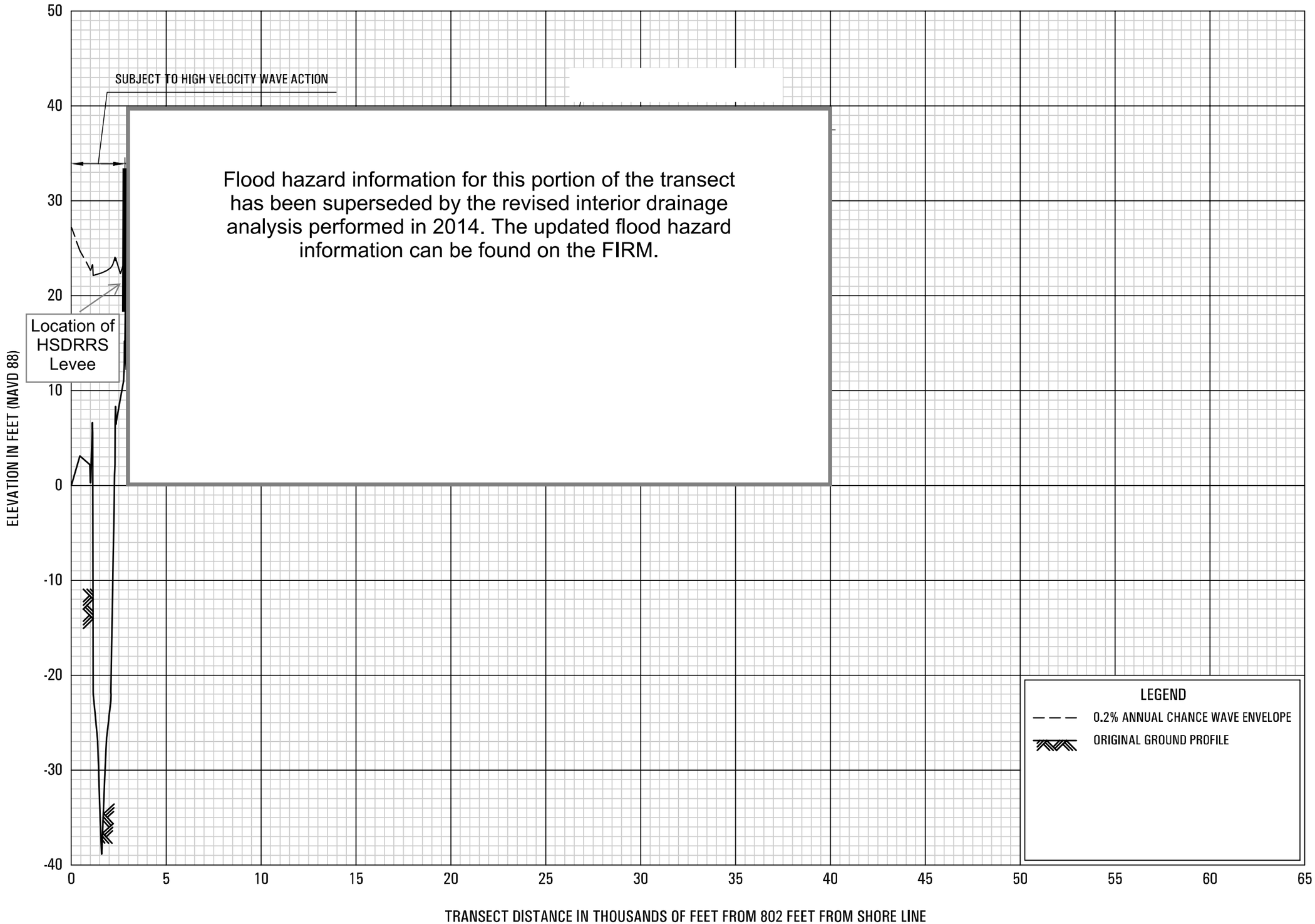
TRANSECT 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. BERNARD PARISH, LA

(ALL JURISDICTIONS)

04P



0.2% ANNUAL CHANCE WAVE ENVELOPE

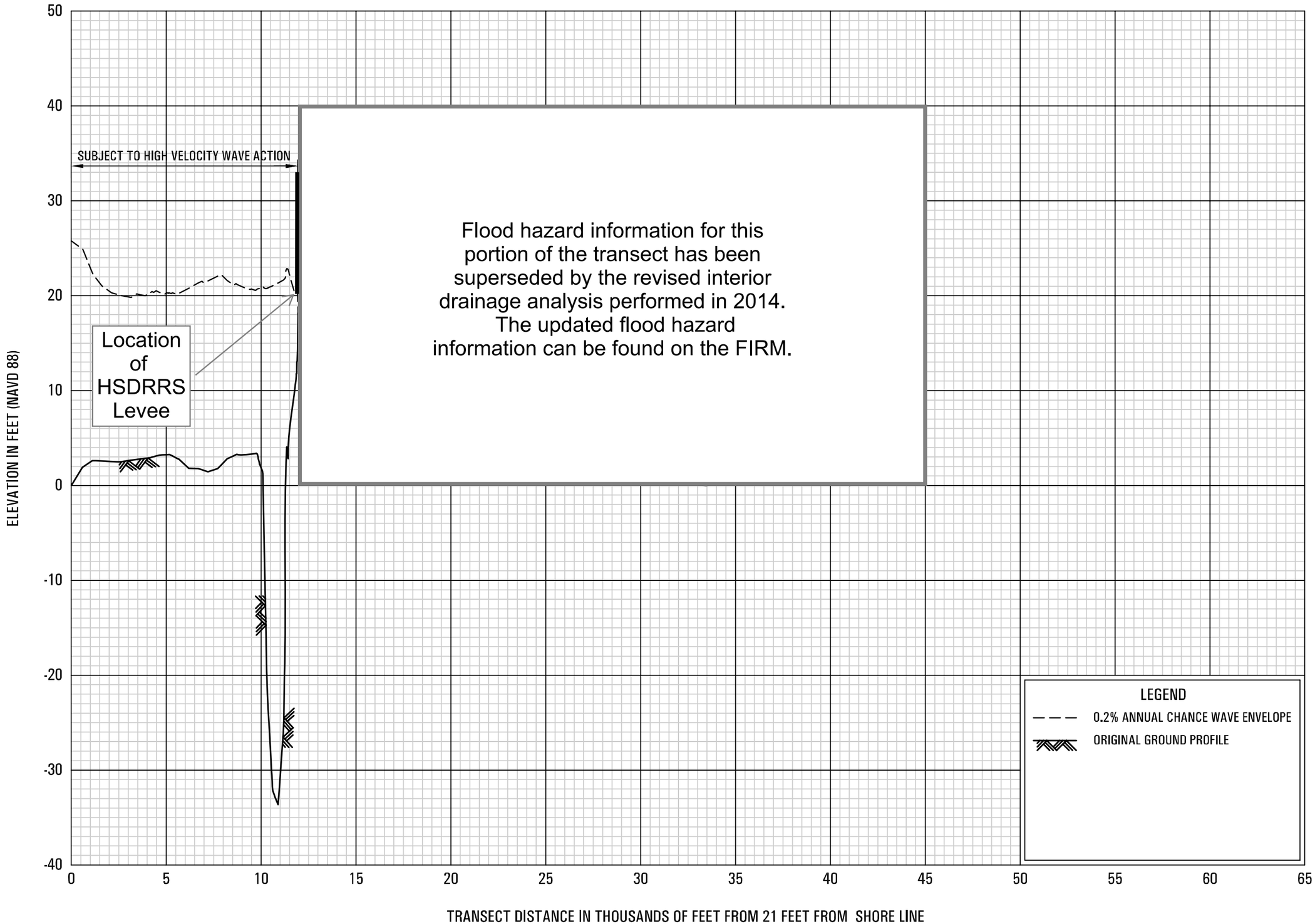
TRANSECT 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. BERNARD PARISH, LA

(ALL JURISDICTIONS)

05P



0.2% ANNUAL CHANCE WAVE ENVELOPE

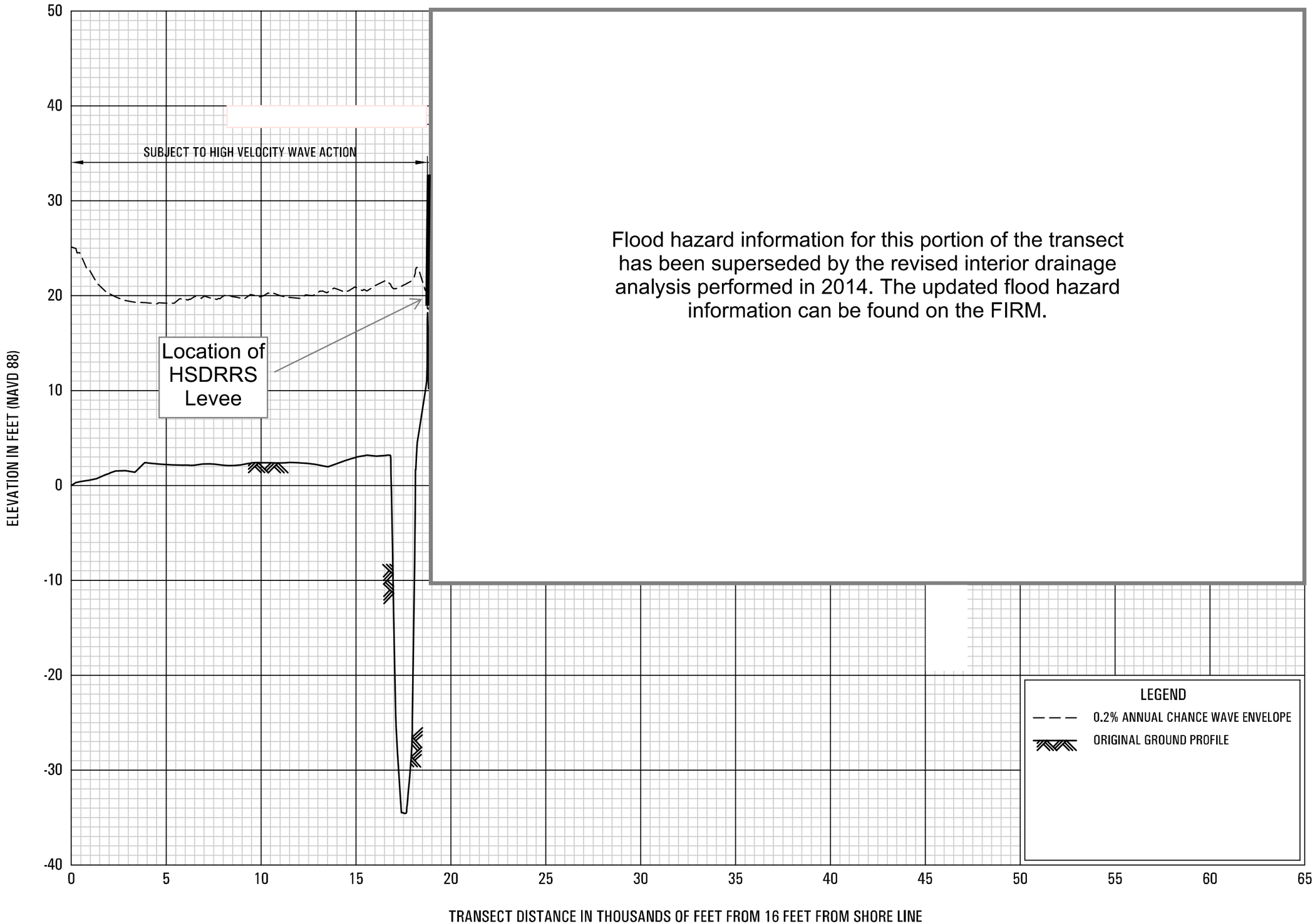
TRANSECT 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. BERNARD PARISH, LA

(ALL JURISDICTIONS)

06P



0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. BERNARD PARISH, LA

(ALL JURISDICTIONS)

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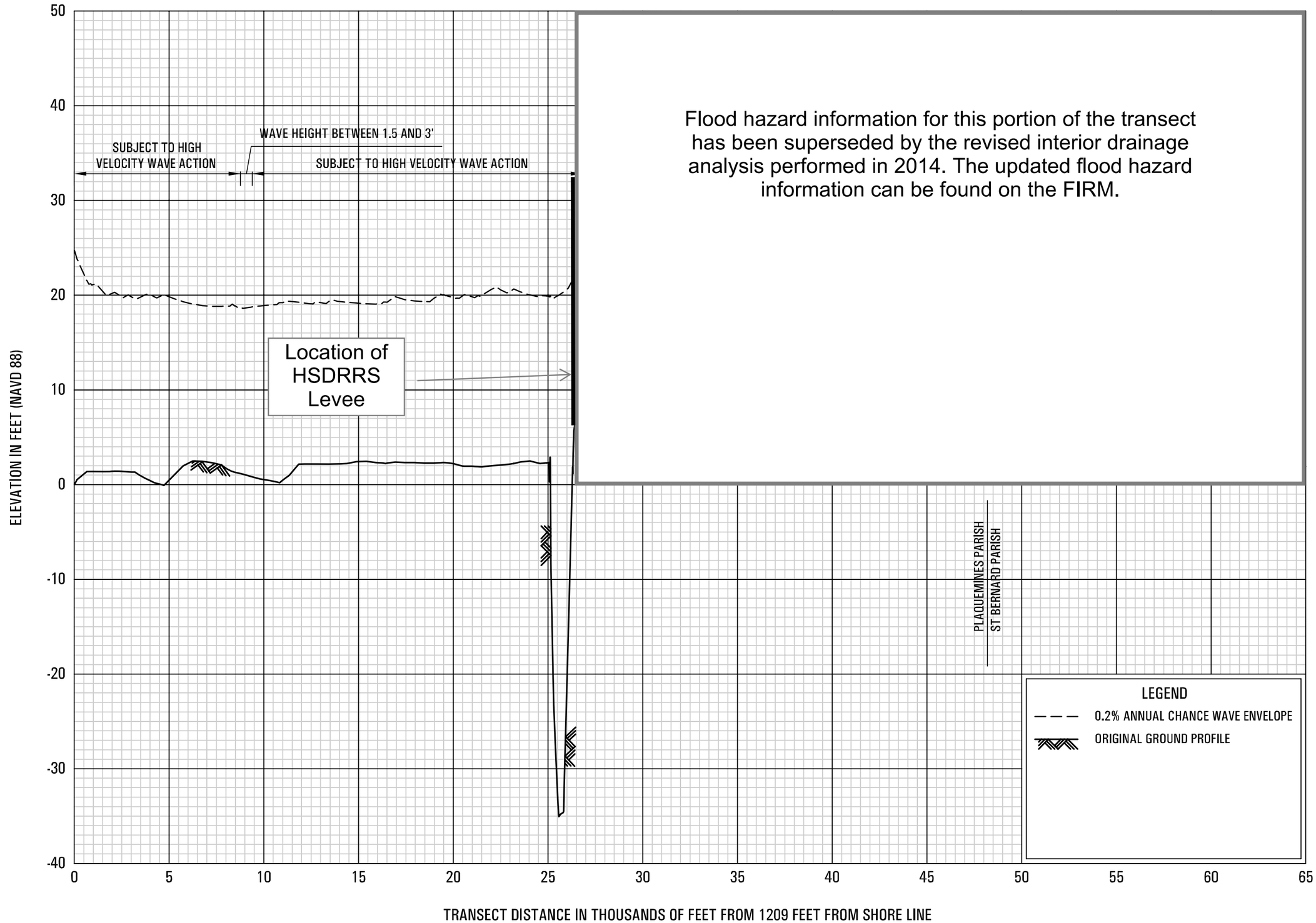

Flood hazard information for this portion of the transect has been superseded by the revised interior drainage analysis performed in 2014. The updated flood hazard information can be found on the FIRM.

0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. BERNARD PARISH, LA

(ALL JURISDICTIONS)

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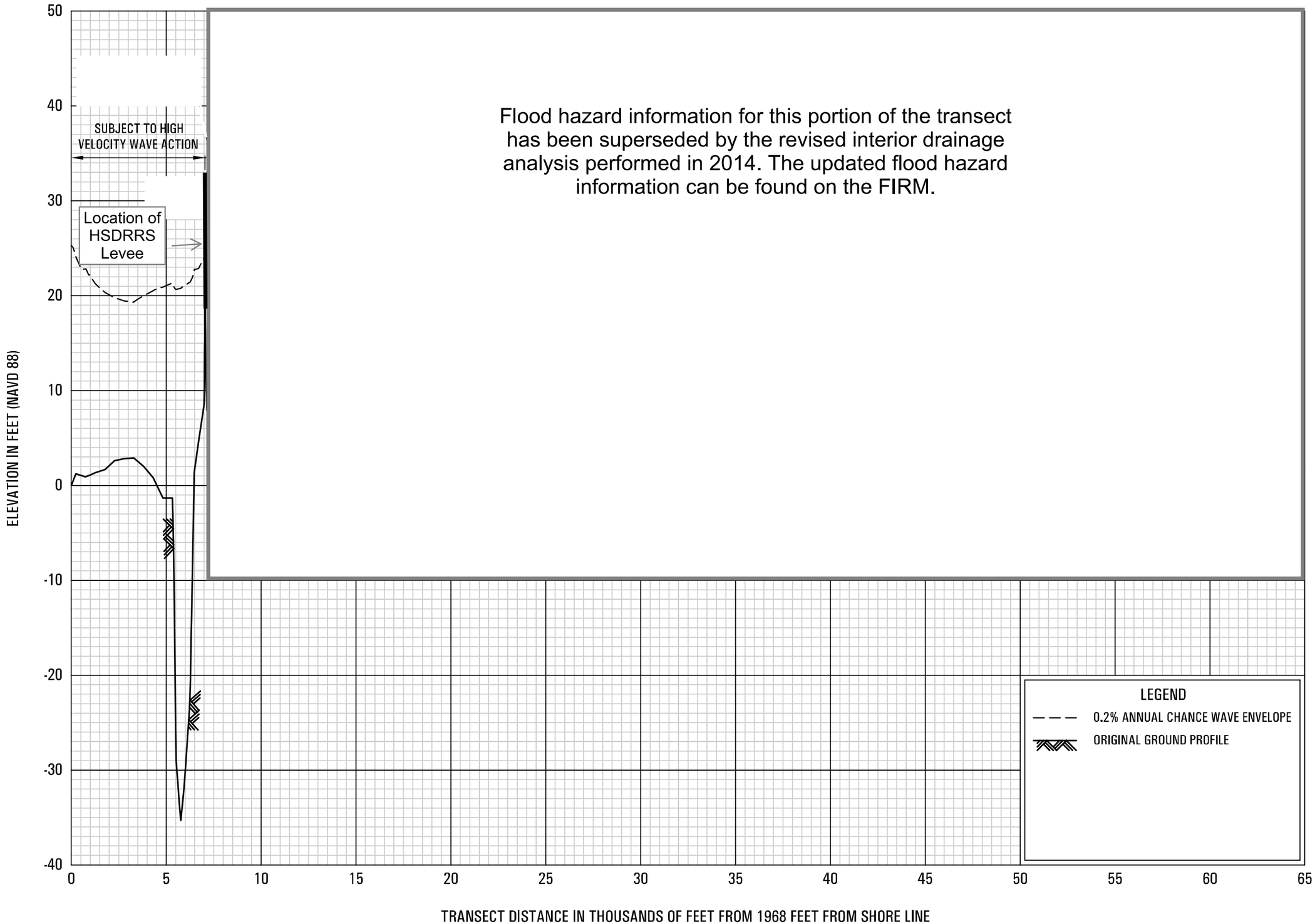

0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. BERNARD PARISH, LA

(ALL JURISDICTIONS)

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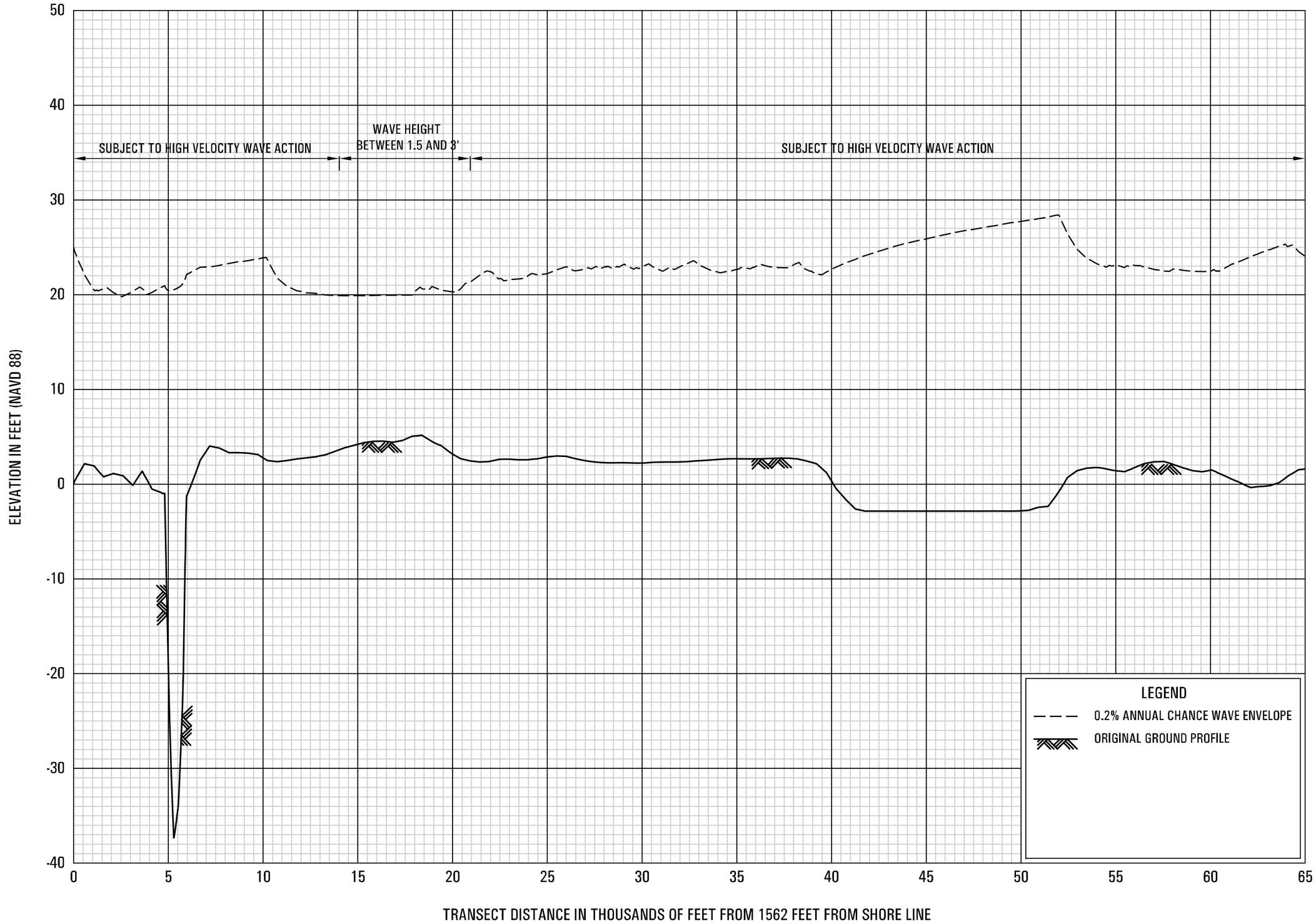

0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. BERNARD PARISH, LA

(ALL JURISDICTIONS)

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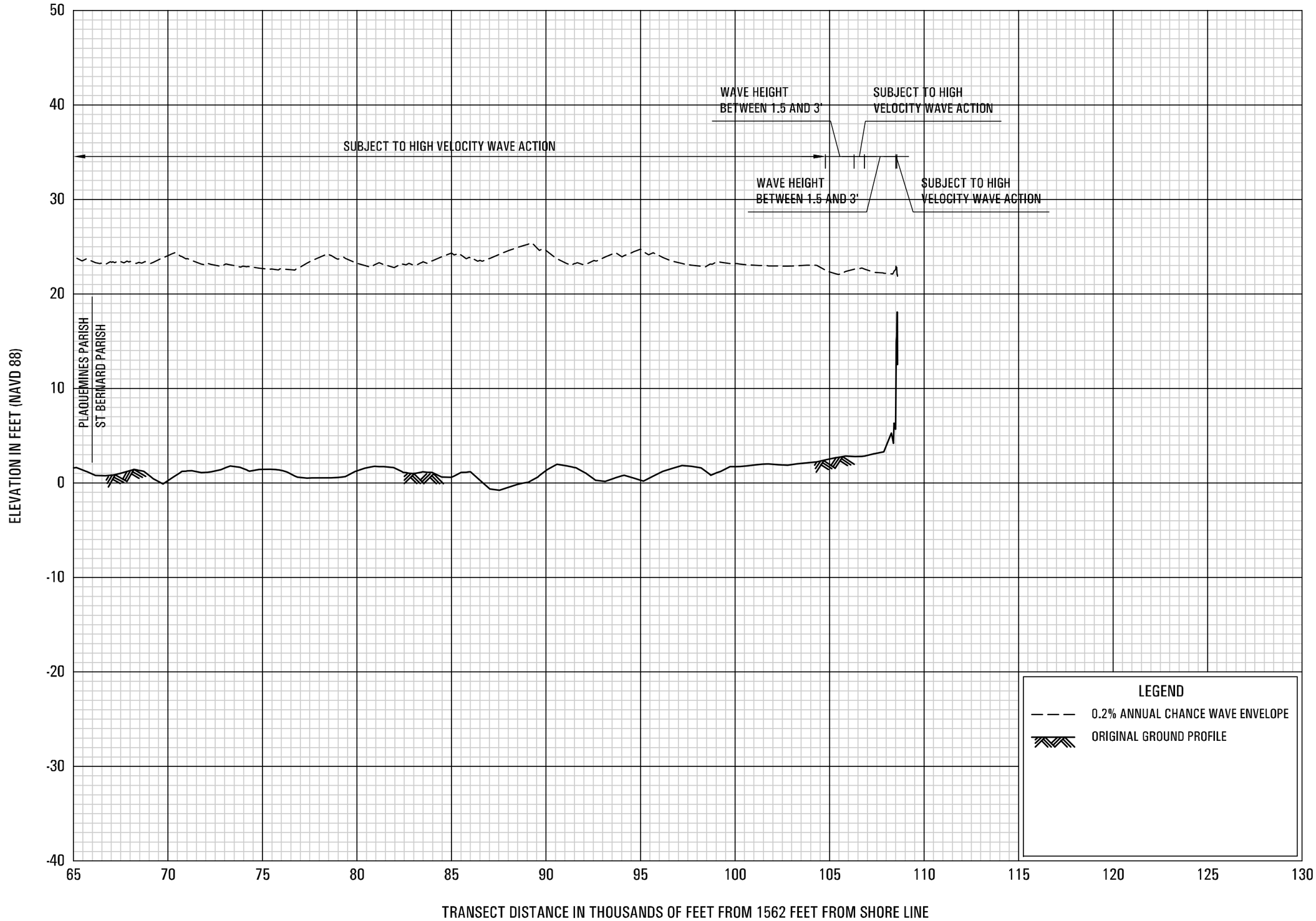

0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. BERNARD PARISH, LA

(ALL JURISDICTIONS)

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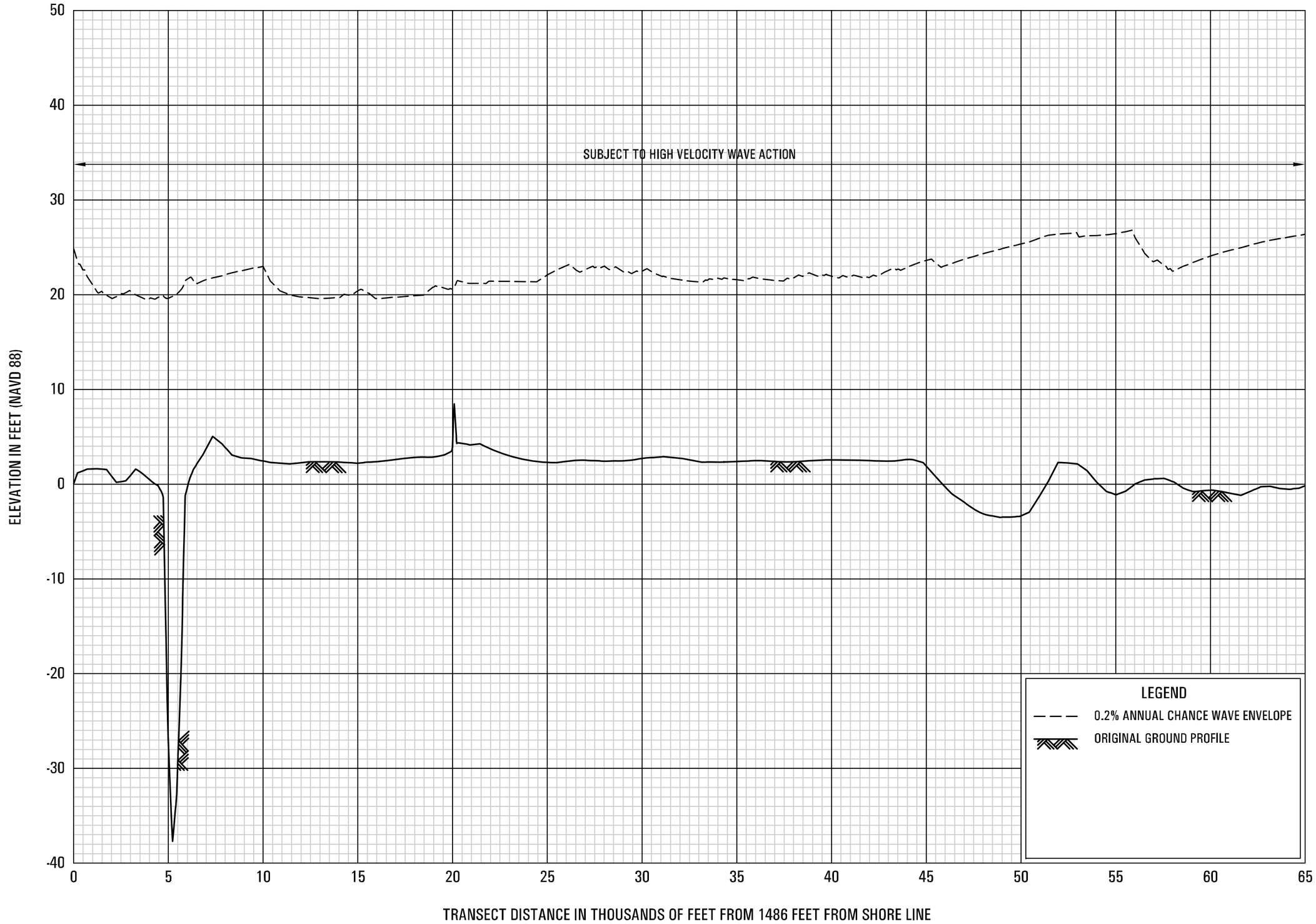

0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 11

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. BERNARD PARISH, LA

(ALL JURISDICTIONS)

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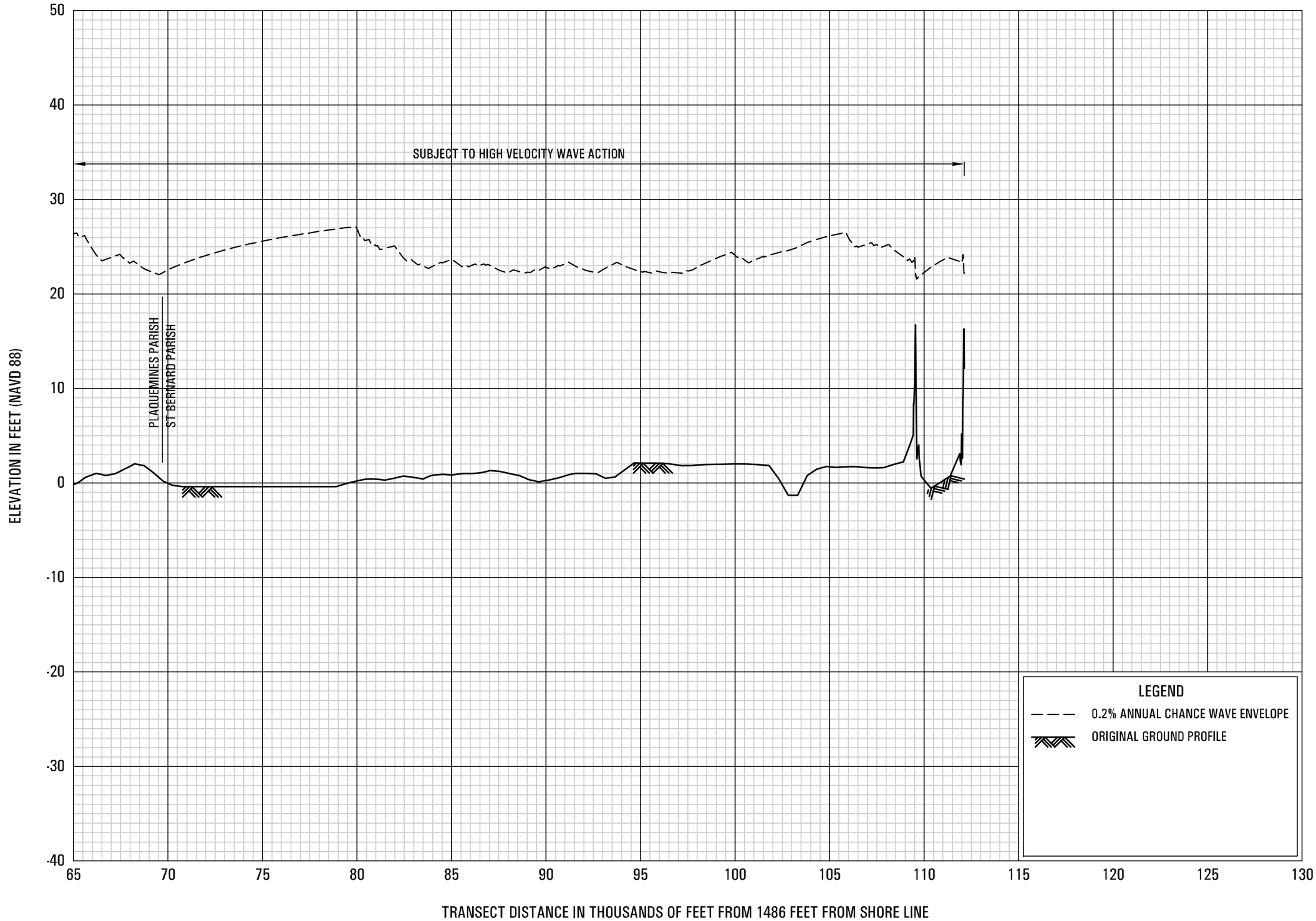

0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 11

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. BERNARD PARISH, LA

(ALL JURISDICTIONS)

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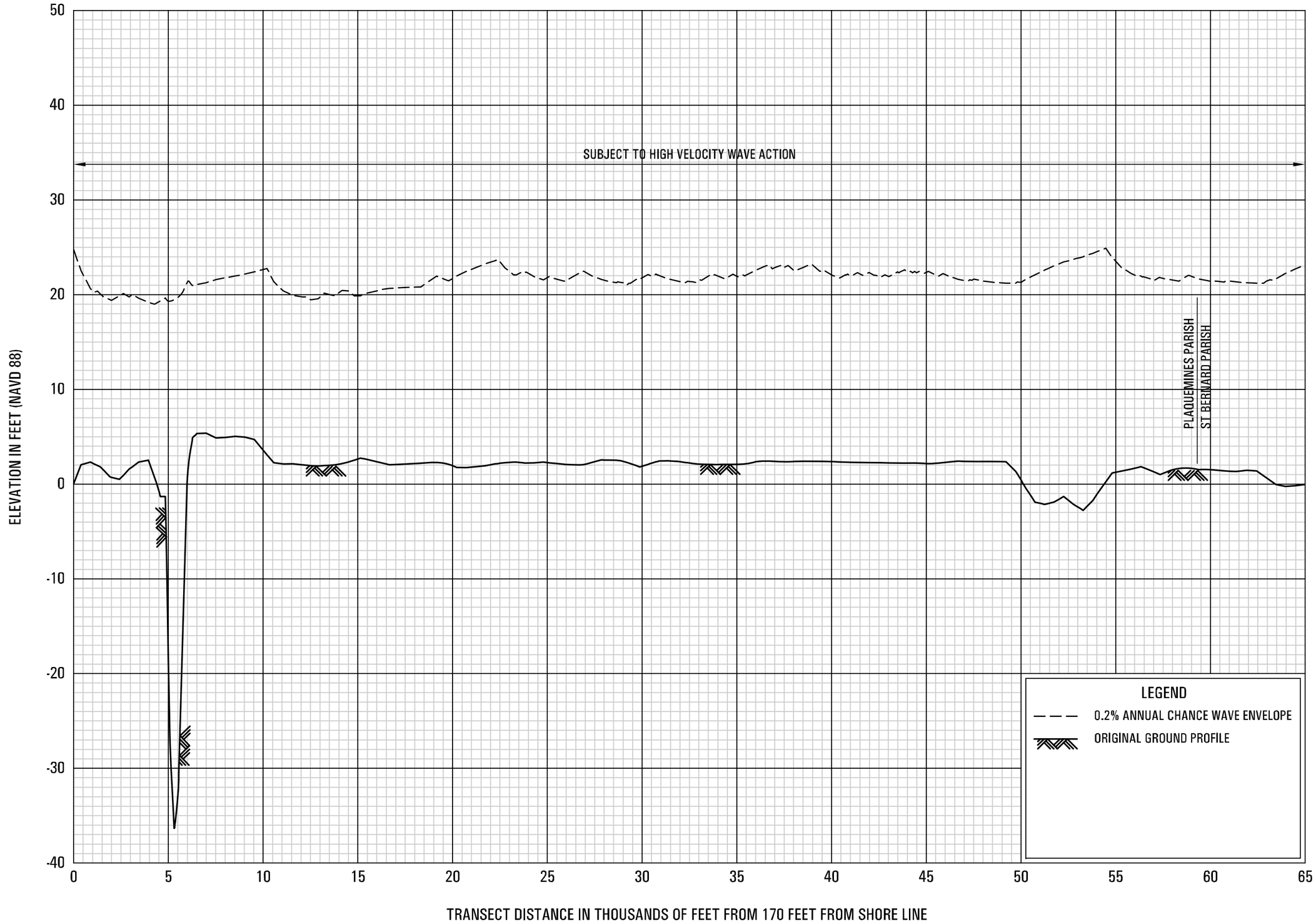

0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 12

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. BERNARD PARISH, LA

(ALL JURISDICTIONS)

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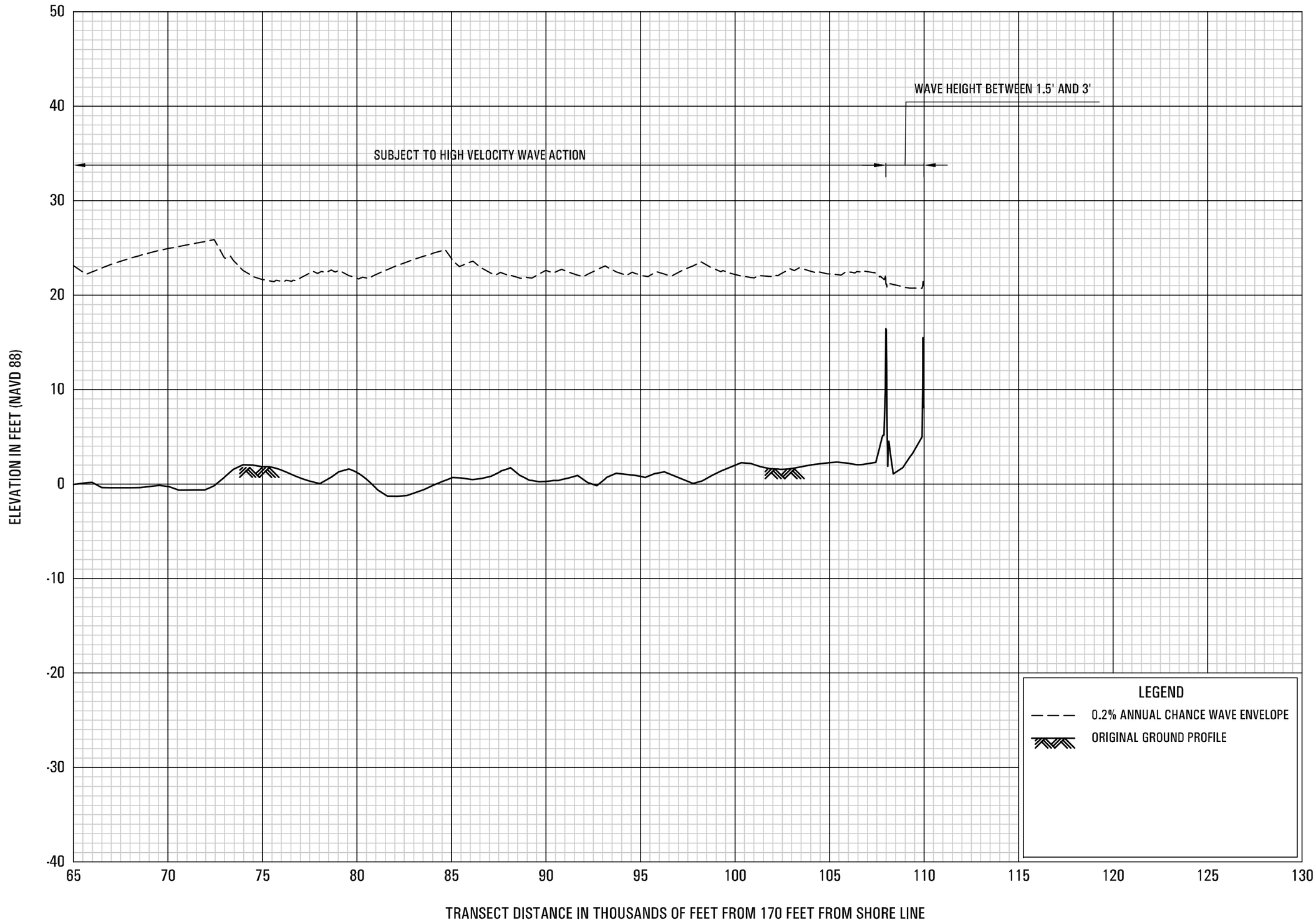

0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 12

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. BERNARD PARISH, LA

(ALL JURISDICTIONS)

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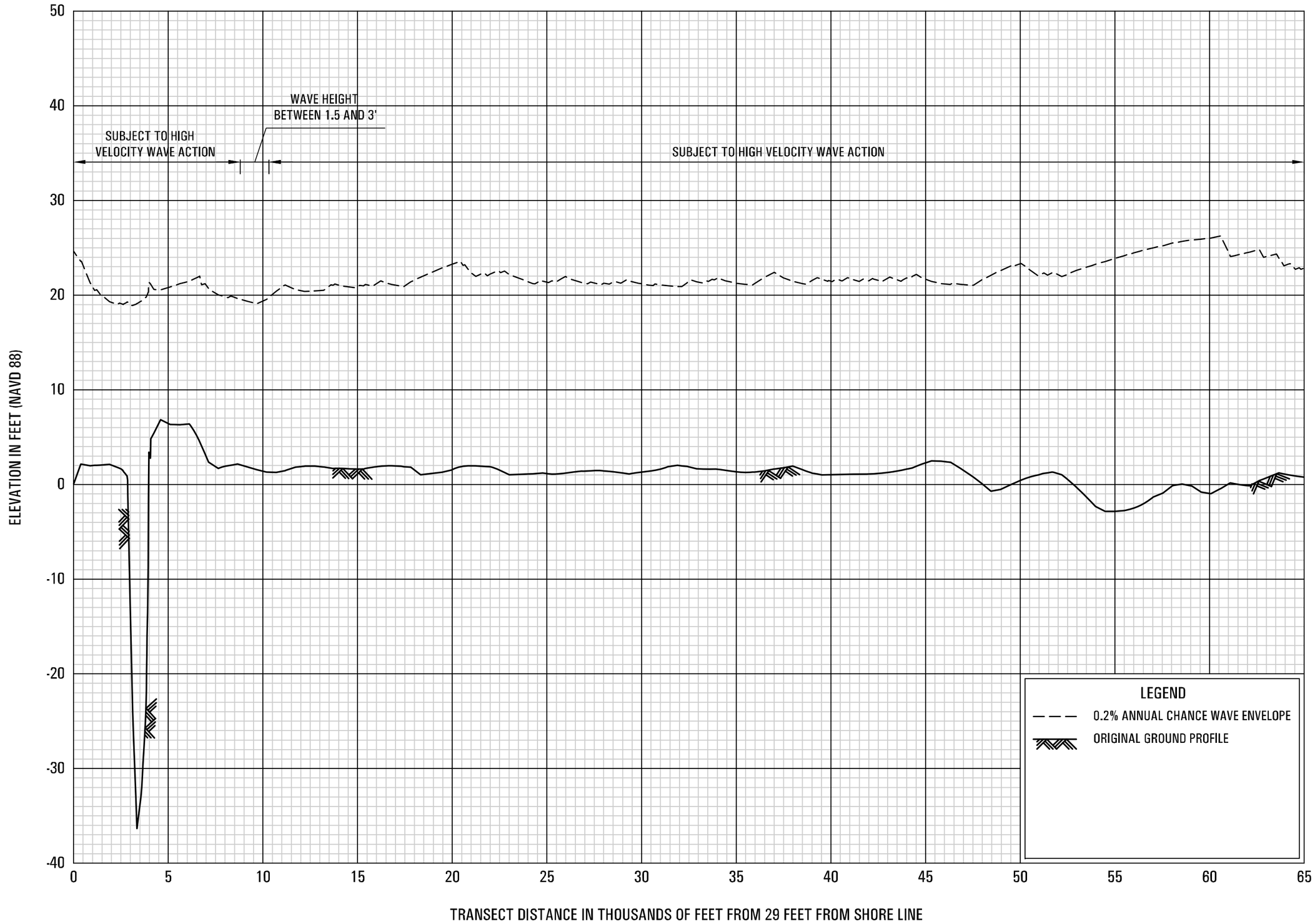


0.2% ANNUAL CHANCE WAVE ENVELOPE

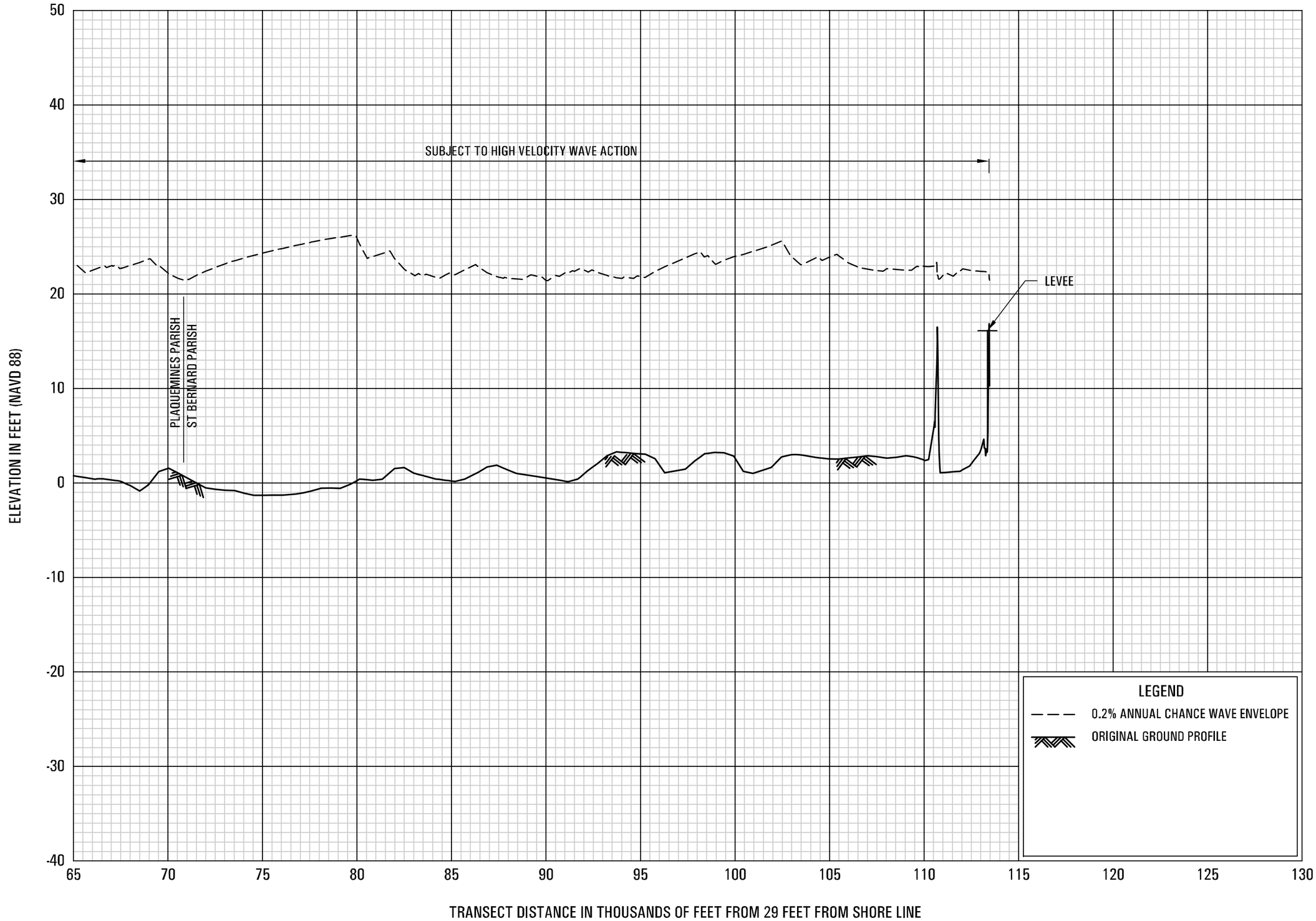
TRANSECT 13

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. BERNARD PARISH, LA

(ALL JURISDICTIONS)

16P



0.2% ANNUAL CHANCE WAVE ENVELOPE

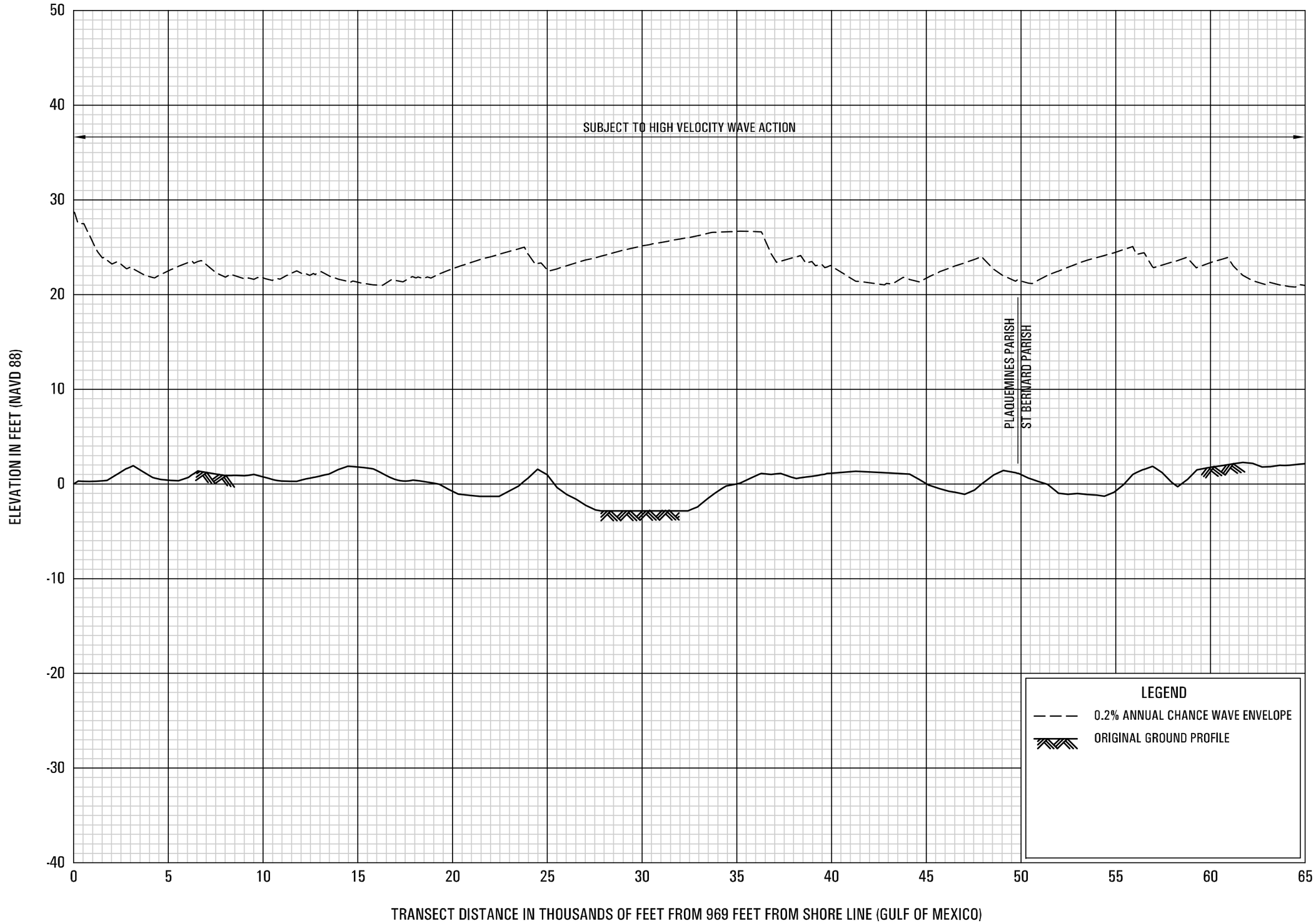
TRANSECT 13

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. BERNARD PARISH, LA

(ALL JURISDICTIONS)

17P



0.2% ANNUAL CHANCE WAVE ENVELOPE

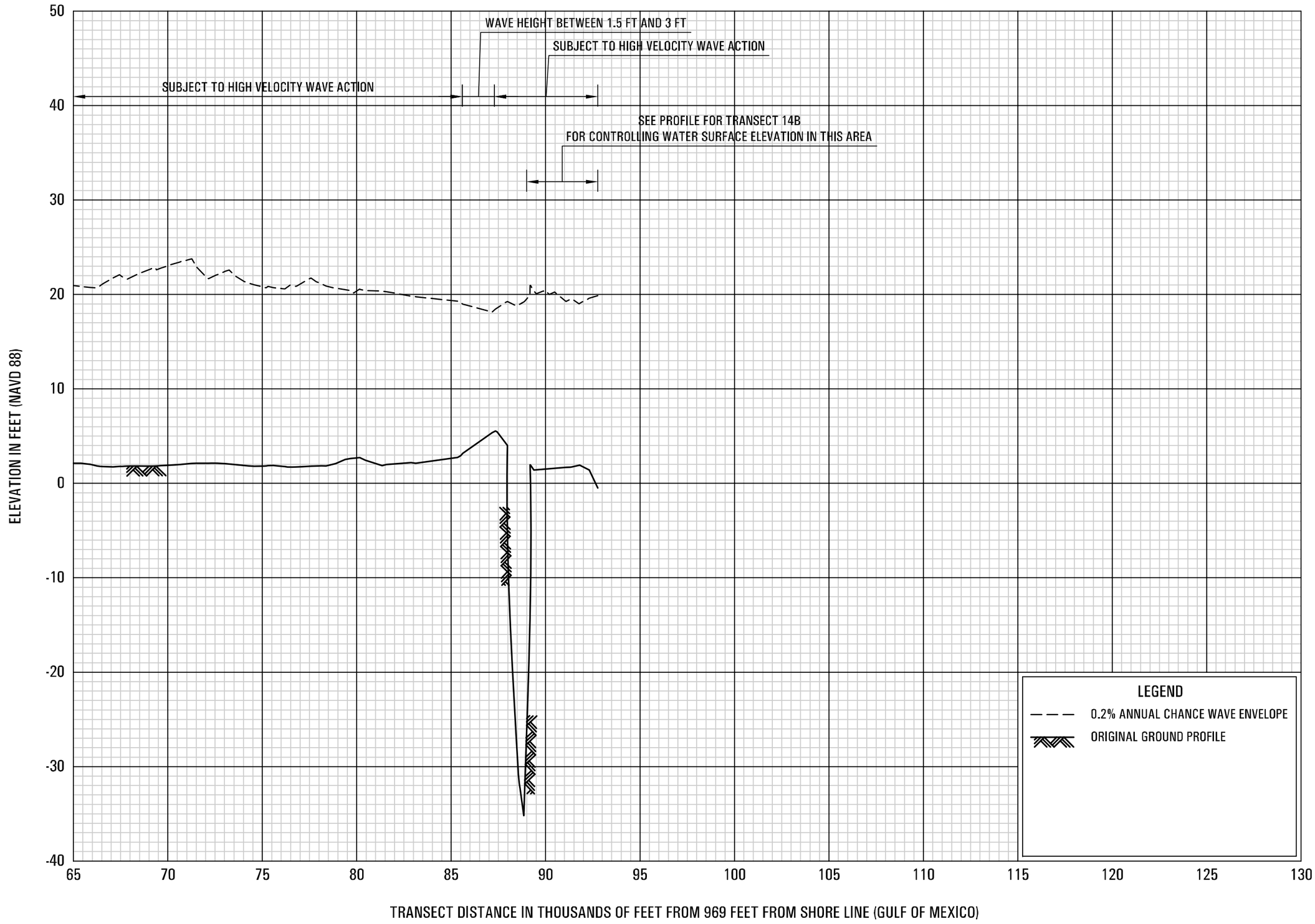
TRANSECT 14A

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. BERNARD PARISH, LA

(ALL JURISDICTIONS)

18P



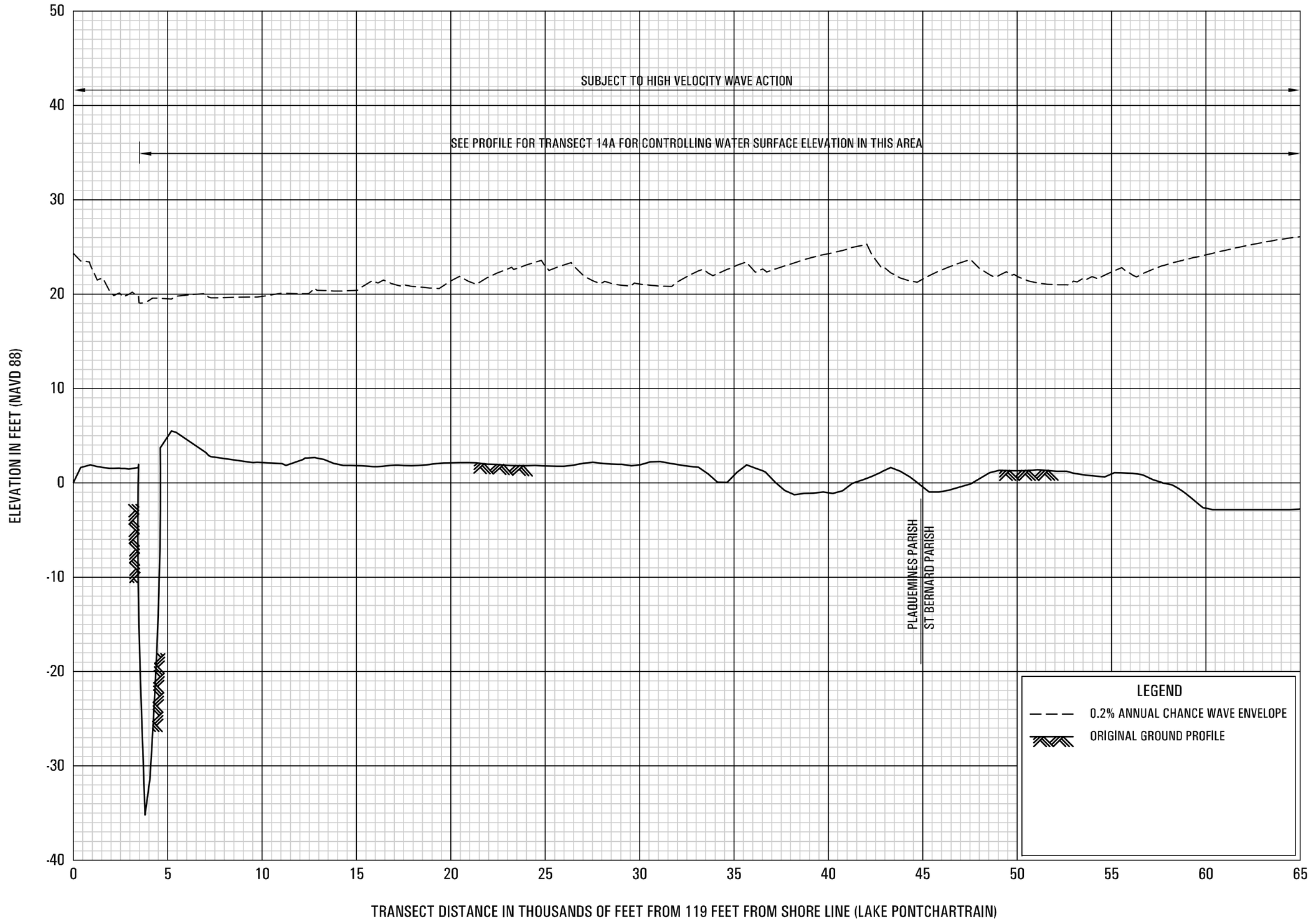
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 14A

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. BERNARD PARISH, LA

(ALL JURISDICTIONS)



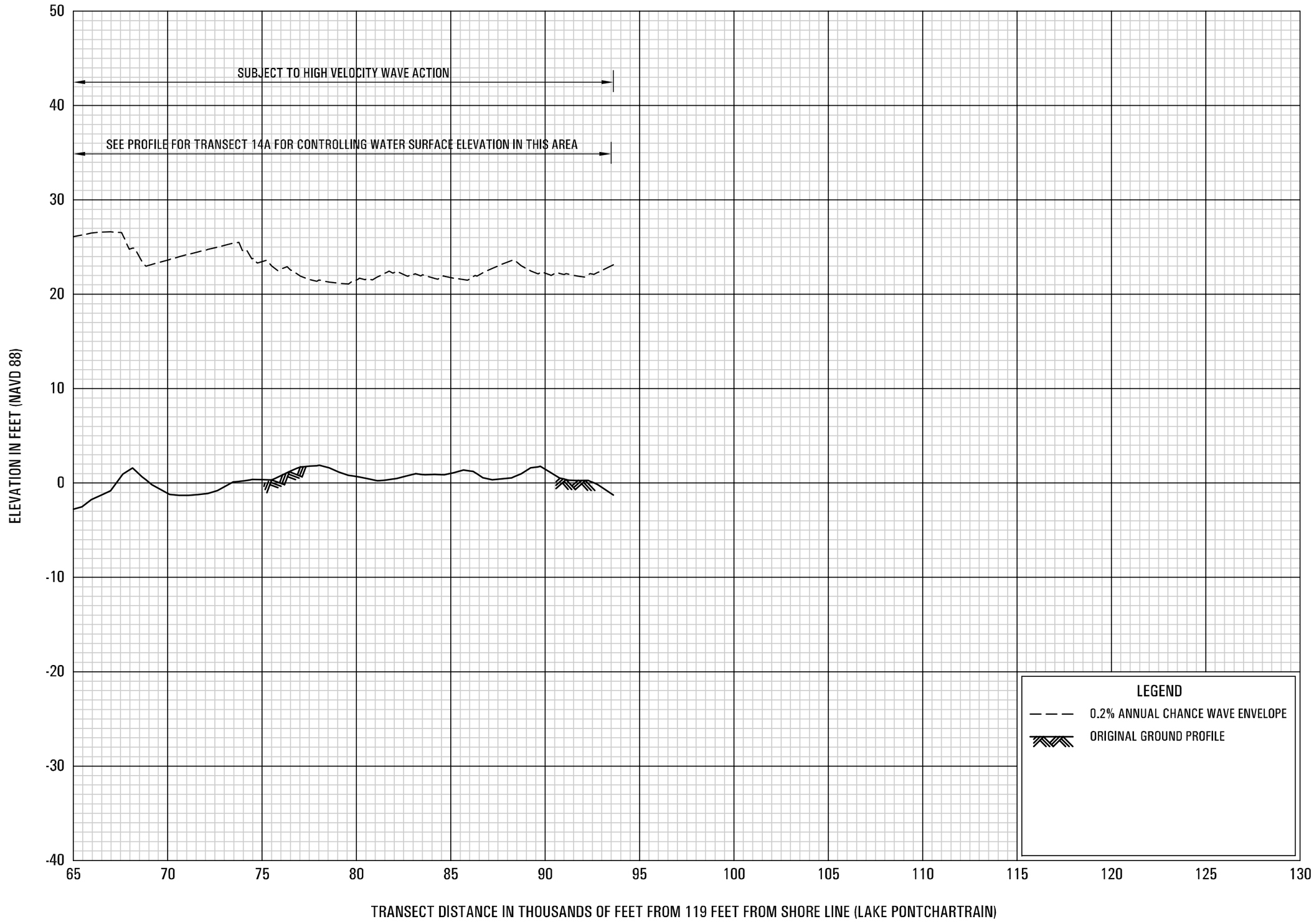
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 14B

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. BERNARD PARISH, LA

(ALL JURISDICTIONS)



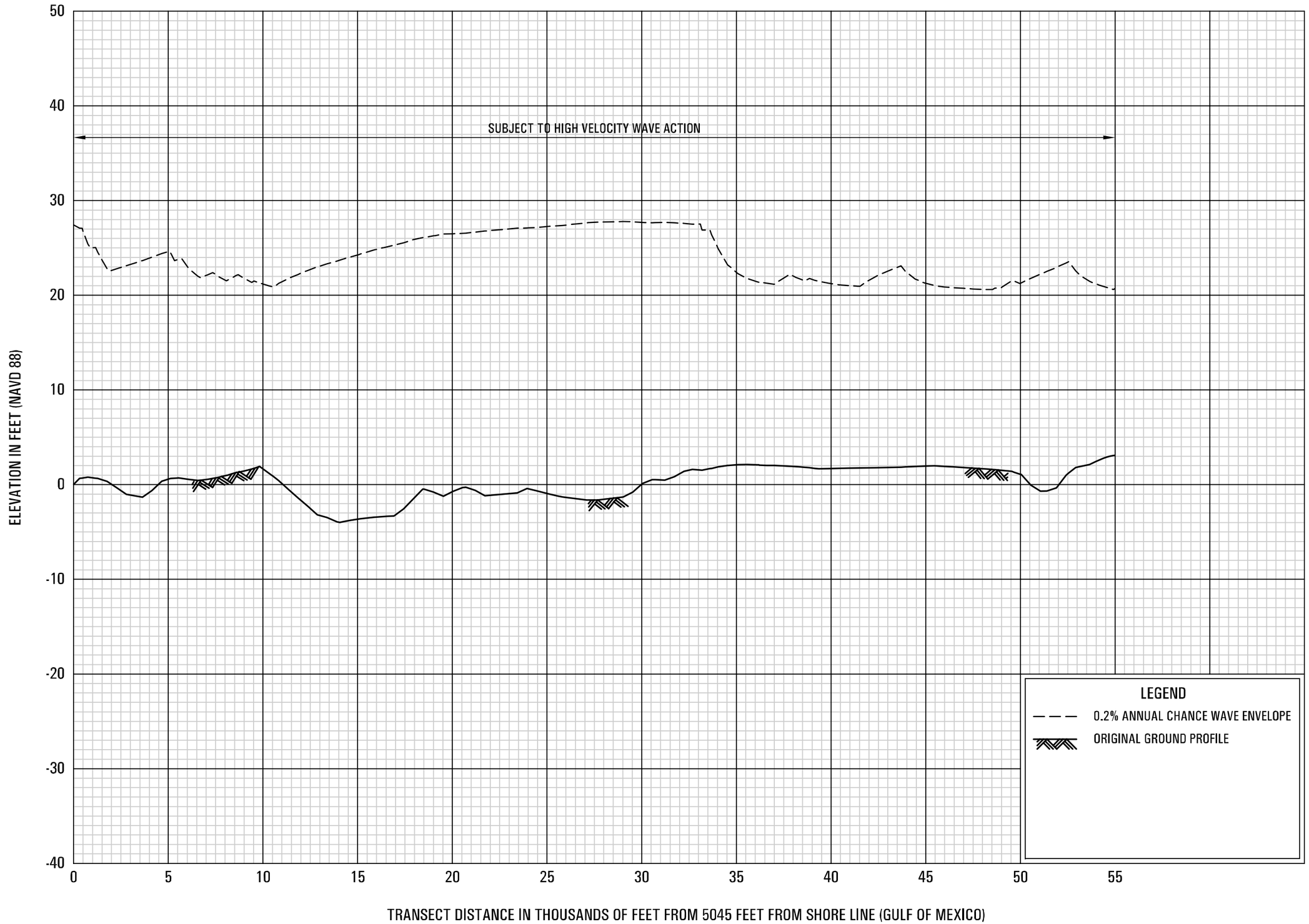
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 14B

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. BERNARD PARISH, LA

(ALL JURISDICTIONS)



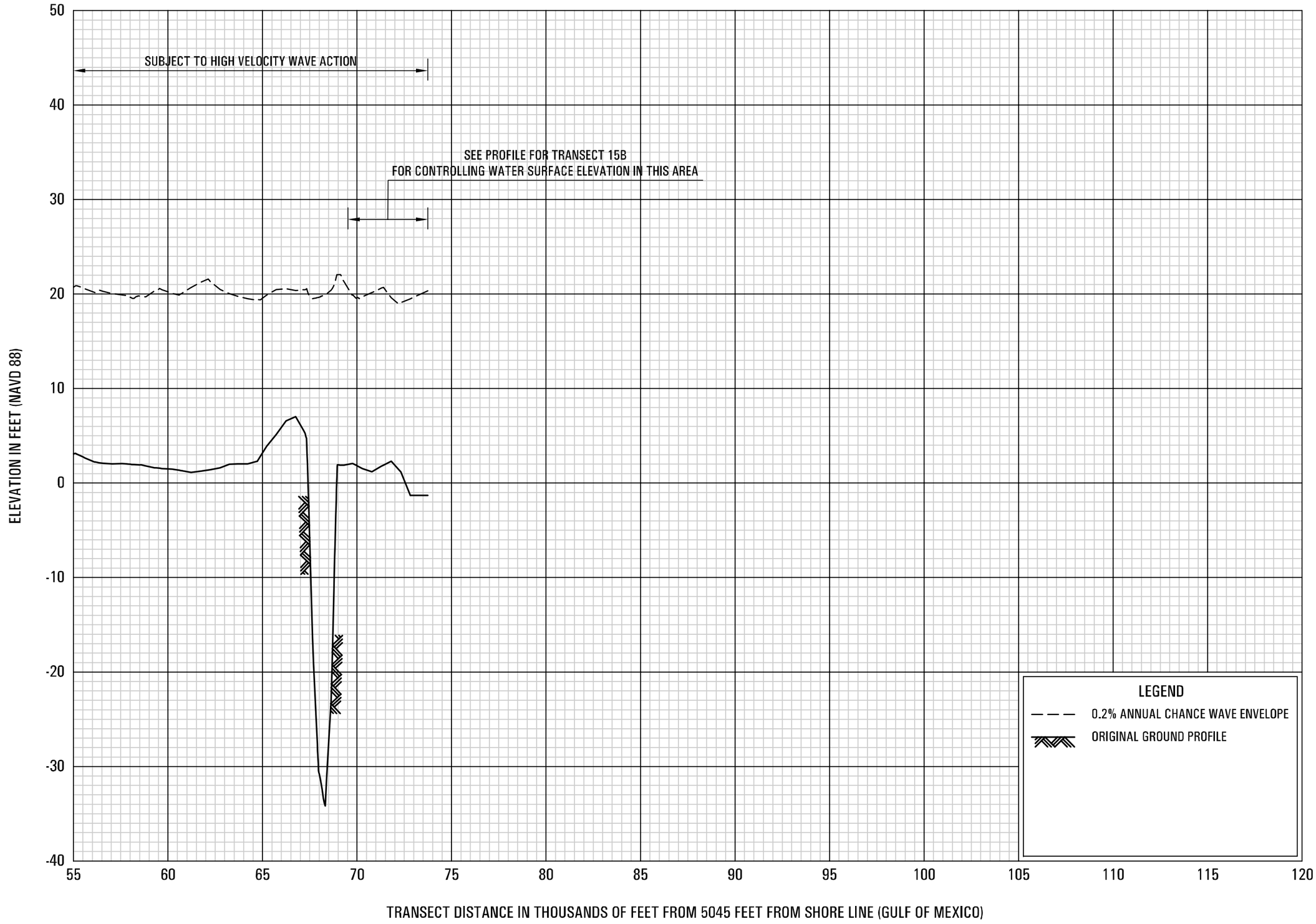
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 15A

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. BERNARD PARISH, LA

(ALL JURISDICTIONS)



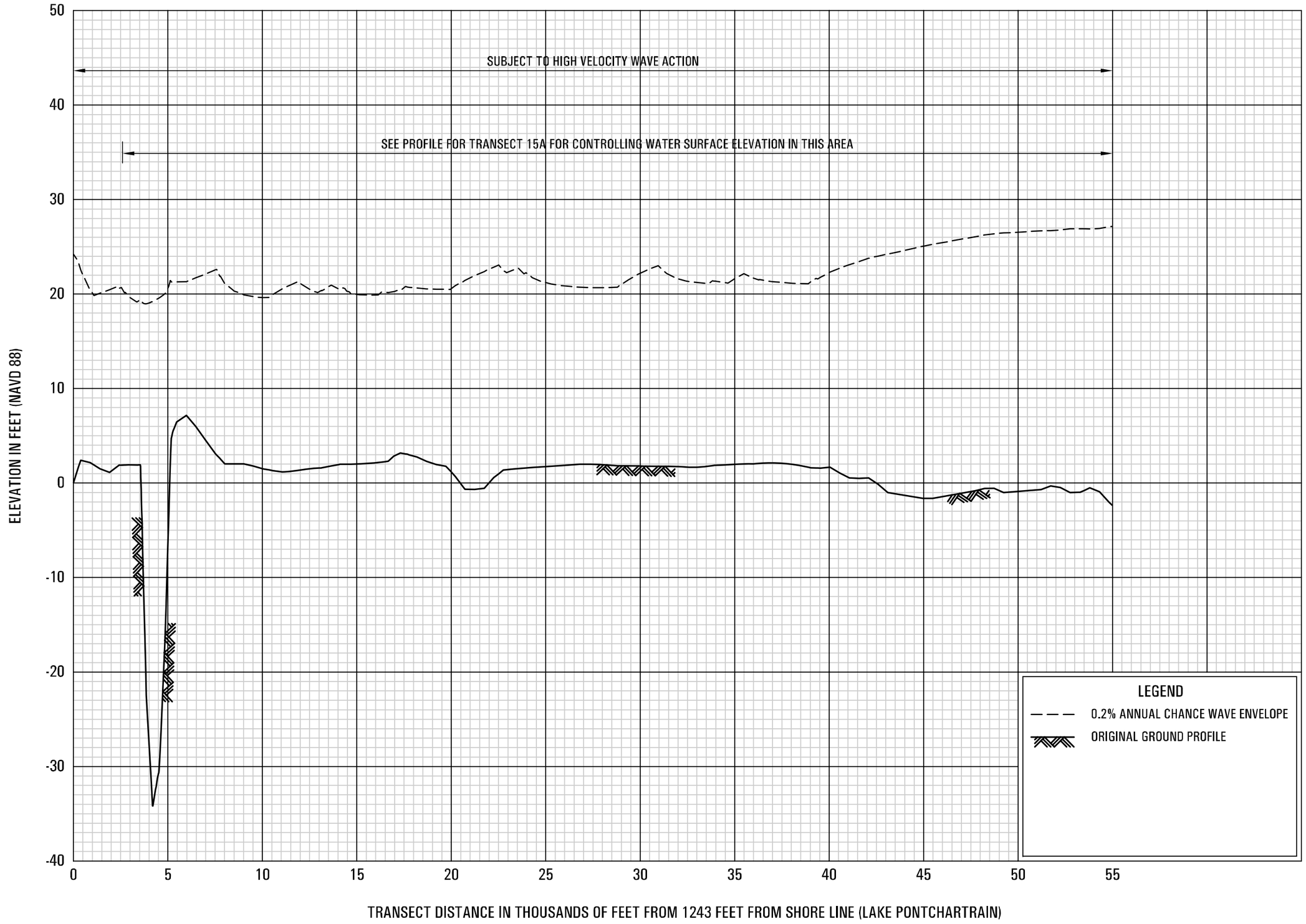
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 15A

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. BERNARD PARISH, LA

(ALL JURISDICTIONS)



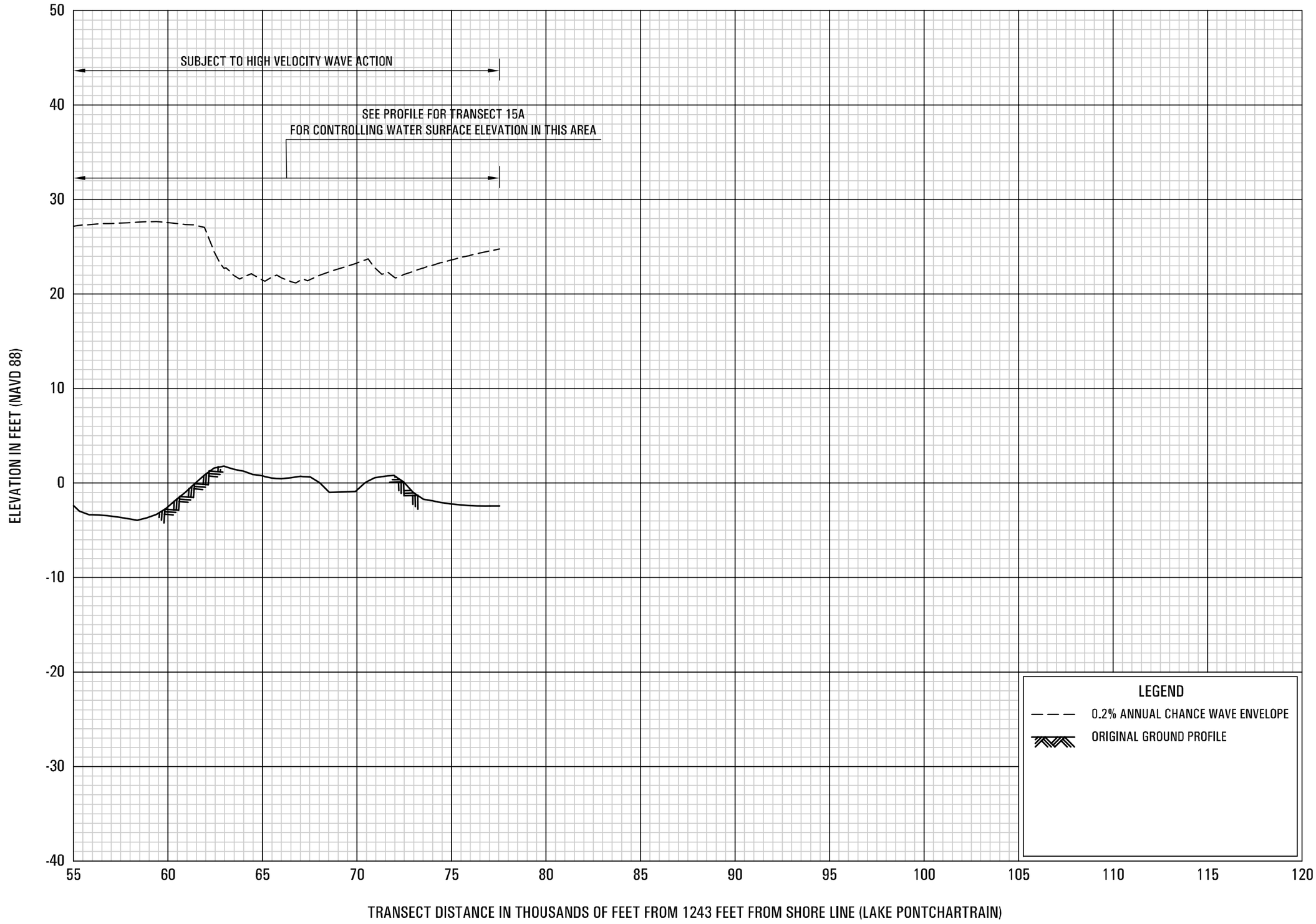
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 15B

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. BERNARD PARISH, LA

(ALL JURISDICTIONS)



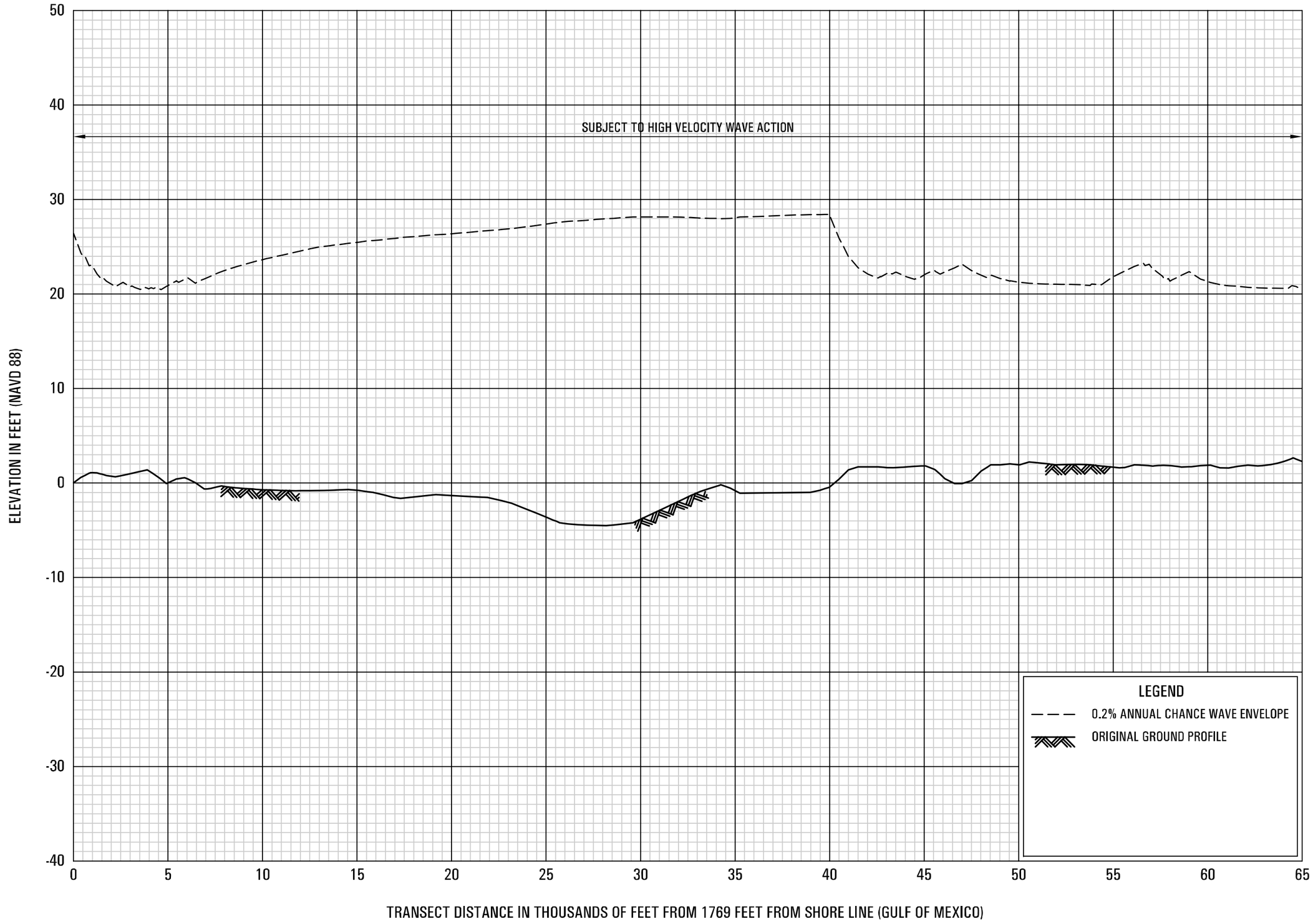
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 15B

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. BERNARD PARISH, LA

(ALL JURISDICTIONS)



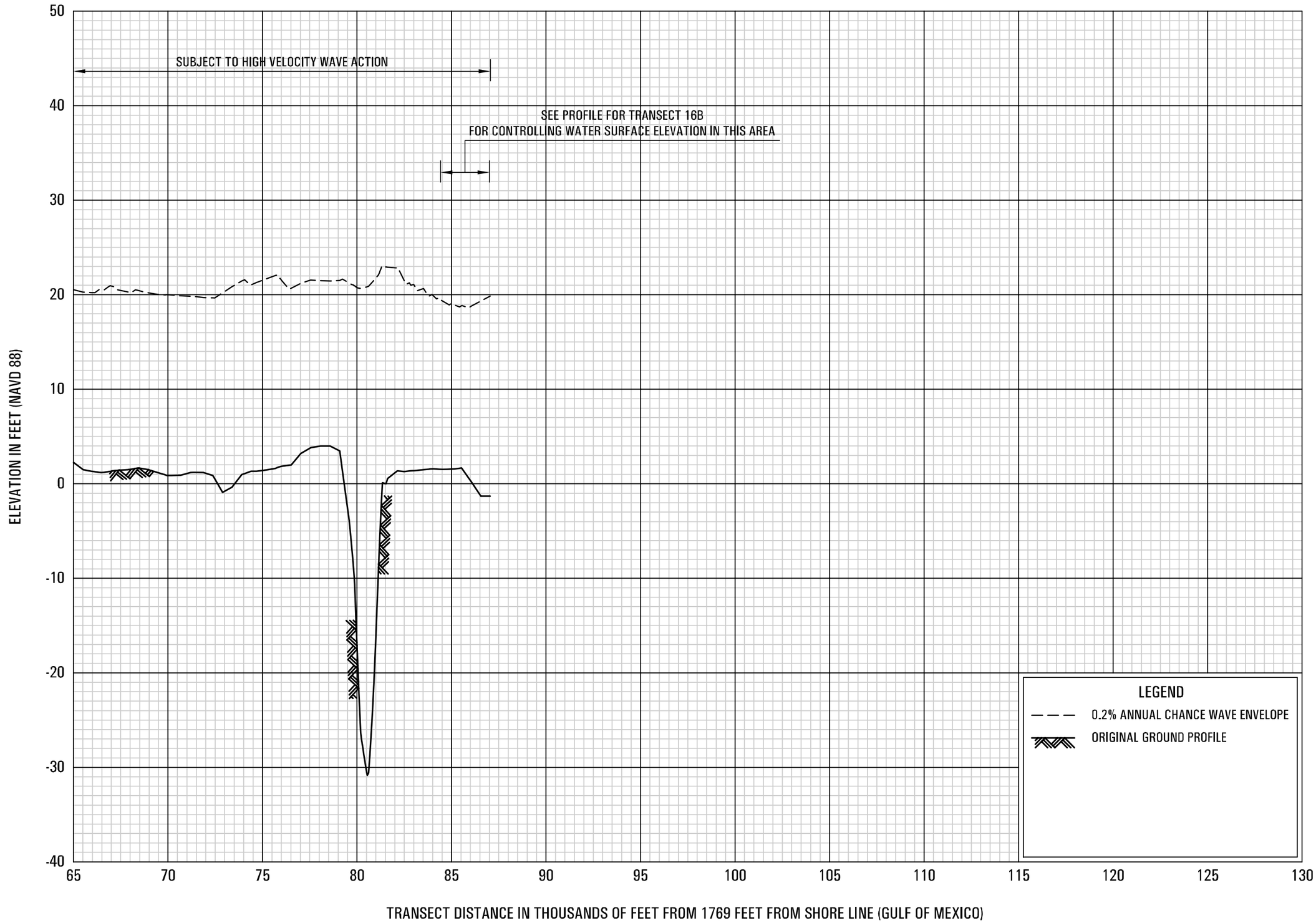
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 16A

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. BERNARD PARISH, LA

(ALL JURISDICTIONS)



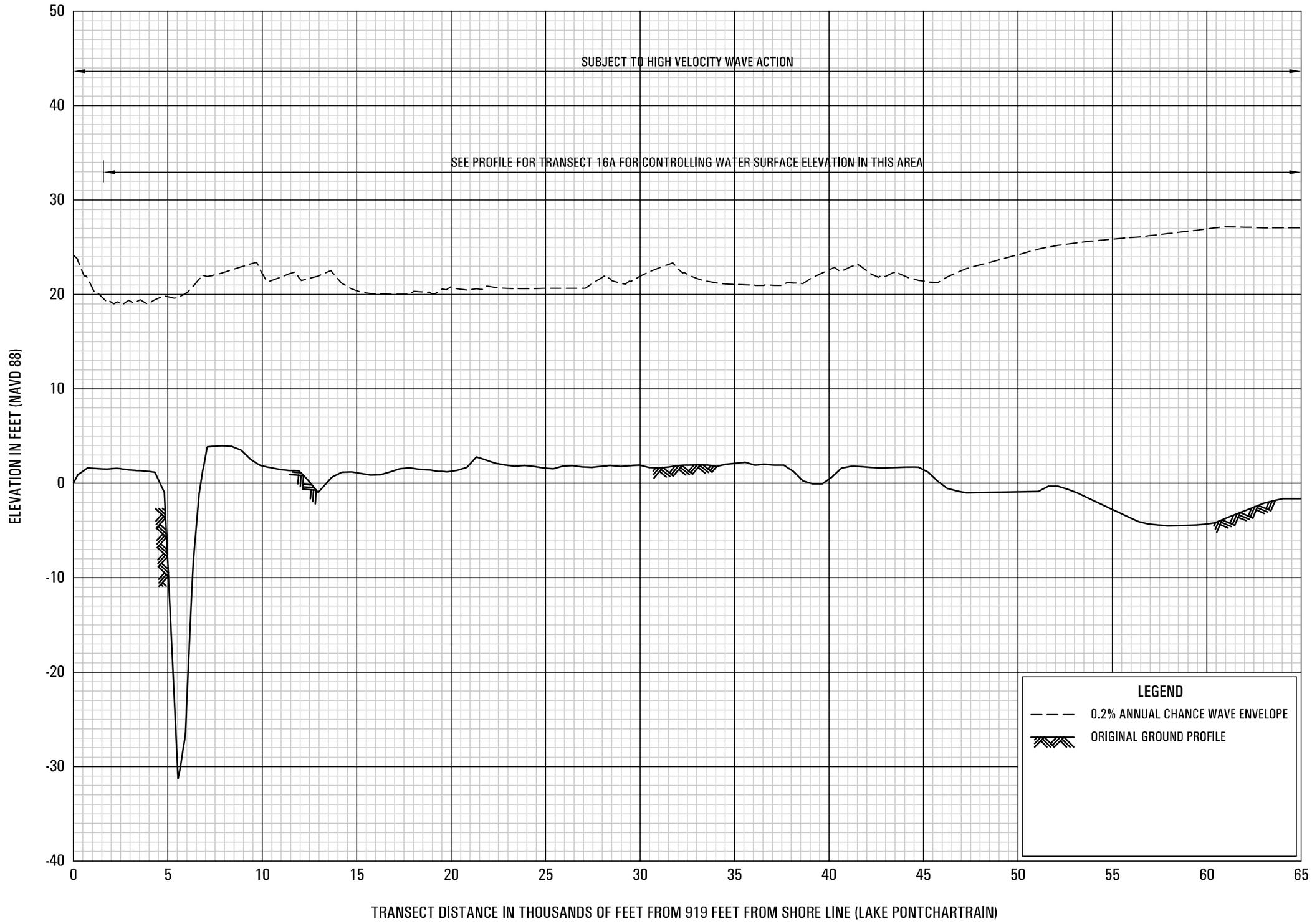
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 16A

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. BERNARD PARISH, LA

(ALL JURISDICTIONS)



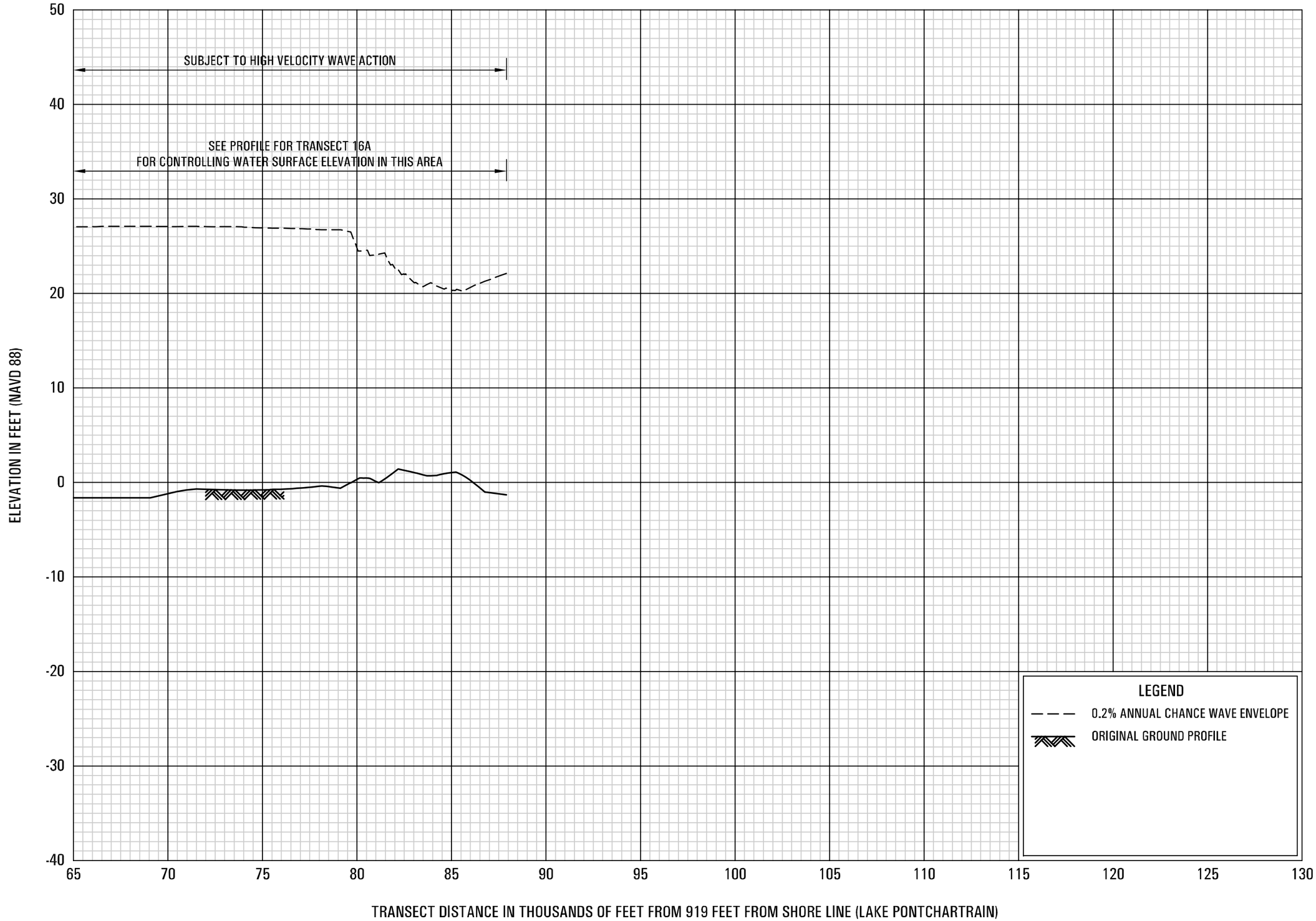
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 16B

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. BERNARD PARISH, LA

(ALL JURISDICTIONS)



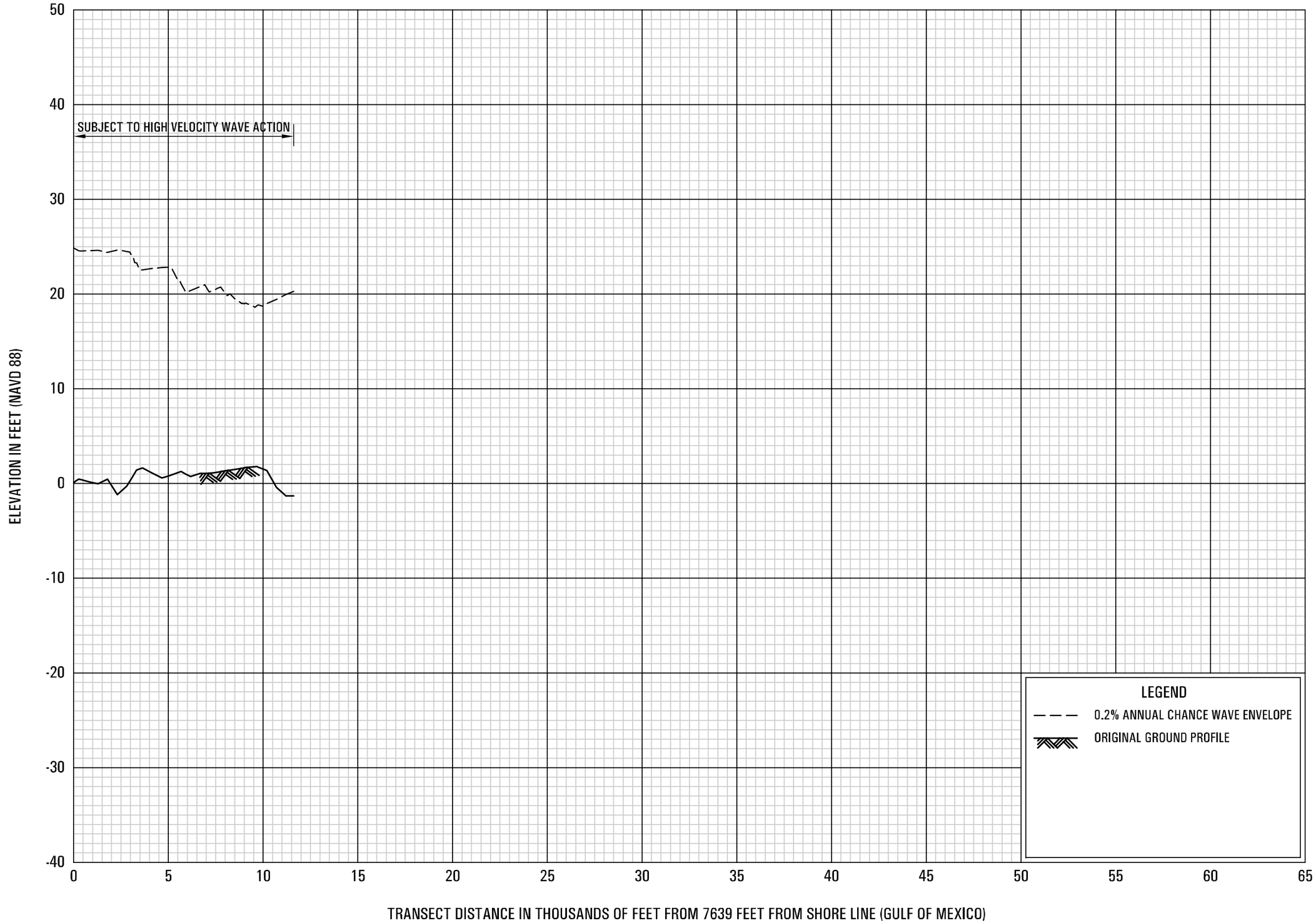
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 16B

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. BERNARD PARISH, LA

(ALL JURISDICTIONS)



0.2% ANNUAL CHANCE WAVE ENVELOPE

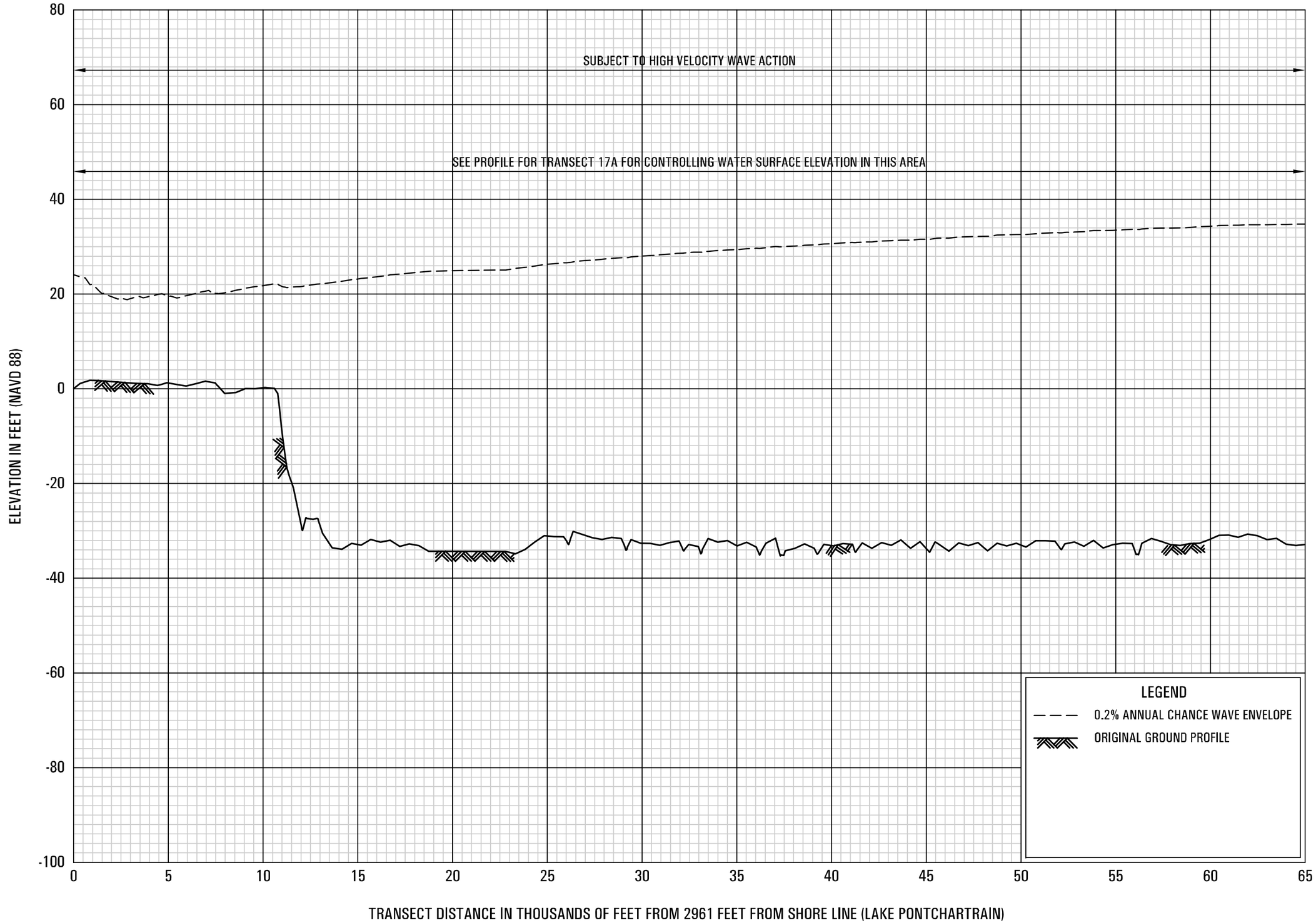
TRANSECT 17A

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. BERNARD PARISH, LA

(ALL JURISDICTIONS)

30P



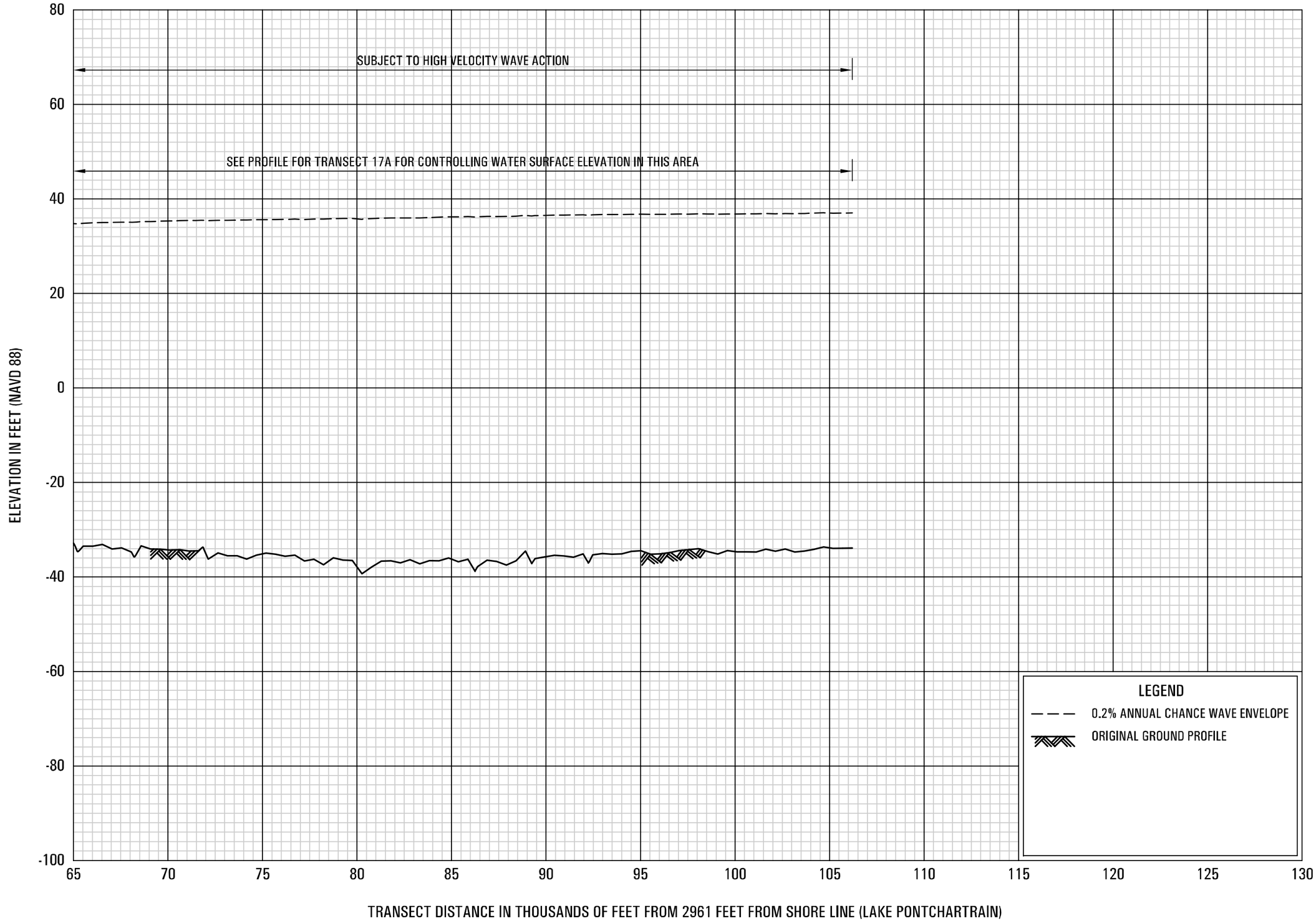
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 17B

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. BERNARD PARISH, LA

(ALL JURISDICTIONS)



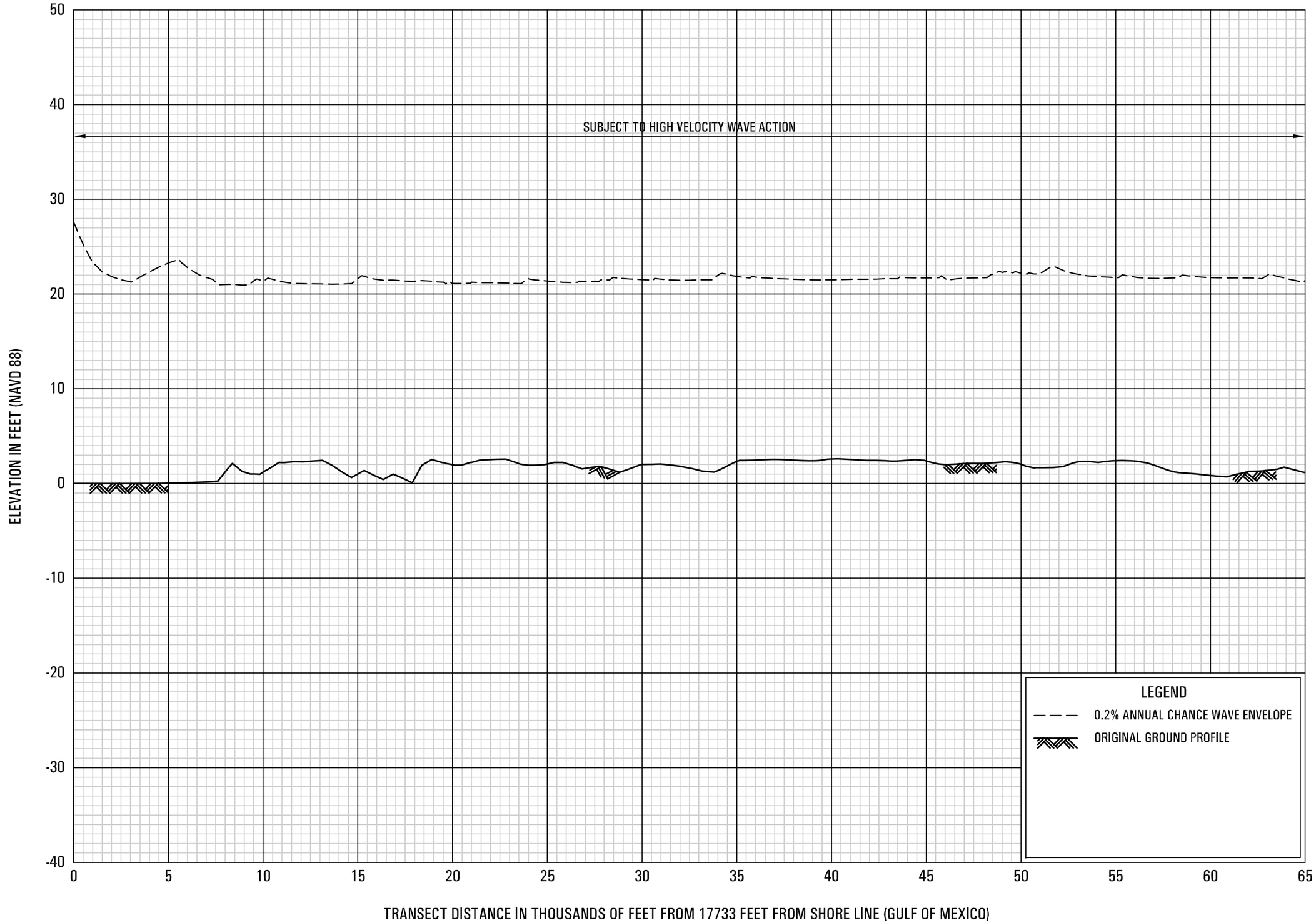
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 17B

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. BERNARD PARISH, LA

(ALL JURISDICTIONS)



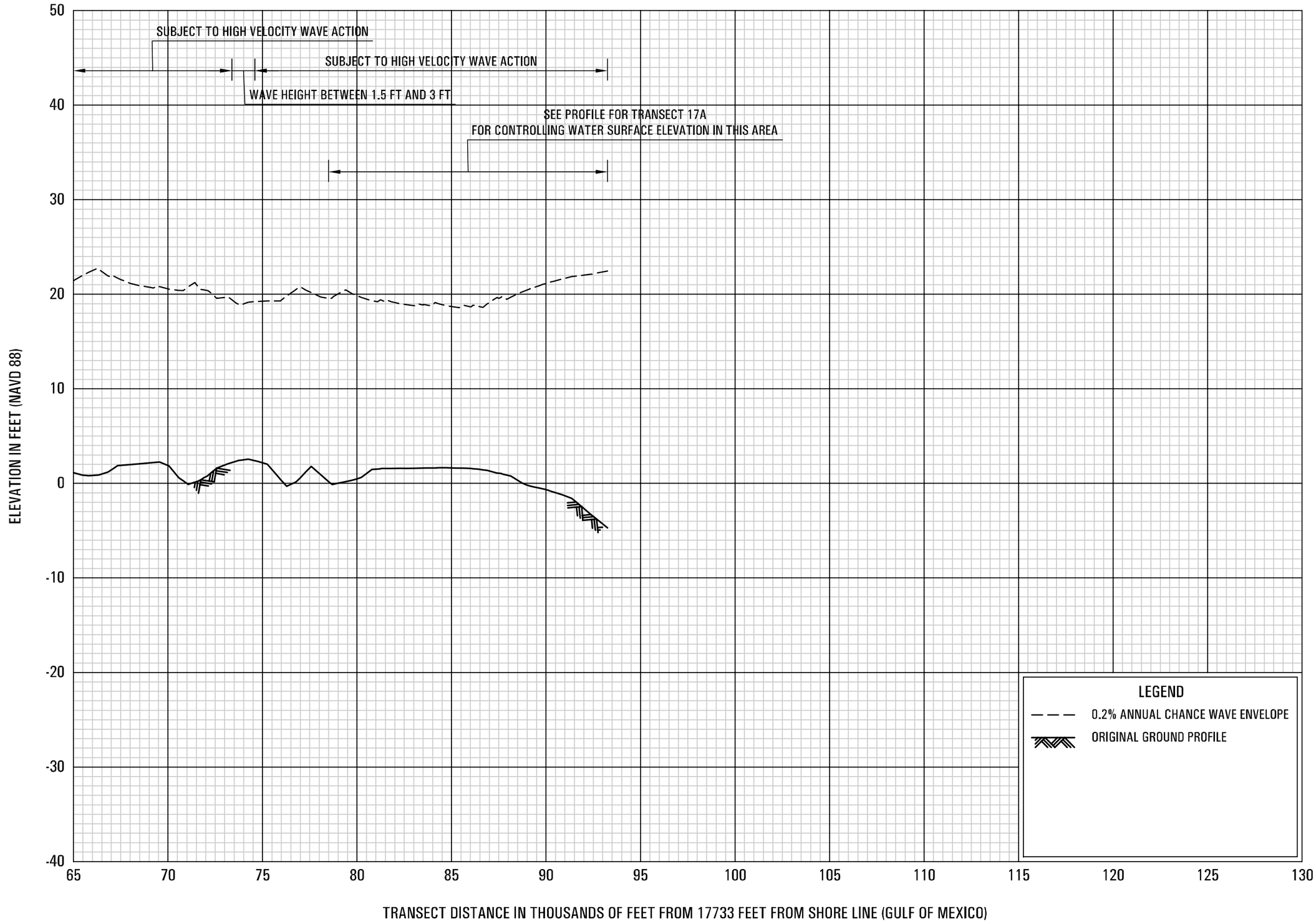
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 18A

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. BERNARD PARISH, LA

(ALL JURISDICTIONS)



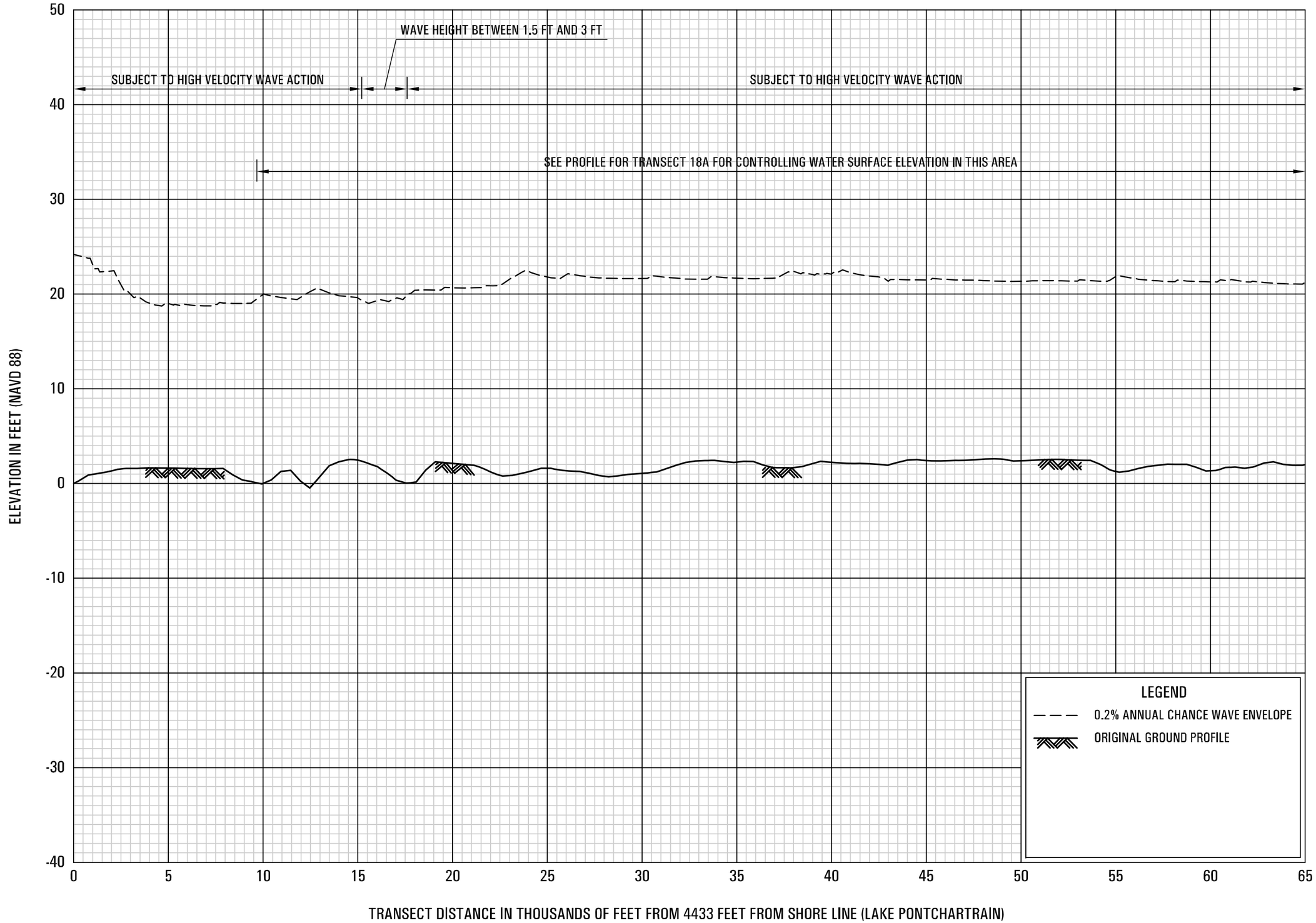
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 18A

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. BERNARD PARISH, LA

(ALL JURISDICTIONS)



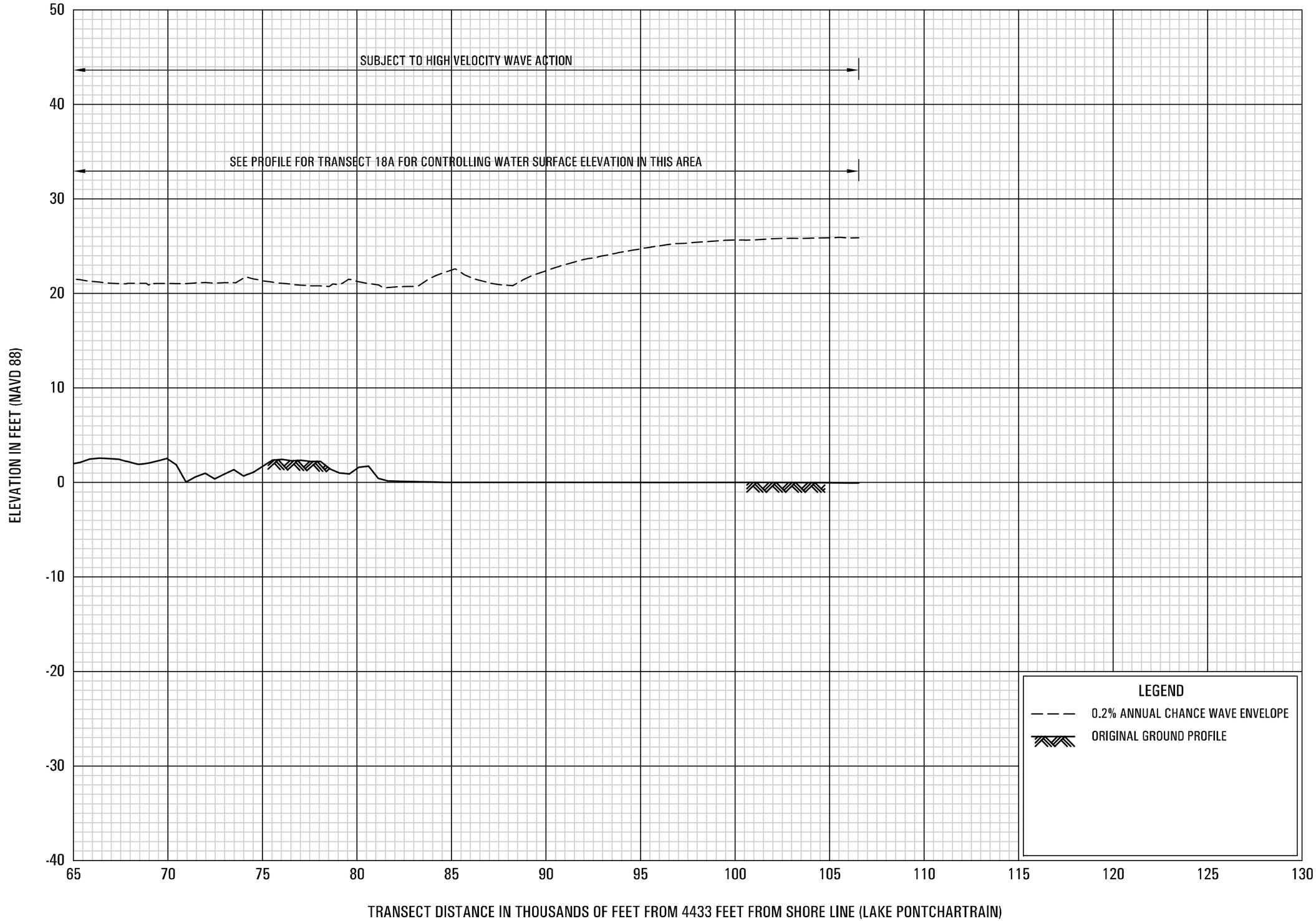
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 18B

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. BERNARD PARISH, LA

(ALL JURISDICTIONS)



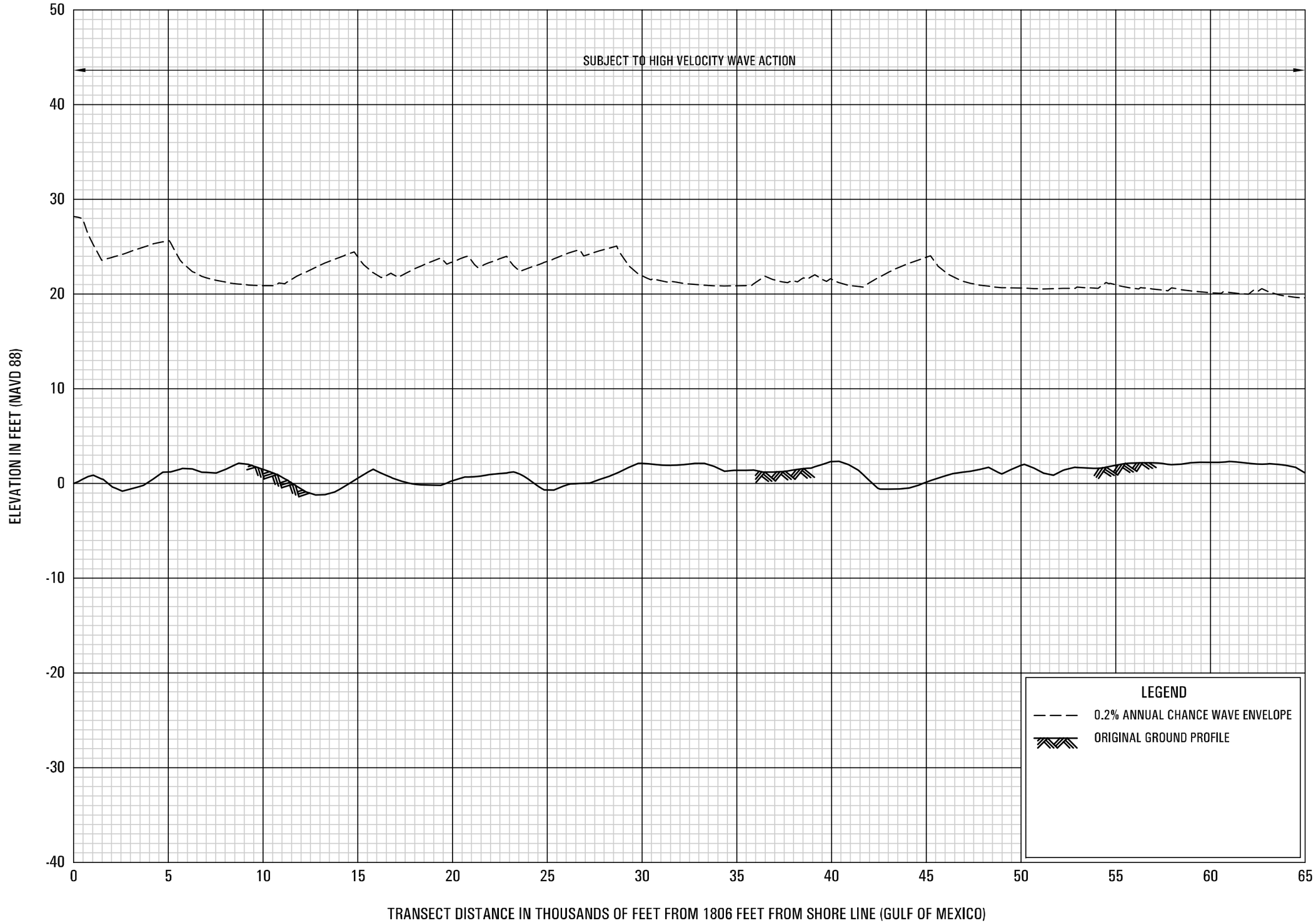
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 18B

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. BERNARD PARISH, LA

(ALL JURISDICTIONS)



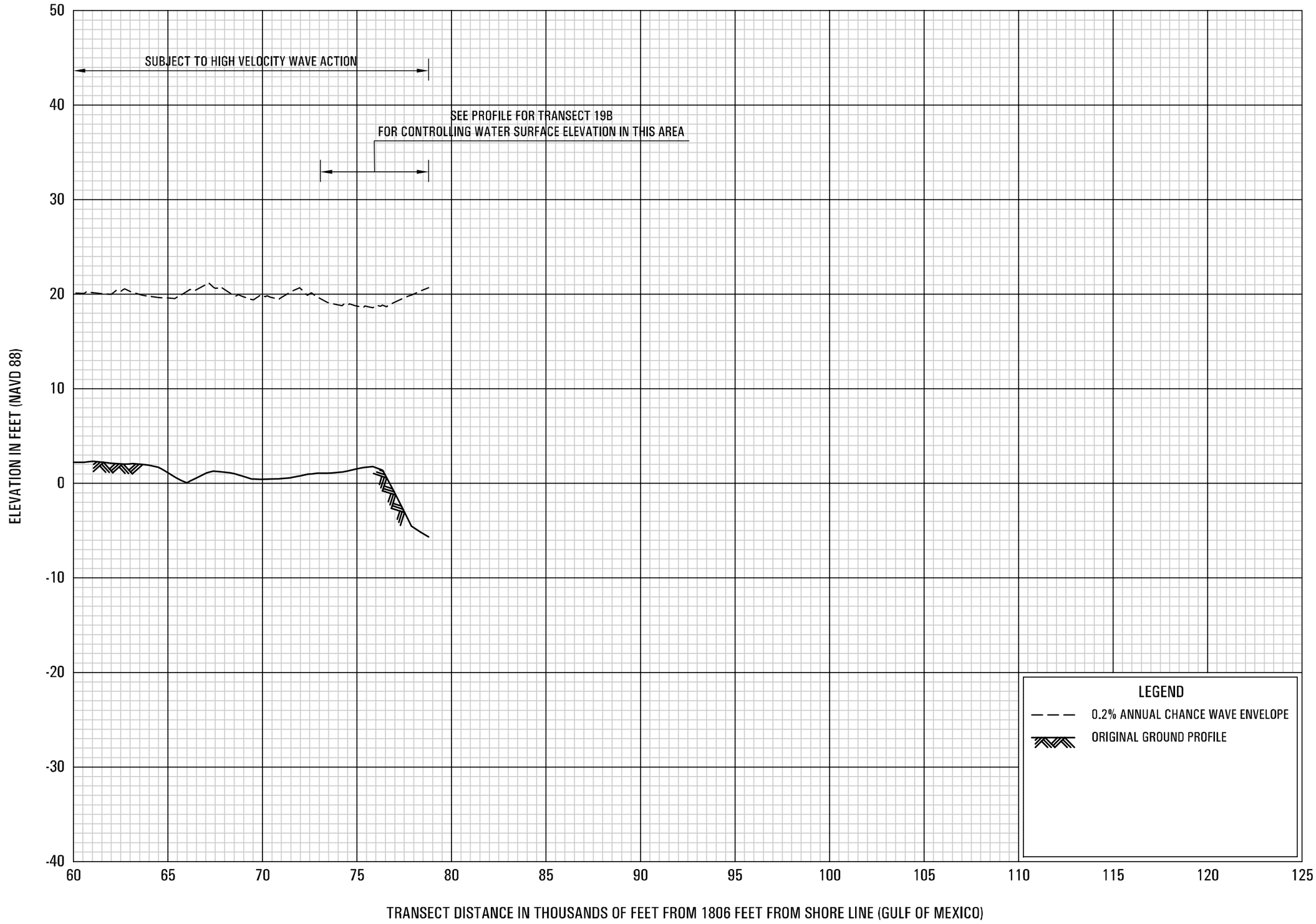
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 19A

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. BERNARD PARISH, LA

(ALL JURISDICTIONS)



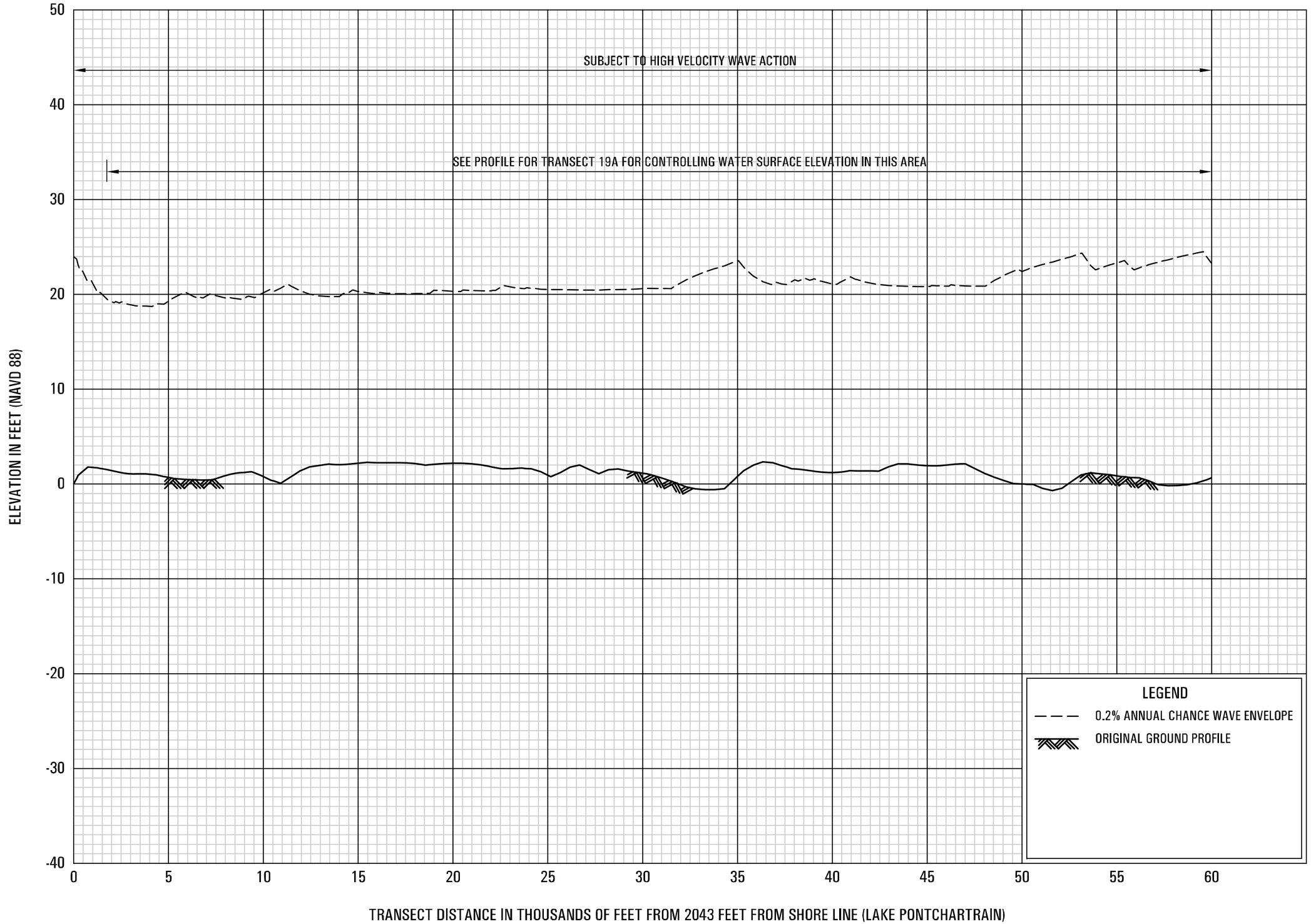
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 19A

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. BERNARD PARISH, LA

(ALL JURISDICTIONS)



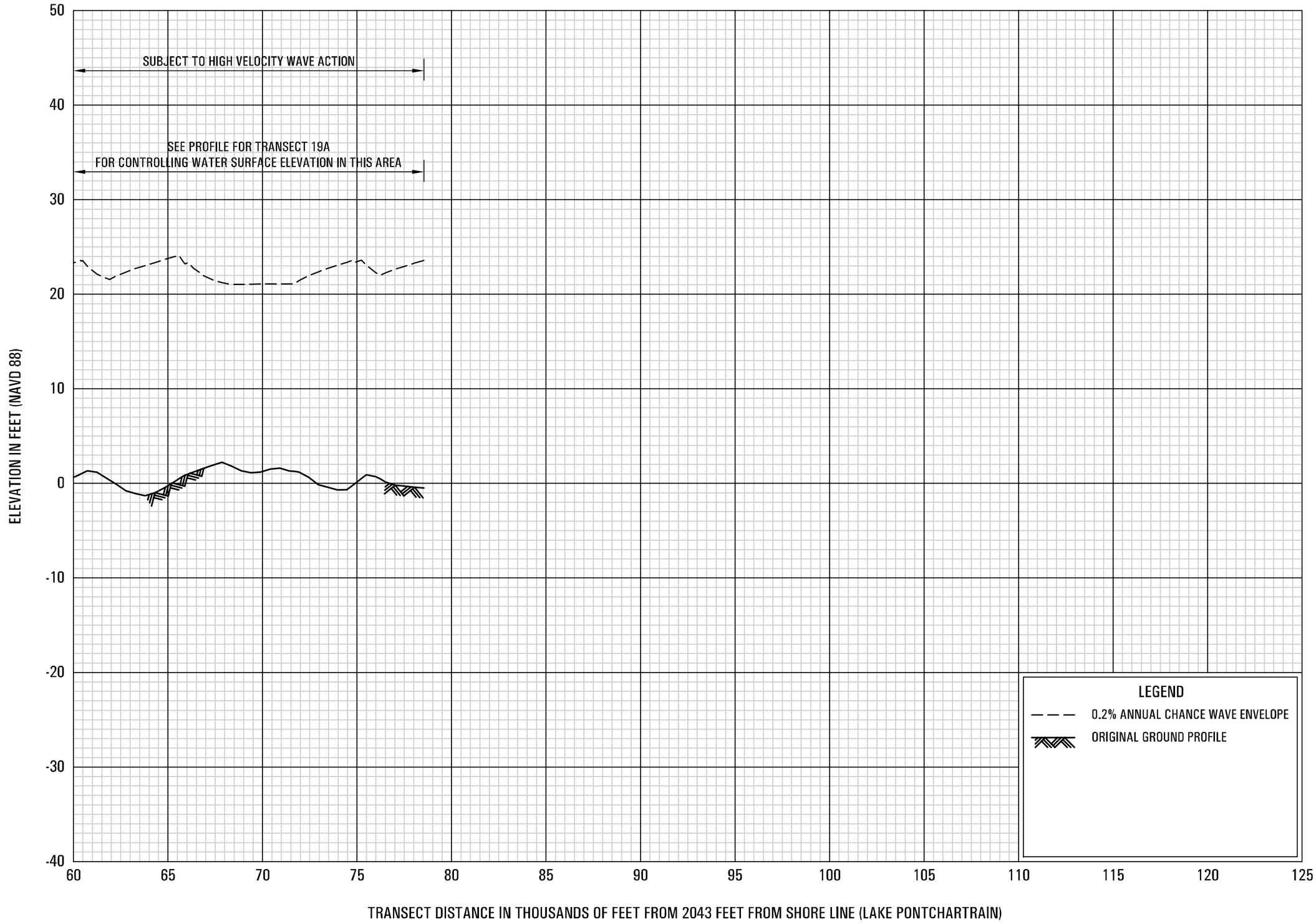
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 19B

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. BERNARD PARISH, LA

(ALL JURISDICTIONS)



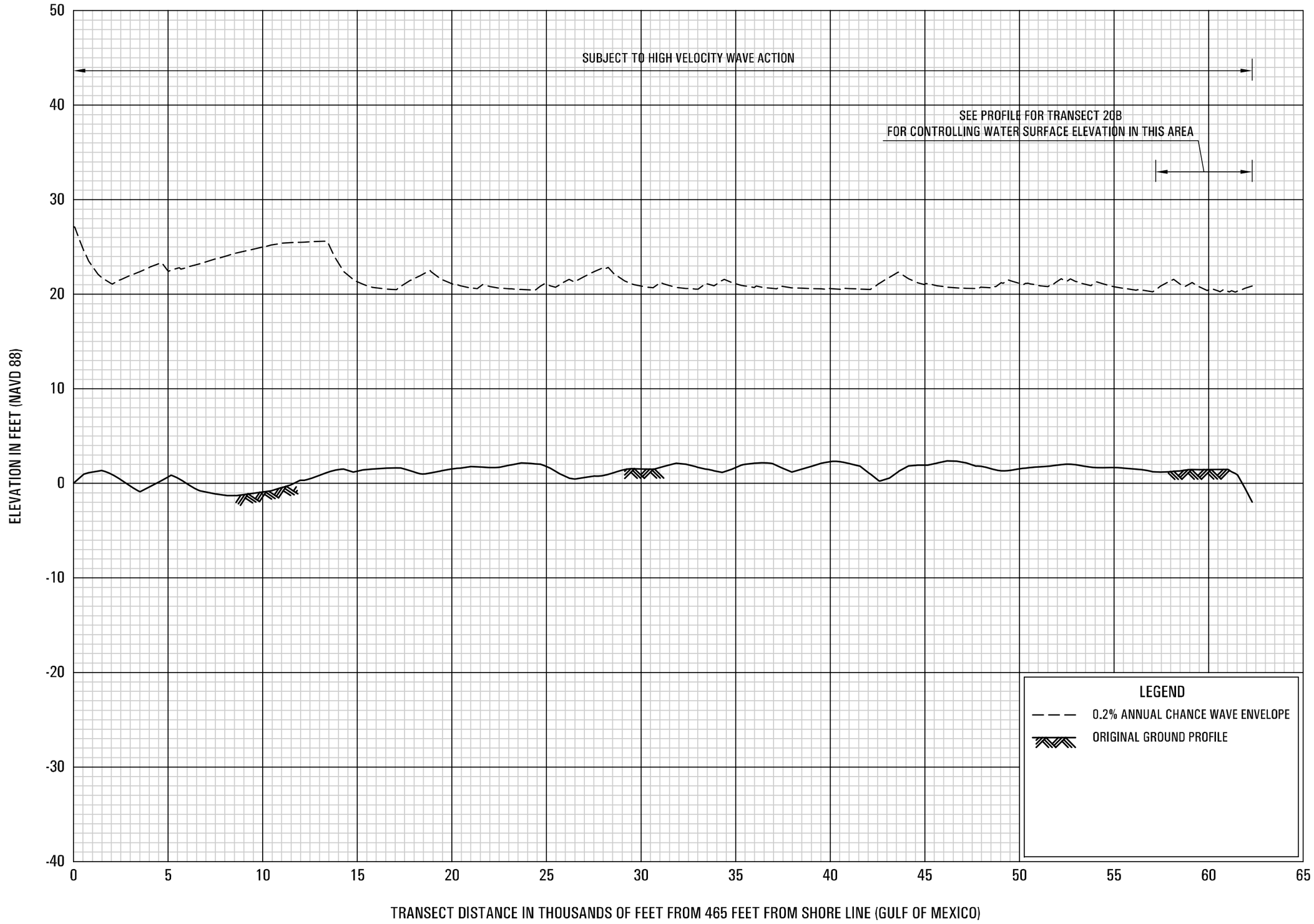
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 19B

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. BERNARD PARISH, LA

(ALL JURISDICTIONS)



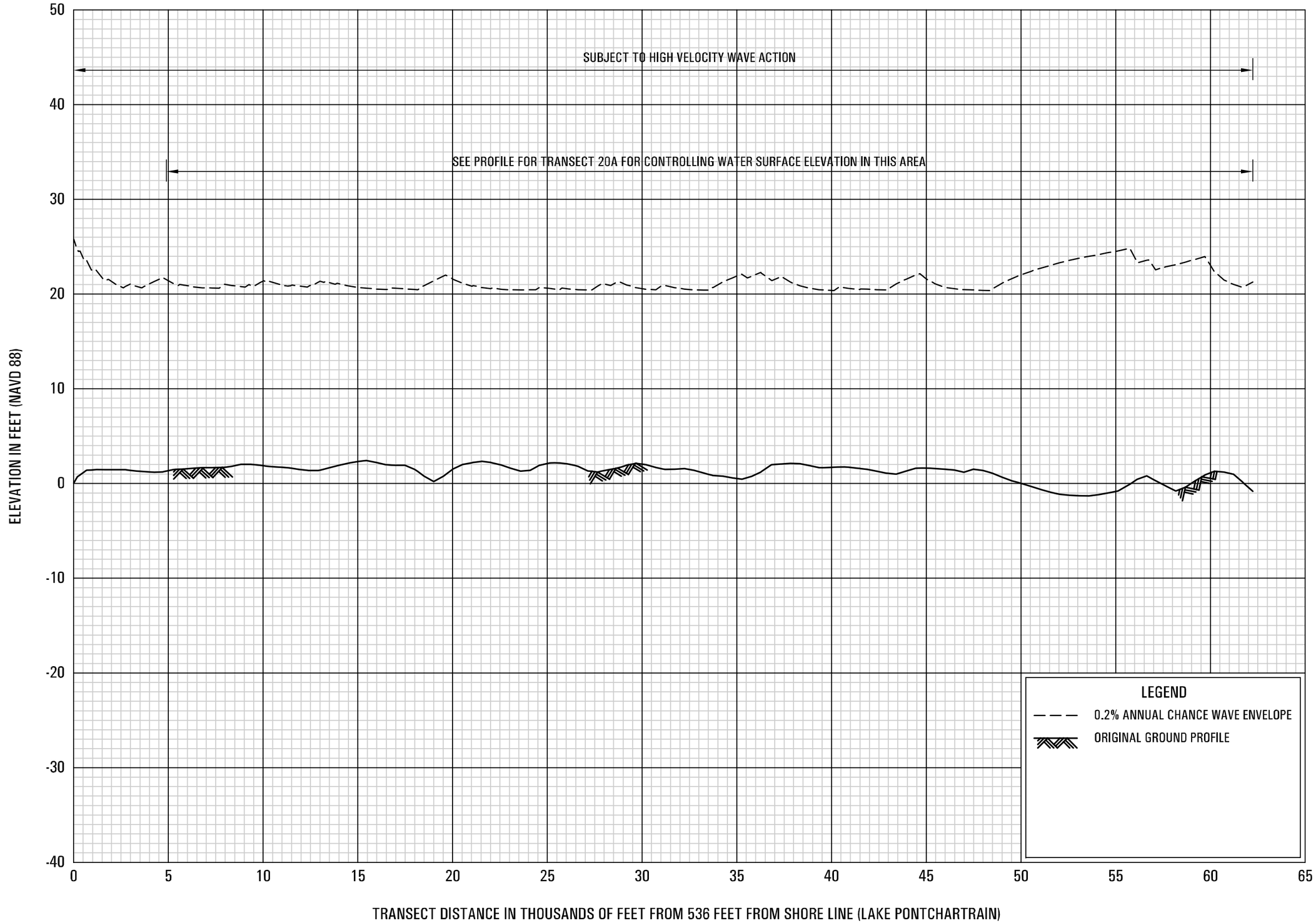
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 20A

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. BERNARD PARISH, LA

(ALL JURISDICTIONS)



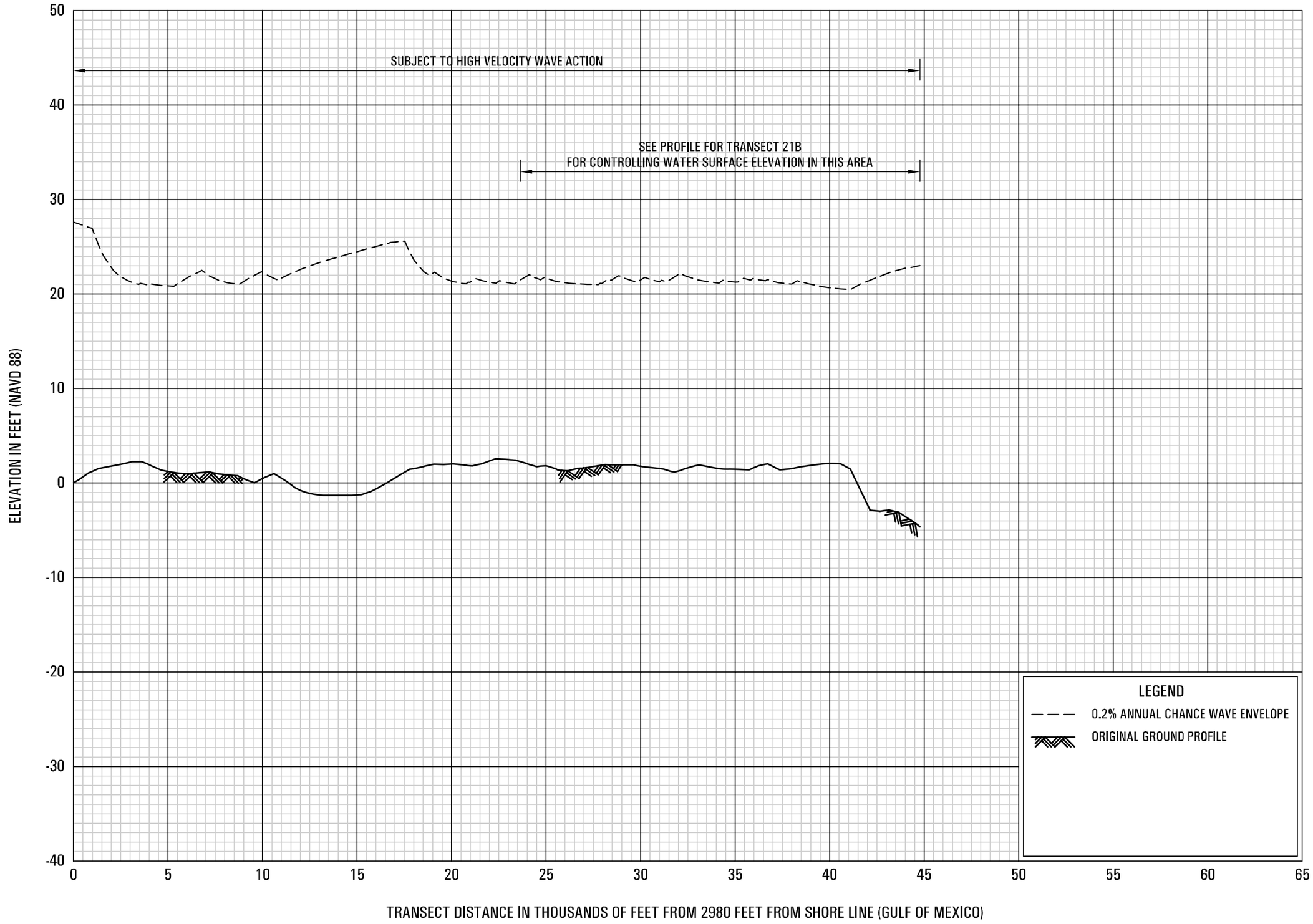
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 20B

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. BERNARD PARISH, LA

(ALL JURISDICTIONS)



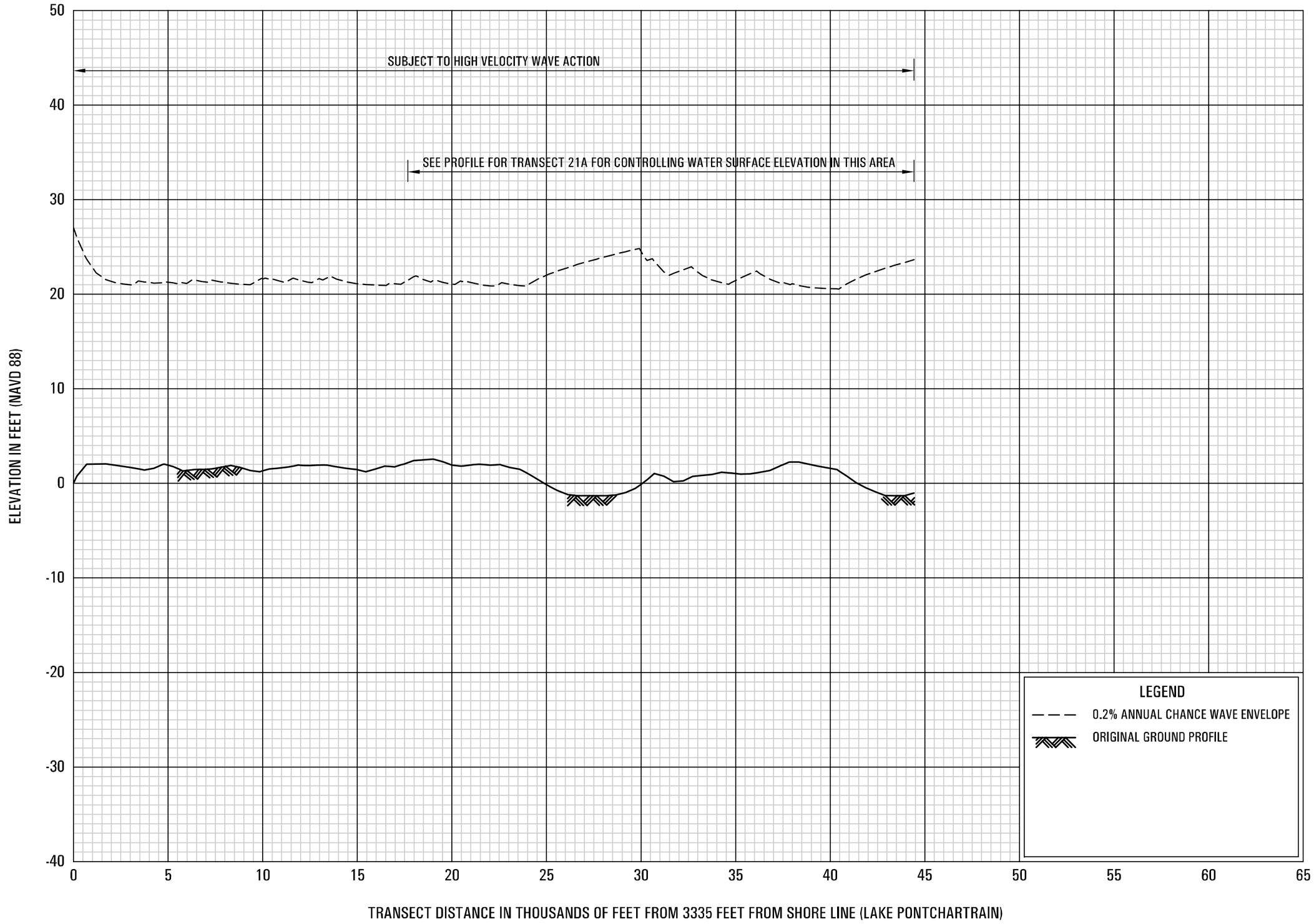
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 21A

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. BERNARD PARISH, LA

(ALL JURISDICTIONS)



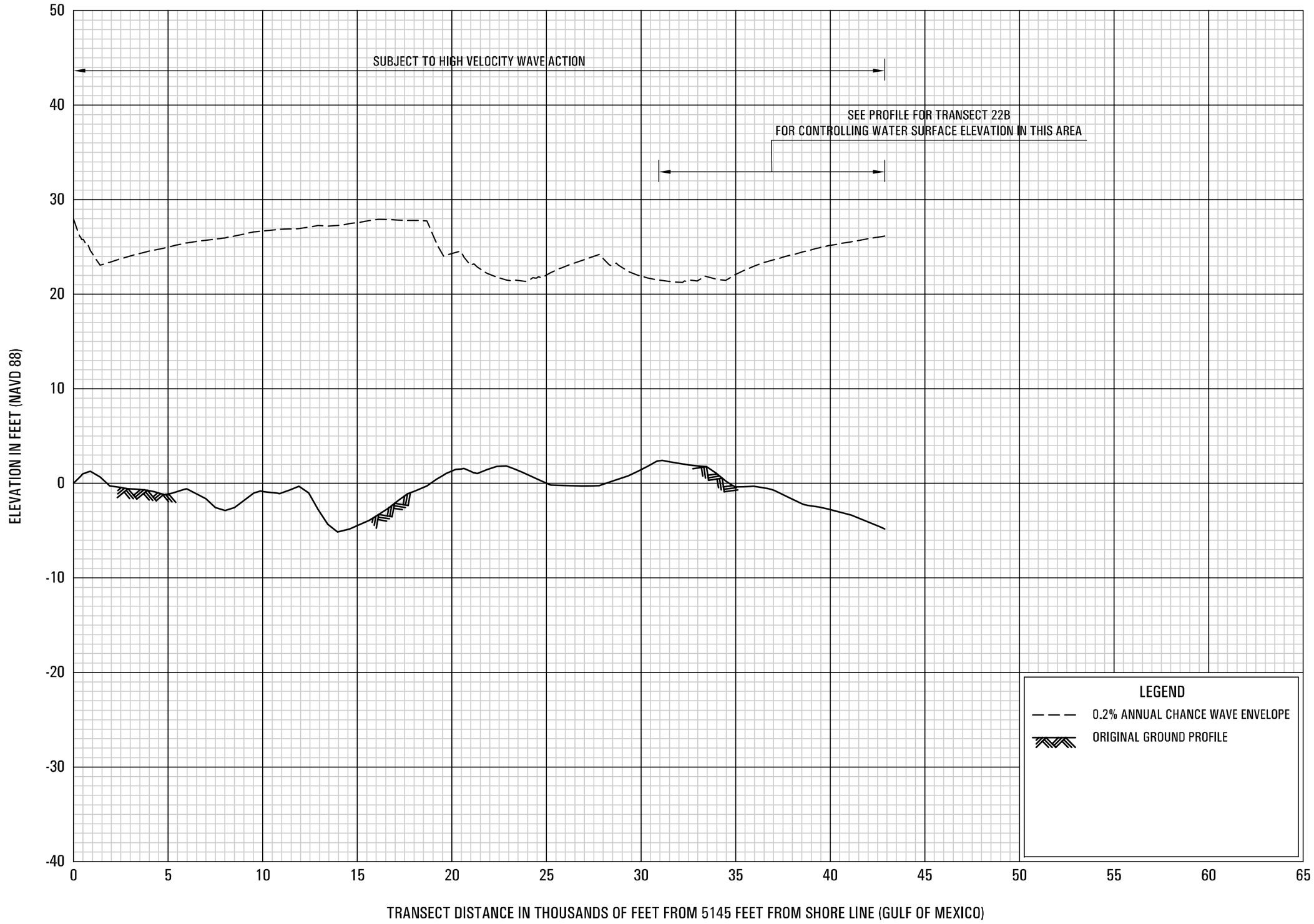
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 21B

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. BERNARD PARISH, LA

(ALL JURISDICTIONS)



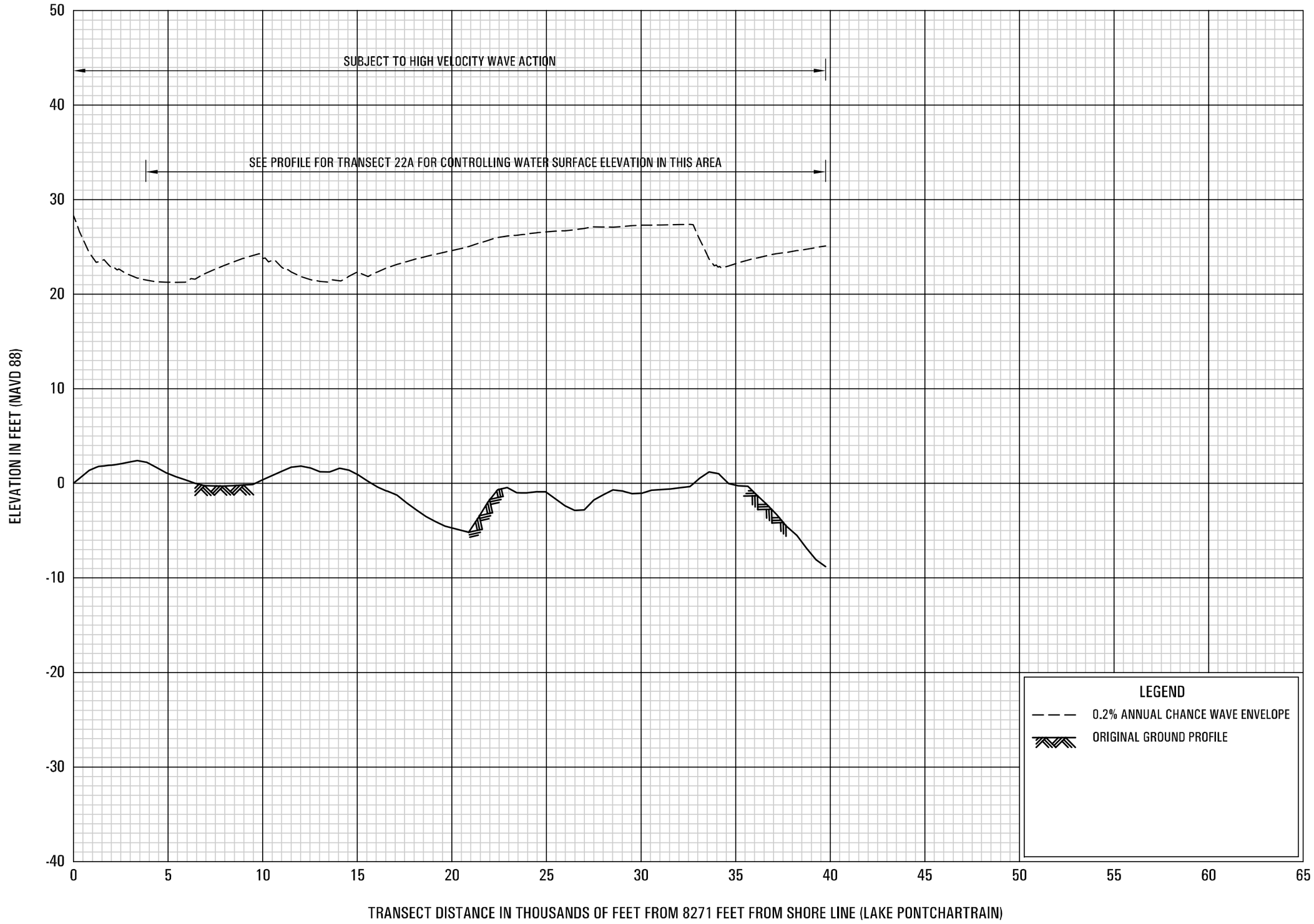
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 22A

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. BERNARD PARISH, LA

(ALL JURISDICTIONS)



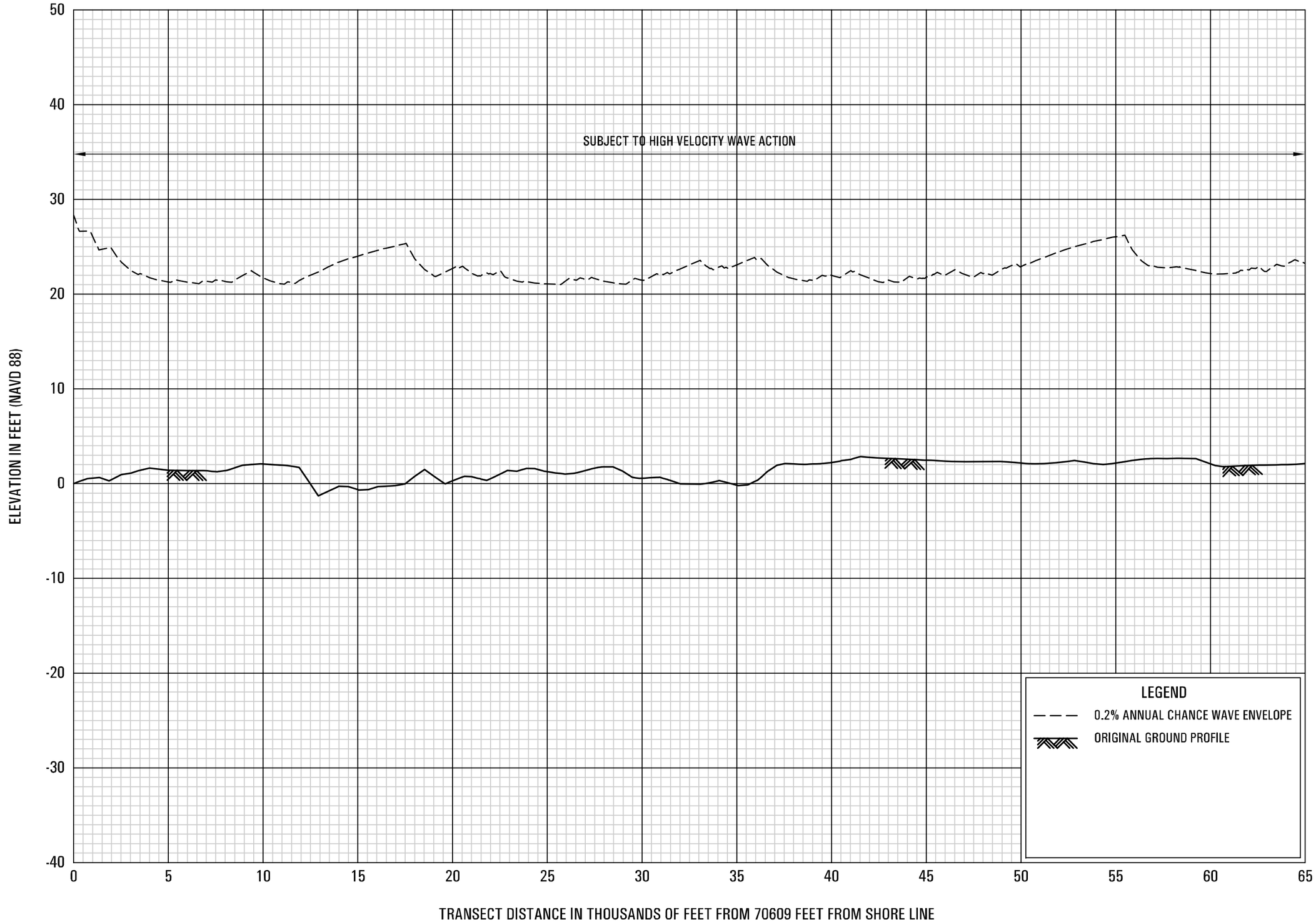
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 22B

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. BERNARD PARISH, LA

(ALL JURISDICTIONS)



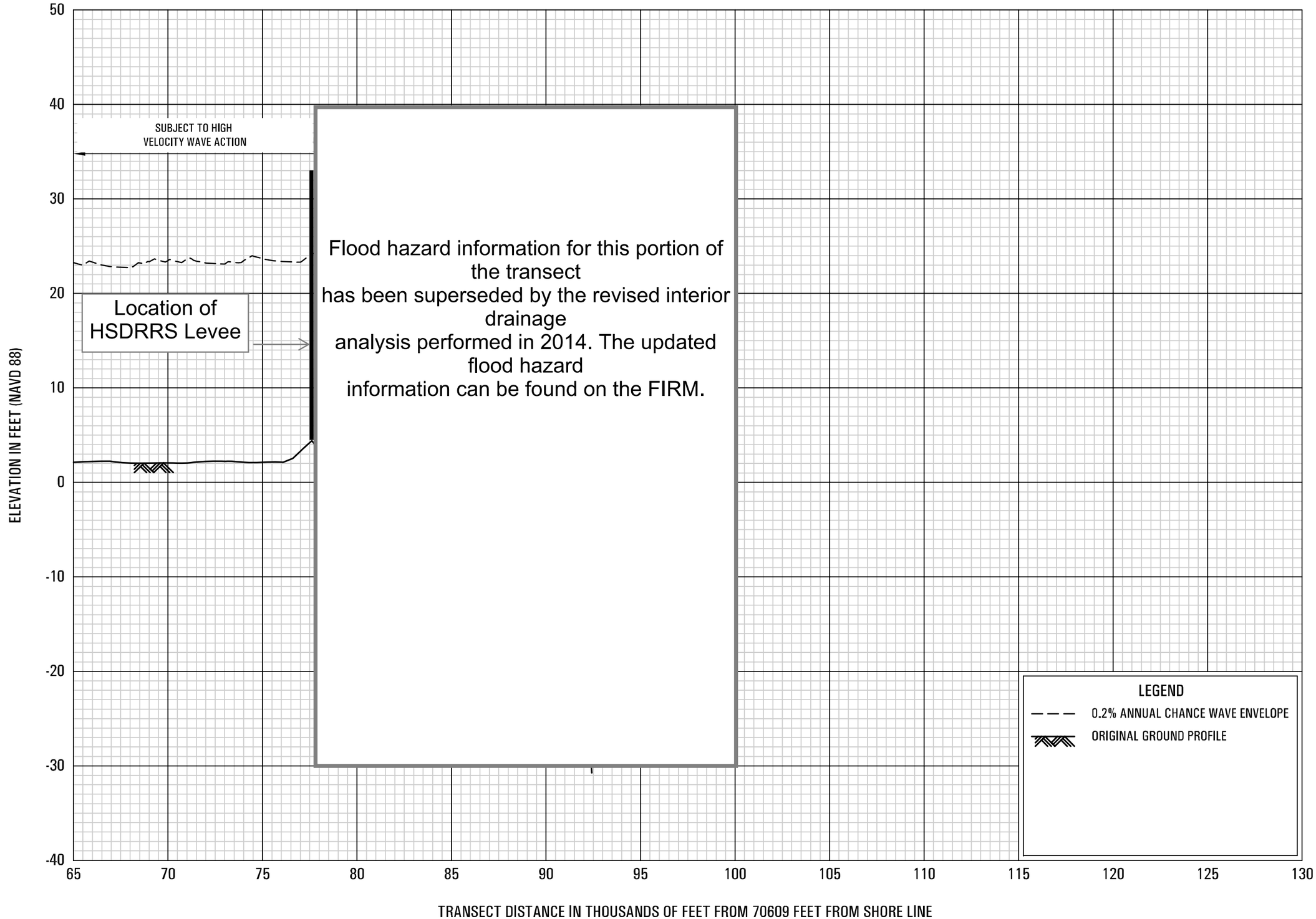
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 23

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. BERNARD PARISH, LA

(ALL JURISDICTIONS)



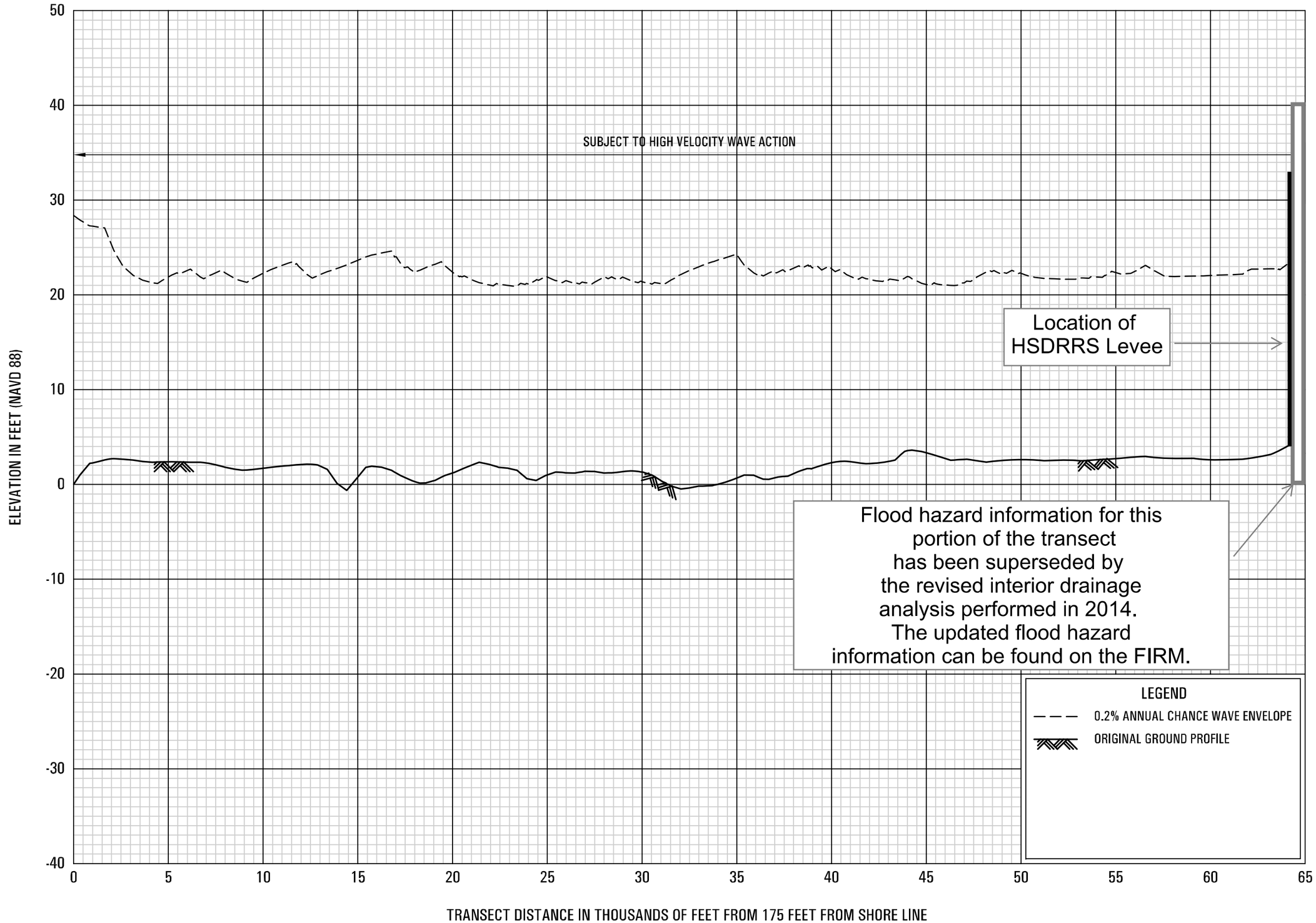
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 23

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. BERNARD PARISH, LA

(ALL JURISDICTIONS)



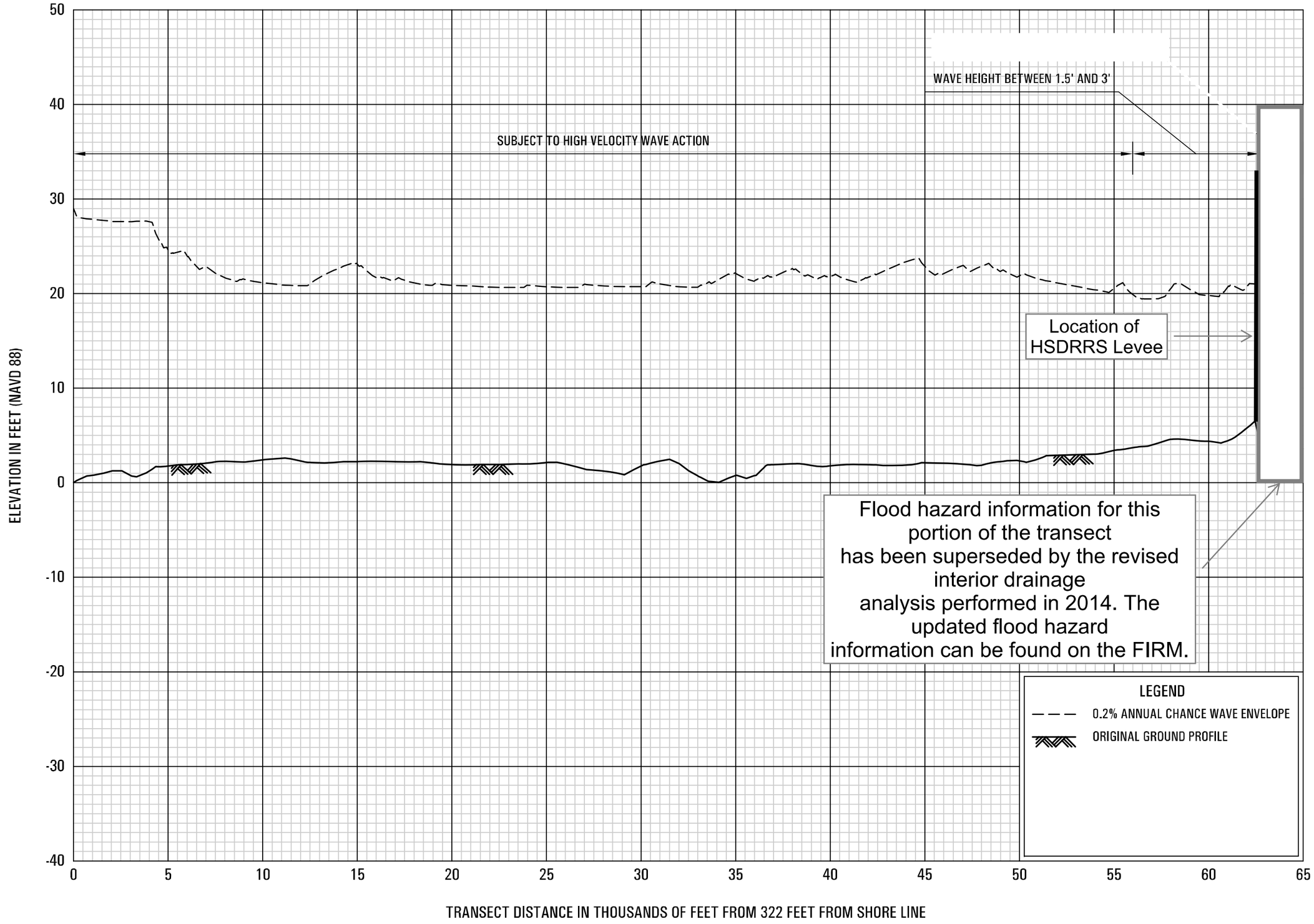
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 24

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. BERNARD PARISH, LA

(ALL JURISDICTIONS)



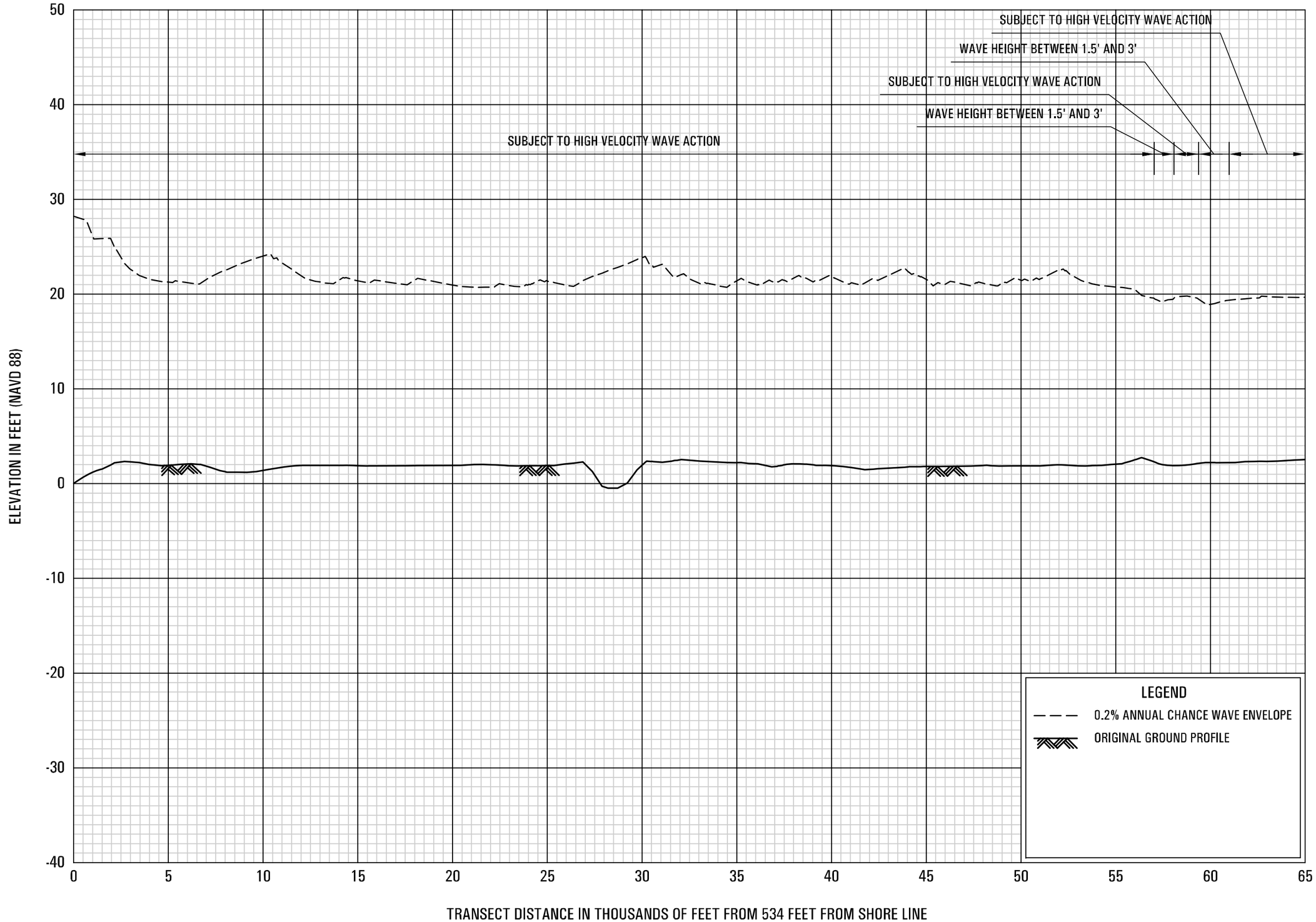
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 25

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. BERNARD PARISH, LA

(ALL JURISDICTIONS)



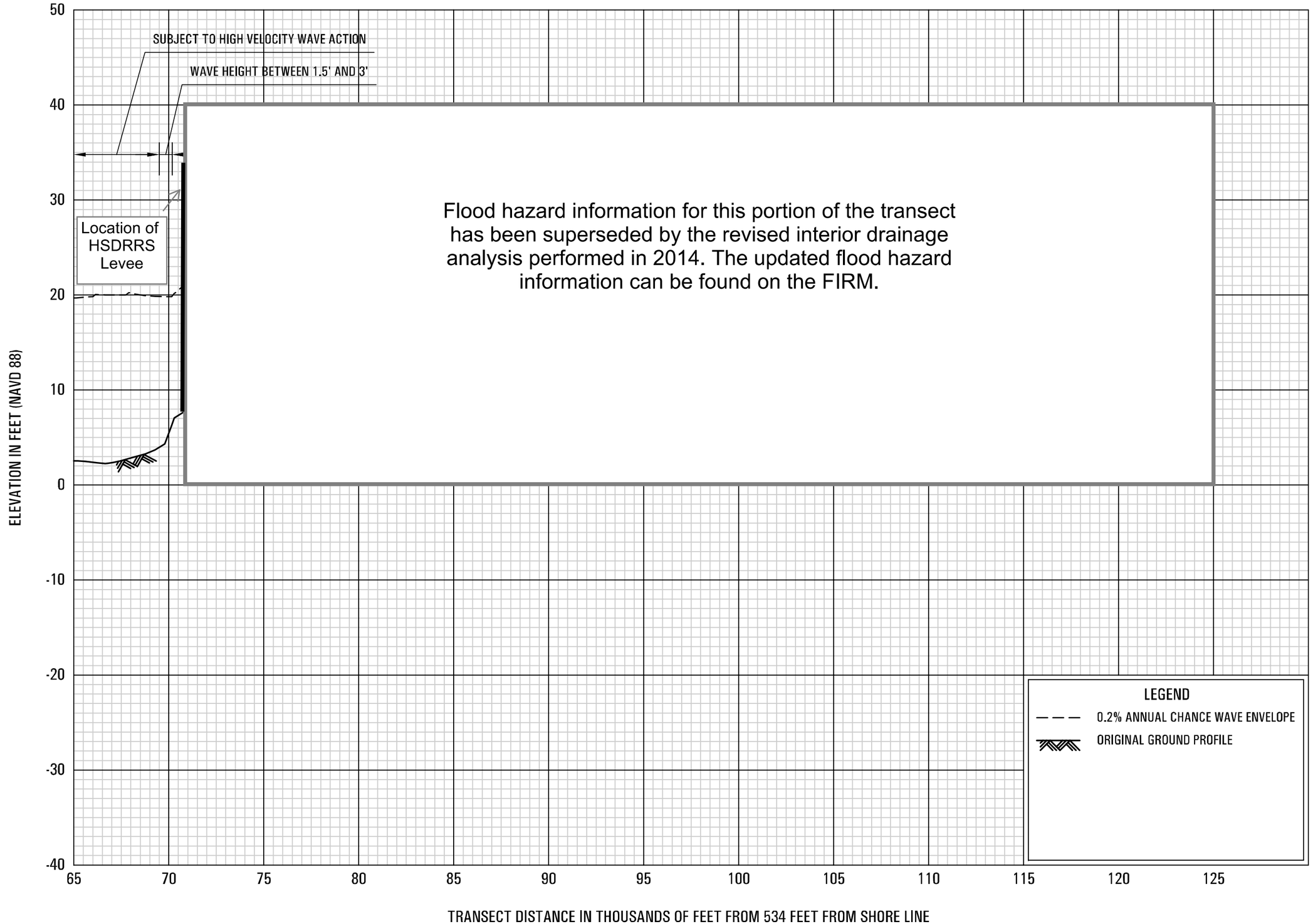
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 26

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. BERNARD PARISH, LA

(ALL JURISDICTIONS)



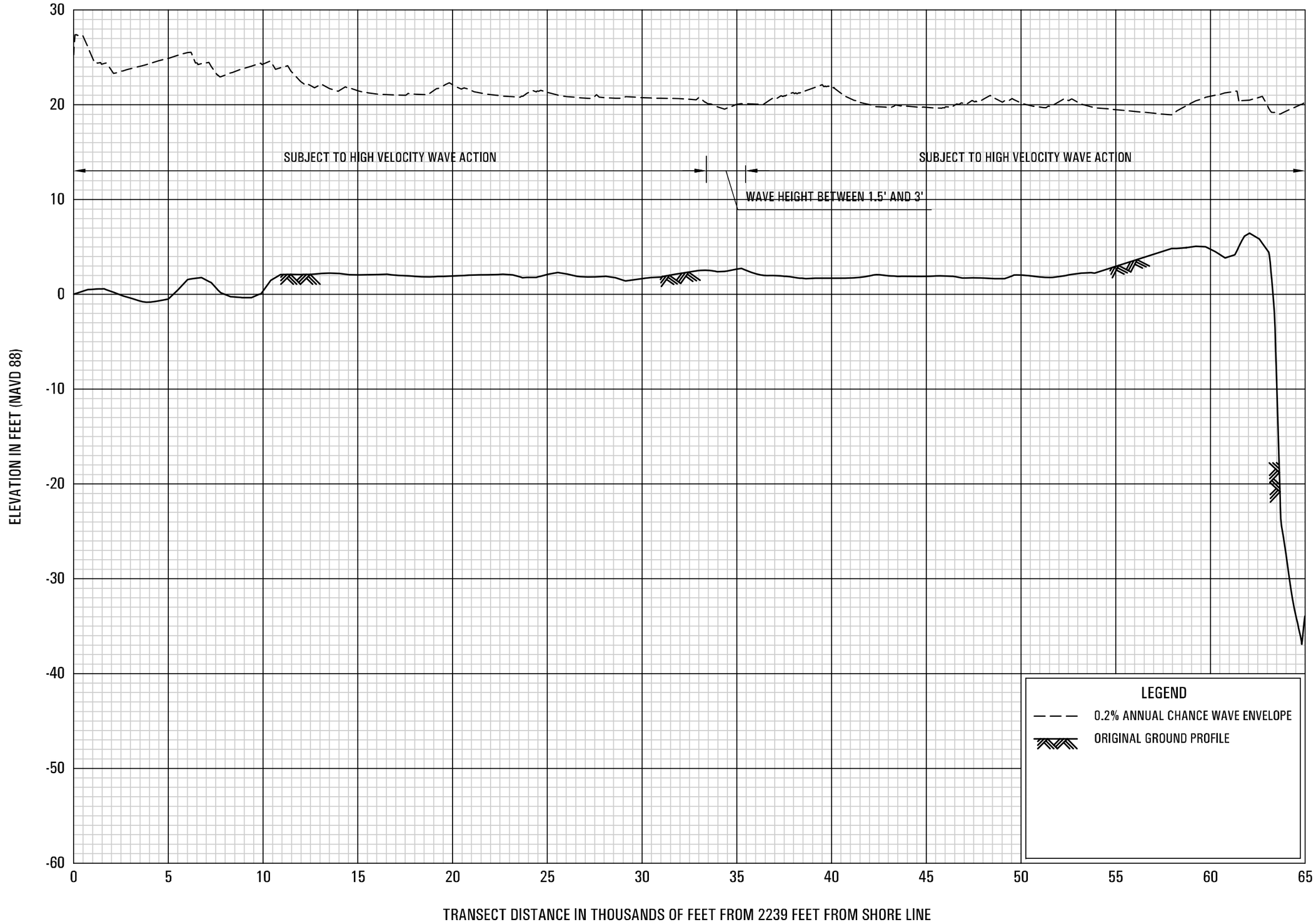
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 26

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. BERNARD PARISH, LA

(ALL JURISDICTIONS)



0.2% ANNUAL CHANCE WAVE ENVELOPE

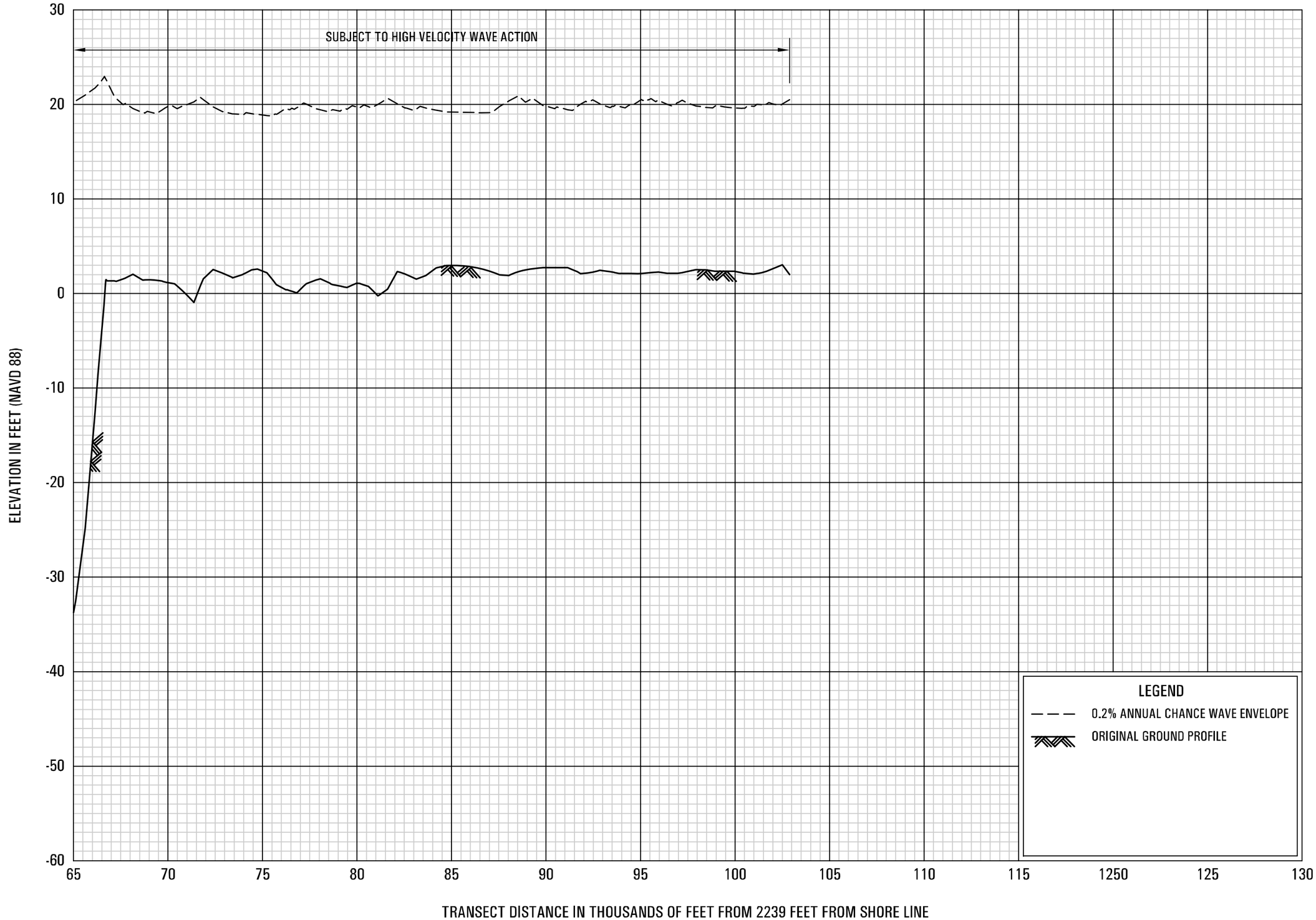
TRANSECT 27

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. BERNARD PARISH, LA

(ALL JURISDICTIONS)

53P



0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 27

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. BERNARD PARISH, LA

(ALL JURISDICTIONS)

54P