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R E P O R T

on

FLOOD CONTROL & SHORE EROSION PROTECTION

of

CITY of NEW ORLEANS

from

FLOOD WATERS of LAKE PONTCHARTRAIN

for

BOARD of LEVEE COMMISSIONERS

of

ORLEANS LEVEE DISTRICT

BEDELL & NELSON

Engineers

840 Union Street, New Orleans, Louisiana

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REPORT
on
FLOOD CONTROL & SHORE EROSION PROTECTION of the CITY of NEW ORLEANS
from
FLOOD WATERS of LAKE PONTCHARTRAIN

I - SCOPE of SURVEY and REPORT

Lake Pontchartrain, like the Mississippi River, is one of the natural blessings enjoyed by the City of New Orleans, but like the Mississippi River it is also a threat to the safety of life and property. The River has been confined with levees; its floods bypassed thru spillways until it is no longer a menace, but only a part of this same safety program has been accomplished in protecting the City from the incursion of Lake waters. Levees and a concrete seawall, built to maximum practical height, still permit Lake water, driven by high northerly winds, to invade the City causing flood damage to public and privately owned property, and extensive erosion damage to the shore of Lake Pontchartrain and the seawall foundations.

It is, therefore, the purpose of this report to present the results of a survey for the determination of -

- (1) Area of the City of New Orleans subjected to flood damage and shore erosion from the incursion of Lake waters;
- (2) Value of land and improvements in the area subjected to damage;
- (3) Climatology and storms of record;
- (4) Estimated past and future damage from hurricanes;
- (5) Recommendations for preventing flooding and shore erosion;
- (6) Estimate of cost of recommended work.

II - AREA SUBJECTED to FLOOD DAMAGE

The immediate area of the City of New Orleans which is subjected to damage from the intrusion of flood waters from Lake Pontchartrain is indicated on the accompanying contour map of the City, Exhibit A. This area is bounded on the north by the south shore of Lake Pontchartrain; on the east by the Industrial Canal Levee; on the south by the embankment of Gentilly Road U.S. 11-90, Gentilly Ridge and the New Orleans Terminal Company's railroad embankment; and on the west along the Orleans Parish line by the levee of the 17th Street Canal. The area is further subdivided into six sections, running north and south, by the levees of existing drainage canals and bayous and the embankment of the New Orleans & Northeastern Railroad; namely, from west to east, the New Basin Canal, Orleans Canal, Bayou St. John, the London Avenue Canal, and the New Orleans & Northeastern Railroad embankment.

II - Area Subjected to Flood Damage (Cont'd)

The contour map of the City of New Orleans, Exhibit A, indicates that the ground surface of most of the City of New Orleans is below elevation +2.0 M.G.L., and further, extensive areas of the City, including the major portion of the area subjected to flooding, are below elevation 0.0 M.G.L. The highest natural ground in the City of New Orleans lies adjacent to the Mississippi River at an elevation of +14.0 M.G.L. From the river the ground surface recedes in a northerly direction towards Lake Pontchartrain terminating in elevations ranging from -2.0 to -4.0 M.G.L. in areas immediately south of the Lake Shore Development.

The original Lake Pontchartrain levees extended from the New Basin Canal along the approximate north side of Robert E. Lee Boulevard in an easterly direction to the embankment of the New Orleans & Northeastern Railroad and the Industrial Canal. Enabling legislation passed by the State of Louisiana in 1928 brought about the construction of the present concrete seawall and the lake shore development lying north of the line of Robert E. Lee Boulevard and extending from the New Basin Canal on the west to the east side of the New Orleans Airport. This development was undertaken by the State of Louisiana thru the agency of the Board of Levee Commissioners of the Orleans Levee District, and the work was completed in 1931. The top of the concrete seawall was set at elevation +9.6, and the area between Robert E. Lee Boulevard and its easterly extension and the seawall was hydraulically filled to a height varying from +8.0 at the seawall to +2.0 along the line of Robert E. Lee Boulevard and the original Lake Pontchartrain levee, all as indicated on the contour map, Exhibit A.

The east boundary of the area subjected to flooding, being the Industrial Canal Levee, is maintained at approximately elevation +9.6. The embankment of Gentilly Road U.S. Highway 11-90 with an elevation of +3.0 to +4.0 M.G.L. forms the part of the south boundary of the area subject to flooding extending westward from the Industrial Canal to the east end of Gentilly Ridge at the New Orleans & Northeastern Railroad crossing of Gentilly Road.

Gentilly Ridge, lying in a generally east-west direction and extending from the New Orleans Terminal Company railroad crossing at Gentilly Road at its western extremity to the crossing of the New Orleans & Northeastern Railroad and Gentilly Road at its eastern end, varies in height from elevation +3.0 to +4.0 M.G.L., thereby forming a part of the south boundary of the area subjected to damage from flood waters. The remainder of the southern boundary of this area is formed by the New Orleans Terminal Company's railroad embankment running in a generally east-west direction and extending from the 17th Street Canal levee at the Orleans Parish line on the west to its crossing of Gentilly Road on the east; this railroad embankment varies in height thru its length from +3.0 to +7.5 M.G.L.

II - Area Subjected to Flood Damage (Cont'd)

The west boundary of the area is the levee of the 17th Street Canal extending in a northerly direction from the New Orleans Terminal Company's railroad embankment to Lake Pontchartrain along the Orleans Parish line. This levee is maintained at approximately elevation +9.6 M.G.L.

The levees of the aforementioned New Basin Canal and Bayou St. John are maintained at elevation +9.6 M.G.L. to the locks which on each waterway are located approximately 1/2 mile from the Lake shore. The levees and sheet pile bulkheads of the Orleans Canal and London Avenue Canal are at elevation +9.6 M.G.L.

The embankment of the New Orleans & Northeastern Railroad varies from +8.0 M.G.L. along the south boundary of New Orleans Airport and the Lake Shore Development to +9.0 at its crossing of Gentilly Road at the south boundary of the area subjected to flooding.

The topographical features of the area subject to flooding, as hereinbefore described, are such that six separate natural basins for the ponding of flood water exist in the area, as indicated on the contour map, Exhibit A.

The approximate areas of these sections from west to east are -

A	-	582	Acres
B	-	1033	"
C	-	925	"
D	-	1110	"
E	-	1438	"
F	-	972	"

making a total area subjected to flood damage, lying between the Lake Shore Development and the south boundary of the area and extending from the 17th Street Canal on the west to the Industrial Canal on the east, of approximately 6060 acres.

The Lake Shore Development, as hereinbefore described and indicated on the map, Exhibit A, is subdivided into zones, the approximate areas of which are from west to east -

Zone 1	-	339	Acres
" 2	-	388	"
" 3	-	275	"
" 4	-	723	"

making the total area of the Lake Shore Development, extending from the New Basin Canal on the west to the Industrial Canal on the east, approximately 1725 acres.

II - Area Subjected to Flood Damage (Cont'd)

The Lake Shore Development is not subject to flood damage from ponding as described for the balance of the area, but is subjected to damage from the direct sheet flow of Lake waters over its surface as the water tops the seawall and flows into the ponding areas to the south.

It is, therefore, concluded that the area of the City of New Orleans, which is subjected to damage from the intrusion of Lake water during periods of high winds and hurricanes, is approximately 7785 acres.

The south shore of Lake Pontchartrain, extending from the New Basin Canal on the west to the Industrial Canal on the east, thereby forming the north boundary of the area subject to flood damage, is protected against normal tides by a concrete seawall constructed to elevation +9.5 M.G.L. which consists of 690 sections each 40 feet in length, making the total length of the wall and shore line 27,600 lineal feet.

The entire shore line and seawall are subject to serious erosion by the action of Lake waters which overtop the wall during high northerly winds and hurricane tides.

III - VALUATION of LAND and IMPROVEMENTS in the AREA SUBJECT to DAMAGE

The area subject to damage, as indicated on the Land Usage Map, Exhibit B, contains the last remaining and most important area for intermediate and high type residential development within the City of New Orleans.

Recreational facilities, both public and private, in this area consist of the following -

925 acres of City Park; approximately five miles of Lake shore parks extending from the New Basin Canal to the Industrial Canal; the Municipal Yacht Harbor; Pontchartrain Beach, a large public amusement park; the West End Country Club; and the Southern Yacht Club, all located in the area subject to damage.

These installations form the major part of all recreational areas and facilities serving the three-quarters of a million inhabitants of both the City of New Orleans and the adjacent residential areas of Jefferson Parish and St. Bernard Parish.

Located in the Lake Shore Development are four separate important military establishments.

III - Valuation of Land and Improvements in the Area Subject to Damage (Cont'd)

One large manufacturing plant is also located on the Lake front at Franklin Avenue.

Considering the areas A thru F, as shown on the Land Usage Map, Exhibit B, -

Area A, consisting of approximately 582 acres, contains 75 acres of developed and inhabited intermediate residential area located at the north end of the area. The West End Country Club, consisting of approximately 100 acres, is located near the south end of this area. The balance of this section, being approximately 407 acres, is undeveloped and partly drained and cleared;

Area B, consisting of 1033 acres, known as Lakeview, is a highly developed intermediate to high type residential area. In this section are located 36 commercial structures, which include restaurants, food stores, bakeries, hardware and appliance stores, drug stores and two theatres; public and institutional buildings consist of 1 fire station, 6 churches, 1 public school, 2 parochial schools and 1 public school under construction;

Area C, consisting of 925 acres of City Park, is a large partly developed recreational area. The developed area contains the City Park Golf Club, a lighted driving range, 5 large playing fields and several acres of landscaped picnic grounds. At the northeast corner of City Park is located the U.S. Department of Agriculture Research Laboratory, a one million four hundred thousand dollar investment;

Area D, a part of Gentilly, consisting of 1110 acres, contains 816 acres of highly developed intermediate to high type residential sections, as well as 2 large private multiple unit apartment projects. The remaining 294 acres of the area are partly drained and cleared but undeveloped;

Area E, the remainder of Gentilly, consisting of 1438 acres, is a highly developed residential section;

In areas D and E, the Gentilly Section, are located 23 commercial establishments of the types as described for Lakeview, Area B. Public and institutional buildings consist of 2 fire stations, 1 large public school under construction, Dillard University, Milne Boys Home, 4 churches and 2 parochial schools.

Area F, consisting of 972 acres is undeveloped with the exception of shipyard and other marine establishments located on the Industrial Canal. A relatively small area of apartment buildings, a Baptist Seminary under construction, and an abandoned temporary defense housing project is located adjacent to Gentilly Highway U.S. 11-90. Land has been purchased and plans are at present being prepared for the construction of a 30 million dollar private housing project to be located in this area.

III - Valuation of Land and Improvements in the Area Subject to Damage (Cont'd)

It is therefore concluded that of the 6060 acres in the area subject to flood damage lying south of the Lake Shore Development land usage is, as follows -

Residential and Commercial and Institutional	3400 Acres
Recreational	1060 "
Undeveloped	1600 "
Total	<u>6060</u> "

Consideration of the population trend and growth in the area south of the Lake Shore Development, containing approximately 5000 acres after excluding parks and recreation areas, indicates that it has been the fastest growing residential area of New Orleans, particularly during the past ten years.

Previous census records and estimated present and future population indicate the following -

<u>1920</u>	<u>1940</u>	<u>1945*</u>	<u>1950**</u>	<u>1975***</u>
4380	17,487	28,450	41,340	78,215

* From unofficial census by Planning & Zoning Commission of the City of New Orleans

** Estimated on basis of 3.9 inhabitants/dwelling unit average for City of New Orleans (Figure reasonably agrees with unofficial 1950 estimates)

*** Estimated by Planning & Zoning Commission, City of New Orleans

Accordingly the census figures indicate an approximate 136% increase in population in the area during the past ten years.

This marked increase in population has been accompanied by a large residential and multiple dwelling unit construction program, made possible by installation of subsurface drainage and all utilities, as well as paved streets, sidewalks, clearing, site filling and other improvements throughout the area.

As of 1950, according to a field survey of the area, there have been constructed approximately 49 miles of paved streets, of which 23 miles are of a permanent type reinforced concrete with curb and gutter and subsurface drainage, or asphalt surface on a reinforced concrete base; the remaining 26 miles are asphaltic concrete or asphalt-surfaced shell streets. An additional 40 miles of streets in the area are unpaved shell-surfaced streets.

Subsurface drainage terminating in open channels conveys storm waters to pumping stations of the New Orleans Sewerage & Water Board which then lift these waters into the principal outfall canals draining by gravity into Lake Pontchartrain.

III - Valuation of Land and Improvements in the Area Subject to Damage (Cont'd)

Practically all of Lakeview and two-thirds of Gentilly are served by extensions of sanitary sewers of the New Orleans Sewerage and Water Board.

Based on recent sales, a fair average value of unimproved land in the area south of the Lake Shore Development is \$3500 per acre.

A determination of the number of buildings in the area subject to damage was made from two principal sources, i.e., an aerial survey made in 1945 and a compilation of the building permits issued for the area by the Department of Regulatory Inspection for the years 1946 thru 1949. The aerial survey supplemented by ground inspection indicated a total of 6600 residences in the Lakeview and Gentilly areas as of the close of the year 1945. The compilation of residential building permits issued during the years 1946 thru 1949 indicated that 3988 residences were constructed in the area. During the same period a total of 9867 residences were constructed in the entire city. It is therefore evident that during the past four years residential construction in this area was equivalent to 41% of the total for the entire city thus indicating clearly the rapid residential growth of the area.

A comparison of the value of these residences with the residential construction of the entire city during this period indicates that altho the total value of residential construction for the city was \$48,344,500, the value of the residential construction in the area was \$21,640,300, showing that 44½% of the total value of residences is represented by the 41% of the dwelling units showing that the class of construction is slightly better than the average for the city as a whole.

The value of residential construction as indicated by building permits can be used for the purpose of comparison only, since prior to 1949 actual contract values were not recorded as the estimated value shown on the permit. Since February 1949 the estimated value as shown on the building permit is the actual contract price and therefore is a true value. A general comparison of recorded permit costs both prior to and after February 1949 indicates that the previous recorded value was actually approximately one-half of the actual construction cost. A field survey of the residential construction in the area indicates an average cost per residential unit of \$11,000, or 203%, of the values indicated in building permit records prior to 1949.

It is therefore evident that an analysis of the value of the residential construction in this area shows the value of residences constructed during the past four years to be \$43,900,000.

III - Valuation of Land and Improvements in the Area Subject to Damage (Cont'd)

Further using the same basis of comparison, the value of the total residential construction in the area is approximately \$116,000,000.

A field survey of all commercial and institutional buildings in the area indicates a value of approximately \$6,400,000.

A large section of Area F has been purchased, plans completed and construction imminent, of a \$30,000,000 privately financed residential housing development, which includes 3000 residential units.

The value of gas and electric distribution systems in the entire area, including the Lake Shore Development, is estimated at approximately \$4,316,200.

Using an average fair value of \$3500 per acre for undeveloped land as determined by recent acreage sales in the area south of the Lake Shore Development, extending from the Industrial Canal to the 17th Street Canal, the undeveloped land value of the 582 acres of Area A is \$2,037,000. The value of streets and improvements other than buildings in the area is \$175,000.

Using current sale prices of \$100 per front foot on Canal Boulevard and \$60 per front foot on other streets in Lake View, Area B, a value reflecting the improved rather than undeveloped land value, thereby including the value of streets, subsurface drainage and sewers, is estimated to be \$15,080,000.

The portion of City Park, Area C, consisting of 925 acres, estimated at \$3500 per acre for undeveloped land, has an undeveloped land value of \$3,237,500 to which is added the estimated value of \$575,000 for concrete drives, bridges, landscaping and other improvements.

Areas D, E and F, located between the Industrial Canal and Bayou St. John with an undeveloped land value of \$3500 per acre and containing 3520 acres, have an undeveloped land value of \$12,320,000 to which is added the value of streets, subsurface drainage, sewers, etc., estimated at \$3,550,000.

The Lake Shore Development, bounded by Lake Pontchartrain on the north, the Industrial Canal on the east, Southline Drive, Hibernia Avenue and Robert E. Lee Boulevard on the south and the New Basin Canal on the west, is subdivided from west to east into four zones.

A part of Zone 1, extending from the New Basin Canal to Canal Boulevard, having a total area of 157 acres, is at present being subdivided and plans are prepared for the construction of four miles of paved streets with curb and gutter, sidewalks and subsurface drainage, as well as the installation of underground utilities. 800,000 sq.ft. of the west side of this area, bordering on West End Boulevard, was recently sold for commercial purposes at \$1.00 per sq.ft. Fifty-one acres of this area are devoted to parks and playgrounds, and are

III - Valuation of Land and Improvements in the Area Subject to Damage (Cont'd)

valued at 50¢ per sq.ft., including landscaping, paving, etc., for a value of \$1,110,780. Seventy-two acres of the area are being subdivided for private sale at an estimated value of 75¢ per sq.ft., including streets and utilities, having a value of \$3,352,240.

The remainder of Zone 1, located between Canal Boulevard and the Orleans Canal, consisting of 182 acres, has a minimum undeveloped land value established by State law of 30¢ per sq.ft., or \$2,378,376. Located on this acreage is the U.S. Naval Hospital, operated by the Veterans Administration, with an estimated value of buildings and improvements of \$1,300,000.

Zone 2 of the Lake Shore Development is the Lake Vista Subdivision, one of the most highly developed subdivisions in the City of New Orleans, containing approximately seven miles of concrete streets and eight miles of interior 5' sidewalks. The entire area is fully improved and landscaped. Based on current sales of lots in this subdivision the value of improved residential property, excluding buildings, is estimated at \$4,742,644. Residential construction to date consists of 459 units which include eight fourplexes, 30 duplex apartments and 421 residences. The average cost of the fourplex units is \$45,000; of the duplex units \$30,000; and of the residences \$20,000, making the total value of residential construction \$9,640,000. A large brick community center building, located in the subdivision, is valued at \$400,000.

Zone 3, located between Bayou St. John and London Avenue, consists of approximately 275 acres of land which is either undeveloped or utilized as lake shore recreation area. The estimated value of this undeveloped acreage at 30¢ per sq.ft. is \$3,593,700.

Zone 4, extending from the London Avenue Canal to the Industrial Canal, contains approximately 723 acres of land, valued at \$9,448,164.

186 acres of this area are leased to the U.S. Navy on which is located the New Orleans Naval Air Reserve Station. The estimated value of buildings, equipment and runways, exclusive of aircraft, is \$2,450,000.

Located at the end of Elysian Fields Avenue is the Pontchartrain Beach amusement park containing buildings, equipment and improvements valued at \$1,200,000. Extending from the Lake front to Southline Drive on Franklin Avenue is located the 46-acre site and manufacturing plant of the American Radiator & Standard Sanitary Corporation, having an estimated value in buildings and improvements of \$7,500,000.

Camp Leroy Johnson, a U.S. Army port of embarkation staging area, consisting of 168 acres, extends from Franklin Avenue to the Industrial Canal south of the Lake Shore Drive, with buildings and improvements valued at \$4,500,000.

III - Valuation of Land and Improvements in the Area Subject to Damage (Cont'd)

The U.S. Naval Reserve Training Station located on the Lake front west of the Industrial Canal is a new installation valued at \$600,000.

The Lake Shore Drive, a 30' concrete roadway paralleling the Lake front and extending from the New Basin Canal on the west to the Industrial Canal on the east for a length of some 7.5 miles, is valued at \$715,000.

Arterial boulevards, including Canal Boulevard, Robert E. Lee Boulevard, Elysian Fields Avenue, Southline Drive, Beauregard Avenue and Franklin Avenue, having a total length of 5.2 miles, are valued at \$746,000.

A concrete seawall extending along the entire Lake front from the Industrial Canal on the east to the New Basin Canal on the west was constructed in 1933 at an initial cost of \$2,640,000. Reproduction cost of this wall, however, according to construction cost indices would be \$5,940,000, which is considered a reasonable current value.

Located on the west side of the mouth of the New Basin Canal is the Southern Yacht Club, valued at \$260,000, and the Municipal Yacht Harbor, valued at \$300,000.

Summary of Value of Land and Improvements in the Area Subject to Damage

Areas A thru F, south of Lake Shore Development -	
Undeveloped Land (A)	\$ 2,037,000
Streets & Improvements (A)	175,000
Land & Improvements including Streets, etc. (B)	15,080,000
Undeveloped Land (C)	3,237,500
Streets, Landscaping & Misc. Improvements (C)	575,000
Undeveloped Land (D-E-F)	12,320,000
Streets, Sewers, Drainage, etc. (D-E-F)	3,550,000
Residential Construction (A thru F)	116,000,000
Commercial & Industrial Construction (A thru F)	<u>6,400,000</u>
Sub-total Value - Land & Improvements South of Lake Shore Development (A thru F)	\$ 159,374,500

III - Valuation of Land and Improvements in the Area Subject to Damage (Cont'd)

Summary of Value (Cont'd)

Lake Shore Development - Zone 1 thru 4 -

Undeveloped Land	\$	15,420,000	
Improved Land		9,006,000	
Residential Construction		9,640,000	
Community Center Building		400,000	
Pontchartrain Beach Amusement Park		1,200,000	
Federal Installations -			
U.S. Dept. of Agriculture Lab.		1,400,000	
U.S. Naval Hospital		1,300,000	
U.S. Naval Reserve Air Station		2,450,000	
U.S. Army Camp Leroy Johnson		4,500,000	
U.S. Naval Reserve Training Sta.		600,000	
Industrial -			
American Radiator & Standard Sanitary Corporation		7,500,000	
Lake Shore Drive		715,500	
Arterial Boulevards		746,600	
Concrete Seawall		5,940,000	

Sub-total Estimated Value of Land & Improvements-
Lake Shore Development \$ 60,818,100

Gas & Electric Distribution System 4,316,200

West End -

Southern Yacht Club	260,000	
Municipal Yacht Harbor	300,000	560,000

Total Estimated Value of Land & Improvements in
Area Subject to Damage \$225,068,800

IV - CLIMATOLOGY and STORMS of RECORD

The New Orleans area has a mild sub-tropical climate due principally to the proximity of the Gulf of Mexico, Lake Pontchartrain, the Mississippi River and its Delta tributaries, and the sub-marginal swamps in the surrounding area which modify temperature conditions and changes.

The annual average temperature is 70°, and varies between an average summer temperature of 89° and an average winter temperature of 61°.

Annual rainfall varies considerably; however, the annual precipitation, based on 76 years of records, averages 60". Extreme recorded annual variations are 85.73" in the year 1875 and 31.07" in the year 1899. A maximum rainfall of 25" in one month has been recorded but

