Lake Pontchartrain Hurricane Protection Project

Materials Preparatory to 7 July 1978 Meeting
with Governor Edwards et al

Q. 1 Is the Standard Project Hurricane too large of a storm to design against?

A. 1 The Standard Project Hurricane (SPH) is a synthetic design storm developed by the National Weather Service. The SPH is a statistical compilation of many combined hurricane parameters or characteristics intended to synthetically simulate a natural hurricane occurrence in this coastal region. The SPH is used not only for this particular project, but is used nationwide for all hurricane protection projects where project failure implies the possibility of loss of life. In the New Orleans area, where intensively developed residential areas may be as low as 8 feet below mean sea level, the potential for loss of life is indeed very great. Even though the economics of using a smaller design hurricane may be more feasible, the threat of loss of human life is a powerful argument for use of the SPH.

Q. 2 What is the effect of the Standard Project Hurricane on stages in Lake Pontchartrain on the west shore with and without the barriers in place?

A. 2 Our mathematical model studies conducted during design of the barriers indicated that for the more frequent moderate hurricanes, such as Hurricane Flossy in 1956, Hurricane Hilda in 1964, or Hurricane Carmen in 1974, Lake Pontchartrain would be held to a flood level 4 to 5 feet lower with the barrier than without the barrier. For rare, more intensive hurricanes, such as Hurricane Betsy in 1965, which produced flood stages ranging between 8 to 12 feet on the southwest shore of Lake Pontchartrain without the barriers, the barrier structures would have reduced these flood stages by 2 to 4 feet. The barrier plan would improve drainage, reduce flood stages, and bring a high level of protection to developed areas around the lake sooner than a plan without barriers.

Q. 3 Isn't the "high-level plan" a more economical and less environmentally damaging means of hurricane protection than the barrier plan?

A. 3 On the surface, the high level plan is simple; just raise all of the lakefront levees to a height that would prevent flooding in the developed areas. Detailed examination, however, reveals that such a plan has many serious drawbacks, including the following:

High level levees would take years longer to construct because of subsidence problems; they would be wider, thus requiring more rights-of-way; more rights-of-way would result in displacement of more residences, businesses, etc. With higher lake levels, the operation of the interior drainage system would be severly hampered when most needed. The high level plan would offer no protection to less densely populated areas such as the north shore; lakefront levees would have to be 6 to 9 feet higher than the present design grade, thus severely affecting the aesthetics and recreational value of the lakefront. Finally, the costs of the high level plan have been estimated to be substantially in excess of those for the barrier plan.

Q. 4 Do you feel that a new study of the high level plan might produce new economic evidence regarding its cost? Why?

A. 4 The only complete cost estimate for the high level plan was made in the early 1960's during project formulation. At that time cost estimates in comparable detail were produced for both the high level and barrier plans. These estimates showed the high level plan to be approximately 50 percent more costly than the barrier plan and this fact contributed to the Corps of Engineers recommendation to Congress that the barrier plan be adopted.

A more detailed estimate of the high level plan is presently being prepared. It is possible that the economic evaluation of the alternatives will change. However, at this time we have no indication as to what that change, if any, may be.

Q. 5 What is the cost and benefit/cost ratio of the high level plan?

A. 5 The project currently authorized comprises two separate and distinct elements: the Lake Pontchartrain Barrier Plan and the Chalmette Area Plan. Since the cost of the latter would be the same for either the authorized plan or the high level plan, its cost will not be considered herein.

The cost of the Lake Pontchartrain Barrier Plan is now estimated at approximately $320 million. Since the cost was developed for the high level plan in 1962, the high level plan has been estimated to cost approximately 1.5 times the barrier plan. Presently that would be something in excess of $450 million. With equivalent benefits, the B/C ratio for the high level plan would be in roughly the same proportions as the costs, or about 11.5 as compared to 15.5 for the barrier plan. The cost and benefits of both plans will be updated during the preparation of the new EIS ordered recently by ruling of the United States District Court.

Q. 6 What level of protection (frequency) would be provided in Orleans Parish with the presently planned hurricane project, less the barriers, completed?

A. 6 The levees on the Orleans Parish lakefront, if constructed to grades consistent with the existence of the barrier, would, without the barriers in place, overtop on the average of once every 35 to 40 years. (Actually, 37 years)

Q. 7 What would be the effect of that system being subjected to the design hurricane? What would be the overtopping height and approximate volume of water over the protection works and the effects of such a volume in the protected area, and the likelihood and effect of such an occurrence breaching the protection works.

A. 7 a. In the occurrence of the design (SPH) storm critical to south shore, without the barriers in place, the lakefront protection system would be subject to overtopping throughout its length. Along the lakefront itself, this overtopping would, where the protective system is made up of earth levees, take the form of wave overtopping. Where the protective system along the lakefront is floodwall, the still water lake level would overtop the walls by about 1 foot. Along the outfall canals, the return levees would be overtopped by about 1 foot along half of their length. The consequences of such overtoping would depend upon whether or not the overtopping resulted in a crevasse or general failure of parts of the protective system.

b. Assuming that the system overtops but remains essentially intact, flooding depths would range from about 1.5 feet to a maximum of 8 feet. About 65% of the approximately 55,000 leveed acres of east bank Orleans Parish would experience some flooding.

c. The consequences of an occurrence of the design storm with some major failure of the protective system would depend upon the nature and extent of that failure. If the failure were very large, say, 10-15% of the system were to crevasse, flooding depths would range from a minimum of about 2 feet to over 12 feet. About 80% of the 55,000 leveed acres of east bank Orleans Parish would be affected.

Q. 8 Carrying the prior question a step further, would such an effect be similar to, less severe, or more severe than what has happened in a recent major hurricane?

A. 8 The consequences as outlined previously would be substantially more severe, in terms of areal extent, depth of overflow, and damage, than those of Hurricane Betsy in September 1965.

Q. 9 Do we agree with the Levee Board that floodwalls (vs higher levees) are unacceptable (because they're unsafe should a barge get loose and strike during a storm)?

A. 9 Use of floodwalls in lieu of higher levees is justified only in certain special circumstances, generally a combination in which higher levee grades are practically unachievable by reason of massively encumbered rights-of-way, and the likelihood of collision damage is remote. Floodwalls are used in the Inner Harbor Navigation Canal area where both of the above described conditions obtain. They are not as desirable as levees there, but they are acceptable. In locations such as the lakefront, we believe that use of the simple sheet pile floodwall would be irresponsible. In those locations, the exposure of the walls to wind-and-wave driven errant marine craft is highly direct. While pile supported and buttressed walls could be designed to withstand heavy impacts, the costs would be several times the costs for the simple sheet pile wall, which itself is twice the costs for a levee. With the above qualifications we agree with the levee board that floodwalls are unacceptable.

Q. 10 During testimony in Federal District Court a New Orleans District witness was asked what would be the effect in the New Orleans East area if the SPH critical to Lake Pontchartrain south shore occurred with levees to barrier grade in place but with no barriers.

A. 10 Based on recollection of the witness and others present, the answer was approximately as follows:

The levee would be subject to overtopping by waves. Assuming no crevasse, the volume of such overtopping would be 16,000 acre-feet, resulting in an increase in the flooding depth caused by rainfall alone of 0.8 foot. This, combined with the 0.8 foot depth generated by rainfall alone, would yield a total depth of about 1.6 feet. There would be essentially no overtopping with the barrier.

Additional explanation, which the court did not allow in the testimony, is essential to the proper understanding of the above reply. The question was directed <u>solely</u> at the New Orleans East area which is essentially flat, thus minimizing maximum depths of flooding. The same situation in the Citrus area, for example, would cause much deeper flooding. In that area, where ground elevations range from -8 feet to +5 feet msl, flooding depths of as much as 6 feet would result from the occurrence of the SPH critical to South Shore with levees at barrier grades but no barrier in place. With the barrier in place, the hurricane overflow would be essentially eliminated and flooding depths, resulting from rainfall only, reduced to about 2 feet.

In the area of Orleans Parish between the Industrial Canal and Franklin Avenue, the same situation would result in flooding to maximum depths of 8 feet. With the barrier completed, the depth of flooding, resulting from rainfall only, would be ~~only~~ 2 feet.

The situation would be similar in other parts of Orleans Parish and in Jefferson Parish.

Q. 11 Do you consider completion of the levee system without completion of the barriers to be on balance, beneficial?

A. 11 The New Orleans Metropolitan Area is perhaps unique in its paucity of escape routes. Past hurricanes have demonstrated that evacuation on a large scale is not practicable. In this light, any increase in the levee protection must be regarded as an advantage in that, as a minimum, it would reduce the likelihood that the system would be overtopped, or, in the event that it were overtopped, would lessen the severity of flooding.

Q. 12 Without the barriers, what protection can be offered the north shore?

A. 12 Under the barrier plan, the flood threat to the north shore is reduced by reducing the stages in Lake Pontchartrain. In order to achieve comparable reduction in flood threat without the barriers, levees and/or floodwalls would be required on portions of the north shore. A favorable recommendation for protective works on the north shore would depend upon favorable economics and upon local interests desire for and ability to finance their portion of such protection.

Q. 13 Since you indicate that continuing to raise the levees would be to the advantage of the metropolitan area, even if the barriers are not constructed, would you consider a plan providing a lesser degree of protection than envisioned by the barrier plan?

A. 13 Corps policy for flood protection projects in highly developed urban settings has always favored a level of protection which would safely accommodate the standard project hurricane. We consider this a sound policy and one from which we would not easily depart. Your question presumably implies a situation in which the provision of SPH protection may, for one reason or

another, be unattainable. Given the unique situation in the New Orleans metropolitan area, I would not rule out a recommendation by the Corps to construct a project to a scale smaller than SPH protection.

Q. 14 How would deletion of the barriers affect the revised EIS which is presently under preparation?

A. 14 The court ordered a revised EIS principally because it judged that the current EIS did not describe the barrier structures which the Corps actually proposed to build, that the alternatives to the barrier were not adequately described and evaluated, and that the impact of the project on the productivity of surrounding wetlands and the impact of the barriers on the movement of aquatic organisms through the passes were not adequately addressed. Though deletion of the barriers would shift the emphasis of the EIS, a revised or new EIS would still be required.

Q. 15 Do you consider the assurances of local cooperation previously furnished to you by the Orleans Levee District and the Governor to have been abrogated by the recent public statements made by the Governor and Mr. Le Mieux?

A. 15 We have not received any formal notification from either the Governor or Mr. Le Mieux of an attempt to withdraw the local cooperation previously provided. We must, however, be concerned with the status of those assurances, and the intent and ability of the assurers to perform. It ~~is evident~~ that the recent public statements by Mr. Le Mieux and Governor Edwards do raise questions concerning the practical effectiveness of the assurances previ~~ously provi~~ded.

Q. 16 Can construction proceed on the levees portion of the project without local cooperation on the barrier portion of the project?

A. 16 The construction of the Lake Pontchartrain barrier plan was, like all Federally sponsored water resource development projects, conditioned by Congress on certain requirements of local cooperation being met, and those requirements are stated with specificity in the project authorization. They do not permit construction of any part of the project without <u>all</u> required local cooperation for the entire plan being made available.

Q. 17 Do you currently have any on-going construction on the barrier plan?

A. 17 We are presently finalizing work on the N. O. East lakefront levee, Paris Road to South Point, which contract is approximately 99 percent complete. The only other on-going work is the environmental restoration work at the Chef Menteur west levee which is in compliance with the order of the U. S. District Court.

Q. 18 Do you have any construction work on the barrier plan planned for the near future?

A. 18 We have 8 construction items on the barrier plan scheduled for award in the next 15 months.

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Q. 19 How would the Chalmette Area Plan be affected if support for the barriers is withdrawn?

A. 19 As an element of hurricane protection, the Chalmette Area Plan is totally independent of the barriers. It is a closed levee loop which provides protection against the SPH.

The assurances of local cooperation for the Chalmette Area Plan are separate and apart from those furnished for the Barrier Plan. The Orleans Levee District has assurred without reservation that portion of the Chalmette Plan which is located in Orleans Parish. The St. Bernard Parish Police Jury and the Lake Borgne Basin Levee District have provided the assurances on the remainder of the plan.

In summary, the Chalmette Area Plan would be unaffected by a withdrawal of local support for the barriers.

Q. 20 How would flood protection at the Jefferson Parish lakefront pumping stations be affected by a high level plan?

A. 20 As is the case with all of the lakefront protection, the protection across the front of the pumping stations would have to be higher under the high level plan than under the barrier plan. At stations 2 and 3 where the protection has been installed to barrier plan heights, the protection would have to be raised.

Q. 21 What are the effects of direct rainfall and tributary flow from streams on Lake Pontchartrain water levels under existing conditions?

A. 21 Direct rainfall causes a rise in water level approximately equal to the amount of rain falling on the lake surface. Tributary flow adds approximately one-tenth of a foot per day during normal rainfall periods at flood peak. As an example, a 100-year rainfall event (13 inches in a 24-hour period) occurring over the Amite River Basin, the largest tributary to Lake Pontchartrain, would produce a peak discharge of 45,000 cfs into the lake. For approximately two days duration this magnitude of discharge would raise Lakes Maurepas and Pontchartrain approximately two-tenths foot per day and would be swept out to the Gulf with the ebb tide preventing accumulation in the lake. Travel time for the flood wave from the upper basin to the lake is 3 to 4 days. In the meantime the direct rainfall on the lake is swept out with the first and second ebb tides in a day and a half, again preventing the direct rainfall from accumulating with the flood wave. Such accumulation would raise the lake one and a half feet. However, if the 13-inch rainfall were produced by a low pressure system (tropical or extra-tropical) in the Gulf of Mexico, in all likelihood the gulf and Lake Borgne would be superelevated during the runoff period by strong southeast winds circulating about the low pressure system. A high gulf level would block the outflow of direct rainfall on Lake Pontchartrain and the tributary flow, and cause inflow into Pontchartrain from Lake Borgne via the Chef Menteur and Rigolets Passes. Such a combination of events associated with extra tropical storms could cause a superelevation of Lake Pontchartrain 4 feet or higher above normal lake level, which equals 1-foot above mean sea level. Superelevations due to tidal action as high as 9 feet m.s.l. are possible with hurricanes.

Q. 22 Under the Barrier Plan, what are the effects of direct rainfall and tributary flows from streams on Lake Pontchartrain water levels?

A. 22 Under the Barrier Plan, if the rainfall were associated with an extra-tropical storm there would be no difference in Lake Pontchartrain water levels from those described in the above response because the barrier structures would remain open during the rainfall period. However, if the rainfall were associated with a hurricane which threatened the Metropolitan New Orleans Area, the tidal barrier would close off the lake to inflows from the Gulf of Mexico for a period of three days thus preventing a rise from tidal inflow. The direct rainfall plus the tributary inflow

would accumulate in Lake Pontchartrain during those three days but would not be adding elevation to tidal inflow because the barrier structures would be closed. The result is that Lake Pontchartrain would be held to a level near 2.0 feet above m.s.l. rather than 5.0 feet or greater above m.s.l. The elimination of the tidal inflow to Lake Pontchartrain from the Gulf of Mexico can maintain lake levels 3 to 5 feet lower than under existing conditions. Following the three-day closure during a hurricane, the barrier structures would be reopened and lake conditions would return to normal.

Q. 23 Taking into consideration the water levels due to rainfall effects and tidal inflow effects without and with the barrier structures as outlined in the 2 preceding questions, what additional effects are expected when hurricane force winds (winds in excess of 75 miles per hour) blow over the super elevated lake surface?

A. 23 Once the level of Lake Pontchartrain has been raised to 5 to 9 feet above m.s.l., depending upon the intensity and forward speed of the hurricane itself, the strong winds can blow the lake water level higher than 9 feet above m.s.l., as high as 13 feet, against the windward shoreline. Such an elevation is of sufficient height to overtop existing protection works on the south shore of Lake Pontchartrain. However, with the barrier structures in place and closed during the hurricane, the water is still blown about the shoreline but there is much less water to be blown toward the windward shore because the lake water level is only about 2 feet above m.s.l. instead of 5 to 9 feet m.s.l. when the full force of the hurricane begins to be felt. As a consequence, the water level of the lake at the windward shore will be 3 to 5 feet lower due to the barrier project and the project levees will not be overtopped.

Lake Pontchartrain Hurricane Protection Project

(Additional Material for 7 July Meeting)

Q. 24 In view of the fact that overtopping of the lakefront levees, if constructed to grades consistent with the barrier, would, even if the barriers are not constructed, be limited to waves, it is difficult to see why more than a minor increase in levee grades would be required to compensate for the absence of the barriers.

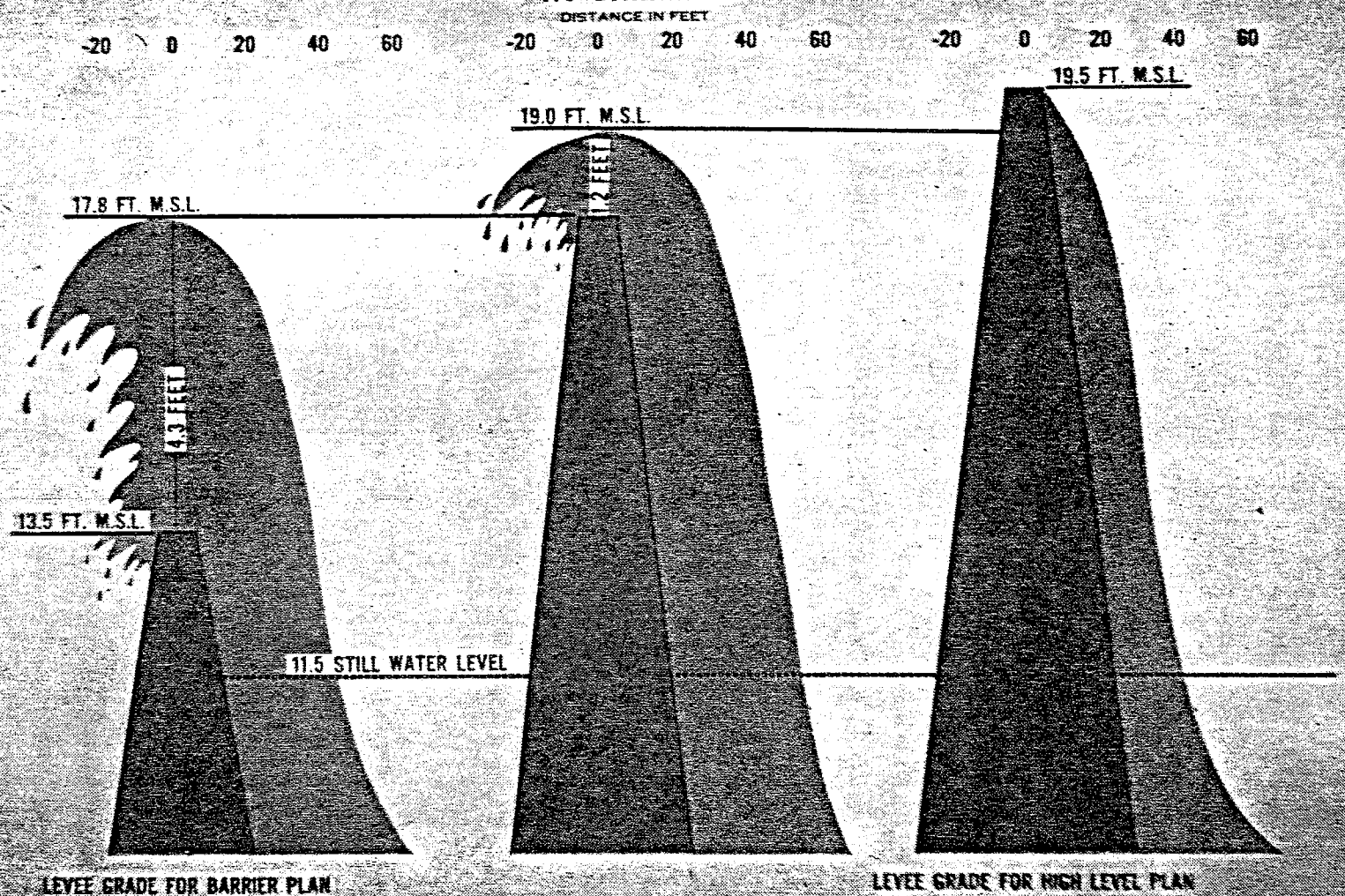
A. 24 The foregoing question suggests (1) that wave overtopping necessarily involves minor volumes of water, and (2) ignores the phenomenon in which waves in effect "climb" over an obstruction. Let us deal with the significance of wave overtopping first, and the phenomenon itself second.

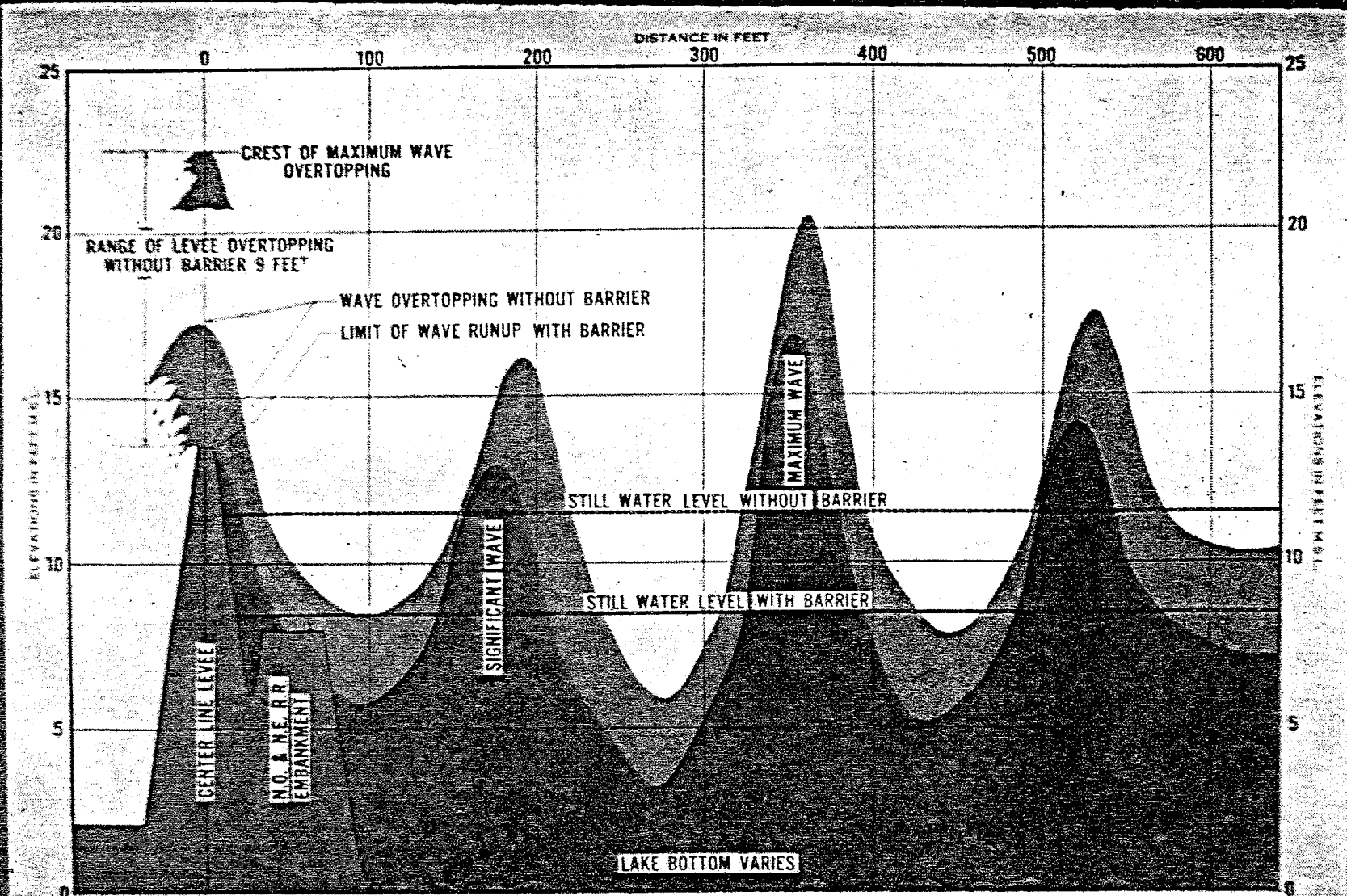
For an occurrence of the SPH critical to the south shore, wave overtopping would produce an average rate of tidal inflow into protective areas of about 5 cubic feet per second for each foot of levee length. Between the Industrial Canal and Paris Road is a distance of about 6 miles. Thus, in a single second, 150,000 cubic feet of tidal water would enter the protected area. This rate of inflow is approximately 60 times the total installed pumping capacity of that protected area. In the hurricane situation we are discussing, the pumping stations, already hard pressed to cope with the excessive rainfall which invariably accompanies hurricanes, would experience a major reduction in capacity by reason of the elevated lake stage. Also, the foregoing overtopping rate assumes that the levee would overtop without crevassing; i.e., that its basic configuration would be unchanged. It is most unlikely that this would occur. It is much more likely that, over a significant portion of the levee length, the cross section would be much reduced by erosion, greatly increasing the influx of tidal floodwaters.

A wave is water in motion. Since water has mass, when it is in motion it possesses kinetic energy. When the wave encounters an obstacle, this kinetic energy must be absorbed by the obstacle in some fashion. A major part of the absorption process takes the form of conversion of the kinetic energy to potential energy; i.e., the mass of the wave is raised from a lower to a higher elevation. If overtopping is to be prevented, the obstacle's height must be sufficient to cause all of the kinetic energy to be converted to potential energy. This involves increasing the height of the obstacle--in our case, the levee--to a level much above the height of the wave as it approches the obstacle. For example, a wave with a crest elevation of 16.5 feet msl, approaching the Citrus lakefront levee with its crown

at 13.5 feet msl, will overtop that levee by 4.3 feet, yielding an overtopping elevation of 17.8 feet msl. If the levee crown were raised in elevation to 17.8 feet msl--i.e., to a height equal to the overtopping height, it would still be overtopped by 1.2 feet. In order to eliminate all overtopping, it would be necessary to raise the levee to 19.5 feet msl, or 3 feet above the crest of the approaching wave.

EFFECT OF LEVEE GRADE ON OVERTOPPING FOR THE SIGNIFICANT WAVE
STANDARD PROJECT HURRICANE CRITICAL TO SOUTH SHORE
NO BARRIERS





WAVE PROFILES WITH AND WITHOUT BARRIERS FOR STANDARD PROJECT HURRICANE
NEW ORLEANS CITRUS LAKE FRONT LEVEES TO GRADE