DECEMBER 1987

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ARNOLD, PECK

ESTATE MON BIJOU
ST. CROIX, VIRGIN ISLANDS

FINAL
DETAILED PROJECT REPORT
AND
ENVIRONMENTAL ASSESSMENT

SECTION 205
FLOOD CONTROL

US Army Corps
of Engineers
Jacksonville District
South Atlantic Division

FINAL

DETAILED PROJECT REPORT
AND
ENVIRONMENTAL ASSESSMENT

FOR

ESTATE MON BIJOU
ST. CROIX, U.S. VIRGIN ISLANDS

DECEMBER 1987

ESTATE MON BIJOU/GLYNN
ST. CROIX, U.S. VIRGIN ISLANDS

SECTION 205
DETAILED PROJECT REPORT

SYLLABUS

The purpose of this study is to determine the feasibility of reducing flood damages and related problems in the Estate Mon Bijou and Glynn residential areas of the island of St. Croix in the U.S. Virgin Islands. This study was conducted at the request of the Department of Public Works for the U.S. Virgin Islands. The report was prepared under the authority provided in Section 205 of the 1948 Flood Control Act, as amended. The U.S. Army Corps of Engineers has primary responsibility for conducting the study and preparing this report.

The Mon Bijou and Glynn residential areas are located in the upper part of the Salt River watershed about 5 miles west of the city of Christiansted, St. Croix. A tributary to the Salt River, Canaan Gut, originates on the south slopes of the northern coastal mountain range of St. Croix. Canaan Gut drains the southern slopes of Blue Mountain and Mount Eagle before entering the Mon Bijou area at the base of the mountains. It travels through the Mon Bijou and Glynn areas before joining with another tributary to form the Salt River just below Glynn. The total drainage area of Canaan Gut is 2.5 square miles, of which only 0.87 square miles lie above the Mon Bijou area. However, due to heavy rainfall generated by the mountains and the steep slopes, flood flows are substantial with a 100-year flood flow of over 3,200 cubic feet per second (cfs) where Canaan Gut enters Mon Bijou. This combined with severe encroachment of the flood plain of the normally dry stream, has resulted in 96 homes being subject to flooding by a 100-year event. This would result in over $1.7 million in damages and related flood losses. Even a 2-year event produces over $340,000 in damages. Total average annual damages are estimated at $442,150. During the period 1975-1980, three major floods occurred in the area which caused widespread damage.

To address these flood problems, several plans were developed and evaluated to determine their effectiveness in reducing flooding and their overall economic, environmental, social, and other impacts. As a result of the investigations performed, a plan was developed which provides for the construction of a bypass channel around the developed portions of Mon Bijou and Glynn. This plan involves the construction of a grass-lined channel about 6,500 feet long. At the upstream end, a levee is included to help divert flows into the new channel. To control flow velocities in the channel, thirty-four gabion-lined drop structures would be required. Additionally, two new bridges would be built to span the new channel. In all this plan would cost $3.6 million initially, or $338,000 annually. Annual benefits are estimated at $415,600. The benefit-cost ratio would be 1.2.

Based on an analysis of overall economic, environmental, and social impacts, the above plan was found to be in the Federal interest and justified for implementation. Therefore, the plan is recommended for approval for Federal construction.

DETAILED PROJECT REPORT AND ENVIRONMENTAL ASSESSMENT
ESTATE MON BIJOU
ST. CROIX, U.S. VIRGIN ISLANDS

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DETAILED PROJECT REPORT
ON
ESTATE MON BIJOU/GLYNN
ST. CROIX, U. S. VIRGIN ISLANDS

This report presents the results of investigations into flooding and related problems for the Estate Mon Bijou/Glynn areas of St. Croix in the U. S. Virgin Islands. The report was prepared in response to a request by the Department of Public Works, Virgin Islands, for assistance in reducing flooding in the Mon Bijou area. This area is a residential suburb of Christiansted and is subject to frequent and severe flooding.

STUDY AUTHORITY

This report was prepared under the authority provided by Section 205 of the 1948 Flood Control Act, as amended. Section 205 authorizes the Chief of Engineers to investigate and construct, within certain cost limitations, small projects for flood control when such work is found advisable. The advisability of constructing a project under this program is dependent upon a detailed investigation of the engineering, economic, and environmental aspects of the area and a determination of the Federal interest in such work. In general, a project must be in the overall public interest, complete within itself, engineeringly feasible, economically justified, and environmentally sound in order to be included in this program. Also, there is a limitation, currently $5 million, on the amount that the Federal Government can contribute to any one project. All costs in excess of that amount, as well as certain other costs, must be borne by local interests.

STUDY PURPOSE AND SCOPE

The primary purpose of this study is to investigate flooding and related problems in the Mon Bijou area, determine if feasible means for reducing these problems exist, and recommend the most appropriate course of action. In this regard, investigations were conducted in accordance with the procedures contained in the Water Resource Council's "Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Study" (48FR10259). Because of the inherent limitations of the Section 205 program, studies were generally confined to the immediate study area of Mon Bijou. However, the investigations were of sufficient detail to identify those problems being experienced, determine probable future changes, identify and evaluate possible plans for addressing these problems, develop detailed plans for possible implementation, determine public support for such plans, and recommend a course of action as appropriate.

PRIOR STUDIES AND REPORTS

Several studies have been conducted regarding flooding and related problems in the Mon Bijou area. The primary reports applicable to this study are:

a. Reconnaissance Report of the Estate Mon Bijou, dated May 1980, prepared by the Jacksonville District, U. S. Army Corps of Engineers. This report was a prelude to this investigation and identified flood problems in the area as well as a need for further study.

b. Post Disaster Report for Virgin Islands, dated 10 January 1978, prepared by the Jacksonville District to document the flooding and damage that resulted from a tropical wave (atmospheric condition) on 7-8 October 1977. This document identified significant flooding and damage in the Mon Bijou and Glynn areas.

c. Cultural Resources Survey: Mon Bijou Project, St. Croix, V.I., dated 17 January 1984, prepared under contract to Jacksonville District to document the cultural resources in the study area as a part of this overall investigation. A summary of this report is contained in Appendix H.

d. Flood Insurance Study U.S. Virgin Islands, Island of St. Croix, dated April 1980, prepared by the Federal Emergency Management Agency to identify flood-prone areas and establish various zones for flood insurance purposes.

e. A Flood Damage Mitigation Plan for the U. S. Virgin Islands, dated June 1979, prepared by CH2M Hill Engineering to identify flood problems in the Virgin Islands and present possible solutions to these problems.

STUDY PARTICIPANTS

The Jacksonville District was the lead agency in the preparation of this report. Valuable information and assistance was provided by the Department of Public Works of the U. S. Virgin Islands, the State Historic Preservation Officer, the U. S. Fish and Wildlife Service, and other local and Federal agencies.

PLAN FORMULATION

STUDY AREA DESCRIPTION

The primary study area is the Estate Mon Bijou and Glynn residential area which is located in the upper part of the Salt River watershed about 5 miles west of Christiansted. Christiansted is located on the north central coast of the island of St. Croix. This island is a part of the U. S. Virgin Island Territories and is located about 1200 miles southeast of Miami, Florida and 80 miles southeast of San Juan, Puerto Rico (see plate 1).

The Mon Bijou/Glynn area is a suburban residential area consisting of medium density, single family units located at the foot of Blue Mountain and Mount Eagle. It is drained by the Canaan Gut tributary of the Salt River. The drainage basin of Canaan Gut covers about 2.5 square miles of which 0.87 square miles lie above the residential development. The terrain is very steep above the Mon Bijou area with elevations ranging from the Blue Mountain peak of 1165 feet above National Geodetic Vertical Datum (NVGD) to 200 feet NGVD at the upper end of Mon Bijou. Within the Mon Bijou area elevations range from 80 feet NGVD to 200 feet NGVD. A second tributary, Little Fountain Gut, drains into Canaan Gut from the east. It joins Canaan Gut just downstream from the start of Mon Bijou. Both streams are normally dry discharging only as a direct result of rainfall.

EXISTING CONDITIONS

The island of St. Croix is the largest of the 50 islands and cays that make up the Territory of the U.S. Virgin Islands. It is 23 miles long and 1 to 6 miles wide. In all, it provides about 80 square miles of land area. These islands are part of the Caribbean Island chain that stretches from just east of the Florida coast to just east of the northeastern tip of South America. This string of islands form the boundary between the Atlantic Ocean and the Caribbean Sea.

St. Croix is typical of these subtropical islands displaying a sharply varying terrain and a very warm climate. It has a low mountain range that forms a spine along its length, a large coastal plain on its south shore and numerous smaller flat areas. The geological composition of the island primarily reflects its volcanic orgin in the ocean environment. It is characterized by a volcanic or limestone base overlain by alluvial clay, marl, and decomposed limestone. The Canaan Gut drainage basin displays this typical topographical and geological makeup with the upper basin having steep slopes of 35 percent and a relatively thin layer of clayey overburden with the volcanic base. This rapidly gives way to a deeper, more varied overburden as the slopes decrease at the Mon Bijou area and the alluvial fan develops. Top soils in this area are generally characterized as a clay loam of varying composition.

The climate of the area is classified as subtropical with warm temperatures that range from a minimum of 67 degrees Fahrenheit to a maximum of 97 degrees. The mean annual temperature is 78.3 degrees. Despite the relatively warm climate and island setting, average annual rainfall is only 45.7 inches and varies widely from year to year. This is apparently due to the small size of the island which is not conducive to generating rainfall. Rainfall patterns also vary within the year with the largest amounts being received during September - December and the smallest amounts during February - March. This reflects the influence of tropical waves and disturbances on the island which occur primarily during the latter part of the year. On the island the distribution of rainfall varies significantly with the mountainous northern area and western end receiving the majority of the rain. Rainfall in the Mon Bijou area tends to be heavier than much of the rest of the island due to the proximity of the mountains.

As a result of the steep terrain and widely varying rainfall, vegetation in the study area tends to reflect a more drought resistant composition. The mountains with their steep slopes and heavier rainfall are covered with decidous and evergreen trees. These rapidly give way to upland grasses, thorn scrubs, and other drought resistant species at the Mon Bijou area. The only significant wetland area is located some distance away at the mouth of Salt River.

Wildlife in the area is very limited, consisting of small birds and animals. There are no criticl habitats or species listed or proposed for listing in the primary study area. Two endangered species which may occur in the general area include the St. Croix ground lizard and the Virgin Islands tree boa.

Land use in the Canaan Gut drainage basin is governed by the two very distinct topographical areas. The upper part of the basin with very steep terrain is sparsely developed and covered with natural vegetation. The lower part of the basin, beginning at Mon Bijou, is considerably less sloping which has allowed development of the area into residential and agricultural use. While agricultural use has been present since early settlement of the islands, the residential development has resulted from the more recent urban growth of the Christiansted area.

Historically, the economy of St. Croix was based on the production of sugarcane and the transhipment of goods. However, these both declined in importance during the 1800's with accompanying decline in the economy and decrease in island population. Developmental pressures remained absent until 1930 when sugarcane reemerged as an important crop. However, it was not until 1960 that significant growth took place. During the period from 1960-1970 the population doubled and the economy turned to tourism as a major activity. This was accompanied by an expanding divergence in the economy with an increase in commercial and industrial activity. The result of this expansion and population increase was urban sprawl which fostered the development of suburban communities for the rising middle class. Table 1 provides information on the historical and projected population of St. Croix.

TABLE 1

ST. CROIX POPULATION

Year	Population
1970	35,945
1975	36,131
1980	49,725
1990	52,260
2000	54,926
2010	57,727
2020	60,670
2030	63,763

The Mon Bijou area is a typical example of the economic activity on St. Croix. It is primarily a medium density, middle class neighborhood comprised of single family, privately owned homes. Much of the commercial activity is located in the Christiansted area and most of the Mon Bijou residents commute to work. Mon Bijou is a typical residential subdivision with paved streets and houses arranged in orderly fashion. Downstream in the Glynn area, development is more random and less dense. Below the Glynn area another major tributary, Bonne Esperance joins Canaan Gut to form the Salt River. At this point the watershed becomes somewhat flatter with a more pronounced flood plain. As such, the flood plain is less developed with considerably more natural vegetation rimmed by agricultural development.

As noted earlier, the distribution of rainfall in the Mon Bijou area varies widely during the year. It is characterized by long, dry seasons with intermittent periods of high intensity rainstorms. The more intense storms generally result from tropical disturbances that move across the area. These dump large volumes of rainfall over relatively short periods of time. Estimates of potential rainfall for various return frequency rainfall events in the study area were taken from the U.S. Weather Bureau's Technical Paper No. 42 and No. 25 for Puerto Rico and the Virgin Islands. Based on this data, a storm with a return period of once every 100 years would generate a six-hour total rainfall of nine inches. A similar storm of 12-hour duration would generate 12 inches of rainfall. By comparison, the storm that struck the Mon Bijou area on 7 October 1977, resulted in a total 12-hour rainfall of 12 to 14 inches. The most extreme events recorded in the general area involved a storm which produced a total of 23.7 inches of rainfall over a 24-hour period at American Hill on St. John Island, and another that produced 15.5 inches at Estate Charlotte Amalie on St. Thomas. Thus, significant events do occur in the study area which generate large volumes of rainfall over relatively short periods of time.

As a result of the intermittent occurrence of rainfall in the study area most of the stream channels are normally dry discharging only during periods of rainfall. Therefore, ground water is often used as the primary source of water supply. Also, the normally dry state of the stream channels belie the runoff that may be conveyed during periods of intense rainfall. In the Canaan Gut Basin, this problem is particularly acute due to the extremely steep nature of the upper basin. This steep slope combined with the soil characteristics yield a short concentration time and relatively high runoff rate. This combined with the intense rainfall that occurs yields a flashflood effect in the Mon Bijou area. This is readily exhibited in the upper part of Canaan Gut by an average lag time of less than 30 minutes. Thus, even with a drainage area of only 0.87 square miles above Mon Bijou, the estimated 10-year frequency flood discharge is in excess of 1800 cubic feet per second (cfs) while the 100-year frequency flood discharge is in excess of 3270 cfs. Not only are the flows considerable, but the flow velocity is also high due to the steep slope of the basin. Even in the flatter Mon Bijou/Glynn area the channel velocity is still 8-10 feet per second under flood conditions.

Flood stages in the area, while dependent on the magnitude and velocity of flow, also greatly reflect the condition of the channel. Previous runoff has established a water course through the area to the Salt River. For the most part this water course reflects the topography, soil composition, and high velocities, i.e., it is a fairly well defined channel with rocky bottom and sides. However, the development associated with Mon Bijou has greatly altered this condition near the center of the Canaan Gut basin. Two roads cross the normally dry channel just above the Mon Bijou residential area. Both have small culverts which pass only minimal flow. Therefore they are frequently overtopped forcing water up and out of the channel. Just downstream of these two roads at the residential area, the stream is diverted into a 700-foot-long, four-foot by six-foot box culvert. Again, the carrying capacity of this structure is so small that much of the storm runoff is forced up and out of the stream channel. However, at this point the overflow enters the residential area and floods homes, streets, cars, and other property.

The flood problem in this area is compounded by the confluence of Little Fountain Gut. The channel for this subbasin is less well defined, even above Mon Bijou. However, as it enters the residential area, it flattens out and becomes completely obscured with no drainage course through the area. Thus, all of its flow is haphazard through the housing area until it reaches the Canaan Gut channel downstream of the culvert. At this point, the flow from both Canaan Gut and Little Fountain Gut is concentrated back in the channel area. The steep slope and well defined channel through the remainder of the residential area contain some of the runoff within the immediate channel area. At the lower end near the beginning of the Salt River portion the slope flattens to generate higher backwater with a corresponding widening of the flood plain and flooded area.

FUTURE CONDITIONS

Because of the nature of the steep terrain in the Canaan Gut drainage basin above the Mon Bijou area, little additional development is expected. Therefore, no increases are expected in runoff from the upper basin. Development within the Mon Bijou/Glynn area is expected to continue. However, this development should be either located outside of floodprone areas or at least compatible with the flood hazard. Therefore, no increase is expected in the amount of property subject to flooding.

PROBLEMS, NEEDS, AND OPPORTUNITIES

In the Mon Bijou/Glynn area there are 31 houses subject to flooding from a 2-year frequency flood. This increases to 96 houses for a 100-year flood. As such, a 2-year flood would produce over $344,000 in flood damages while a 100-year flood would generate $1.7 million damage. Average annual damages amount to $442,150. In addition to the monetary damage, the nature of the flooding endangers residents of the area. As noted earlier, there is only a 30-minute lag time for the watershed above Mon Bijou. Thus, within that time a heavy rainstorm can send a 4 to 6 feet deep torrent through the

residential area. Under these conditions, there is a substantial and significant threat to the safety of the Mon Bijou residents.

The frequency of flooding of the Mon Bijou area compounds the problem of severe flooding. From 1975-1980 the area was subjected to three significant floods. The flood in October 1977 was by far the worst with an estimated return frequency in excess of 100 years. As a result of the significant and frequent flooding of the area, many of the more flood-prone homes have been periodically abandoned. However, because of the need for housing and the disarming appearance of the dry streambed, reoccupancy by others occurs quickly.

From the previous description of the area and the flooding experienced, it can be readily seen that the flood problems are primarily the result of encroachment into the flood plain and obstruction of the flood flow by inadequate facilities. Given the nature of the flooding with significant damage and threat to human life, there exists a definite need for measures to reduce the flooding or its effects on the area. There also exists a substantial opportunity to enhance the economic status, safety, and general well-being of the Mon Bijou community through the reduction of flooding in the area.

PLANNING OBJECTIVES

In order to determine a potential solution to water resource related problems such as those described above, it is necessary to identify the objectives that any such solution should strive to attain. The Water Resource Council's (WRC) Principles and Guidelines (P&G), noted earlier, provide the national objective for all water resource related studies. Specifically, the study should strive to develop plans that enhance, or make positive contributions to National Economic Development in a manner that is consistent with protection of the environment. For the Mon Bijou study area this can be refined to objectives which address the specific problems of the area, namely:

a. Reduce flood damages and other related costs in the Estate Mon Bijou and Glynn areas;

b. Restore, enhance, and/or preserve environmental attributes of the area;

c. Enhance recreational opportunities in the study area;

d. Reduce hazard to life and property due to flooding in the study area; and

e. Protect, preserve, or minimize impacts on significant historical and cultural resources of the study area.

PLANNING CONSTRAINTS

While the above planning objectives describe the goals of the study, there are certain limitations which must be considered in evaluating any plan for possible implementation. The primary constraint that must be considered is the overall scope of the study. As noted earlier, this investigation is being conducted under the Continuing Authority Program as provided by Section 205 of the 1948 Flood Control Act, as amended. As noted in the authorizing legislation, this program specifically addresses small projects for flood control. Therefore, any study conducted under this program should be primarily for flood control and be of a more localized or limited nature. Basinwide or regional studies are beyond the scope and intent of this program. Based on this constraint, the study was directed primarily at flood control for the Mon Bijou/Glynn area. Study investigations were then conducted only to the level of detail necessary to define and quantify the flooding and related problems and identify the most appropriate plan for addressing these problems.

Additional constraints relate to various laws, Executive Orders, directives, and regulations which govern the investigation of water resource problems. Of these, two Executive Orders, 11988 governing Flood Plain Development and 11990 concerning conservation of Wetland areas, provide specific criteria which must be addressed by any proposed action. E.O. 11988 requires consideration of 4 specific criteria. Namely:

* Avoid development in the base flood plain (100-year) except where it is the only practical alternative.
* Reduce the hazard and risk associated with floods.
* Minimize the impact of floods on human safety, health, and welfare.
* Restore and preserve the natural and beneficial value of the base floodplain.

POSSIBLE MEASURES

In light of the above objectives and overall study constraints, the possible measures that were initially considered were directed primarily at the problem of flooding in the Mon Bijou/Glynn area. These include:

a. No action

b. Flood warning

c. Floodproofing

d. Flood plain evacuation

e. Clearing and snagging

f. Levees

g. Retention/detention reservoirs

h. Channel modifications

i. Streamflow diversion

The "no action" alternative represents the expected future conditions of the area in lieu of implementation of any of the other above plans. It provides the baseline conditions against which all effects and impacts may be measured. It is carried through the entire planning process as a selectable option should studies fail to identify a more feasible and implementable alternative. Under this alternative flood plain zoning is assumed to be in effect. Thus, future development is assumed to be either in areas without flooding or to be compatible with the flood hazard.

Flood warning is used primarily to provide residents of flood-prone areas an opportunity to prepare for an impending flood. It is very useful to alert such residents of approaching storms that may generate flooding or on large watersheds, to warn of flood waters that are moving toward a particular area.

Floodproofing can be used to modify existing flood plain development to make it more compatible with the flood hazard. Generally, this is accomplished by elevating structures above flood levels, providing ring levees, or dikes, or waterproofing a structure.

Flood plain evacuation involves the removal of damageable property from the flood prone area. This can be done by moving the house or structure to another location or by demolishing the existing structure and rebuilding elsewhere. Evacuation thus restores the flood plain to original condition allowing it to function as an overflow storage area.

Clearing and snagging can be used on streams that have obstructions to flow. Such obstructions retard the streamflow causing a decrease in velocity and an increase in water levels. This is very useful for areas where vegetation may clog the channel, old trees or debris may fall or be blown or discarded into the channel, or low velocities are insufficient to maintain a well defined and efficient channel. In such cases clearing and snagging can be used to increase flow rates and reduce flood levels.

Levees generally involve either earthen or concrete walls which block water movement into certain areas. Thus, they reduce the extent of area subject to flooding and the property subject to danger. In this manner, the flood plain is altered to be more compatible with existing or planned development. Occasionally, training levees may be used along either or both sides of the stream to confine flood water to the stream area or floodway. In reducing the extent of flooding and the flood plain, levees also reduce available storage and can cause an increase in flow rate and flood level. Therefore, the usefulness depends a great deal on the topography and other physical characteristics of the area.

Flood retention/detention reservoirs can be used to temporarily store flood waters above flood-prone areas, thus reducing the downstream flow volumes and flood levels. Later, the flood waters can be released at a controlled rate to minimize the downstream effect. The usefulness of such reservoirs is very dependent on the physical characteristics of the upper watershed and the status of development within that area.

Channel modification can be used to alter the existing stream channel and increase its carrying capacity. This is usually acomplished by excavating to make the stream channel either wider or deeper or both. This increases the velocity and flow rate of the floodwaters thereby reducing flood levels and the extent of flooding. The magnitude and extent of the effect of channel modification on flooding is directly dependent on the extent of excavation, the larger the channel the greater the reduction in flood levels. However, since flood plain storage in the channelized area is reduced and flow velocities are increased, downstream flooding may actually be greater due to greater flow rates and hydrologic regime alteration. Thus, the usefulness of this measure may depend on downstream conditions as well.

Stream flow diversion can be used to redirect flood waters around a particular area. This precludes their entry into the problem area thereby greatly reducing the flood problems of that area. This is often accomplished by constructing a secondary channel bypass around the problem area to connect at some downstream point or to another drainage course. The effectiveness of this measure is thus very dependent on the physical setting and characteristics of the area.

INITIAL SCREENING

In order to develop alternative plans for the Mon Bijou area it was necessary to examine each of the above possible measures in light of its specific applicability to the problems at Mon Bijou. In this manner, plans could be developed that incorporate features applicable to the specific problems being experienced. As noted earlier, the "no action" measure provides the basis of the without project conditions for the study area. Therefore, it was carried through the evaluation process as the "No Action Plan".

Flood warning in the Mon Bijou area is based solely on prediction of excessive rainfall. Because of the small basin size and short lag time, there is no warning of approaching flood water. Thus, flood prediction is indirect depending on the accuracy of meterological forecasts of rainfall volume and intensity. Based on the nature of flooding experienced, this is generally good only for significant atmospheric disturbances such as tropical depressions. Even for these, the residents can only remove themselves and readily transportable belongings to areas of relative safety. Little can be done to protect the houses from the flood waters. Thus, while this measure is good for protecting life and some property, it is not

considered adequate for effectively reducing flood damges in the area. For this reason, it was not considered further in this study even though it should be continued and enhanced at the local level to protect life in the area.

Floodproofing was reviewed based on the physical characteristics of the Mon Bijou area. The nature of the flooding, i.e., rapidly rising flood waters with high velocity, make floodproofing by structure raising or waterproofing undesirable. With the high velocity flows, there is some danger of potential structural collapse due to the water force on the structures. Also, the need for emergency evacuation may actually increase due to the perceived protection provided which results in people remaining in houses too long and thus becoming trapped. The extent and density of development preclude the use of ring levees as a possible measure for reducing flood damages. Therefore, the alternative of floodproofing was not considered further in the analysis.

Flood plain evacuation can be used in the Mon Bijou area to remove the more flood-prone structures from the area. This would tend to restore the flood plain area to a low or no damage floodway. The current residents would be relocated to property elsewhere thus protecting them from future floods. The homes would be permanently removed thus preventing further flood damage or future reoccupancy. Since implementation of this measure is potentially feasible for the Mon Bijou area, it was retained for more detailed consideration.

Clearing and snagging in the main problem area of Mon Bijou was not deemed appropriate since much of the flood problem stems from insufficient culvert capacity at Mon Bijou. Below the culvert, the natural channel is maintained in reasonably good condition by the high velocities, even though vegetation has overgrown the channel in some areas. Because of the large volume of flow, additional clearing or debris removal would not significantly alter flood conditions. Therefore, this measure was not considered further.

Levees could be used in the Mon Bijou area to channel flood flows around housing areas where topography would permit. In examining the Mon Bijou topography there appears to be only one area where a levee could be used, that is near the Little Fountain Gut drainage entrance into Mon Bijou. A levee could be used there to divert runoff from Little Fountain Gut away from the houses. Elsewhere, along the Canaan Gut Channel, the density of development, nature of flooding, and topography generally preclude the use of levees as a singular solution. Also, the levee diversion at Little Fountain Gut would have to be accompanied by additional Canaan Gut channel work to reduce overall flood levels at Mon Bijou. Therefore, levee construction was only considered in combination with other structural measures for the area and generally as a flow diversion action. Where warranted it was included with other plans as discussed below.

The potential of flood retention/detention reservoirs in the Mon Bijou area is dependent on the upstream basin size, shape, and other physical

characteristics as well as the volumes of runoff expected. As previously noted, the drainage area above Mon Bijou is very small. However, the slopes are steep and the runoff rates are high. This combination of features precludes the use of an upstream storage reservoir. The large volumes of runoff and limited capacity of any site yield poor conditions for upstream storage possibilities. Therefore, no plans were developed and this measure was dropped from further consideration.

Channel modification can be used at Mon Bijou to enlarge the channel through areas where natural or manmade features obstruct or retard flow causing higher flood levels. Upstream of the Mon Bijou area there is a relatively well defined channel with little development which obviates any need for enlargement or modification of the channel. At Mon Bijou the original channel has been replaced by a small box culvert through the upper part of the housing development. This culvert is grossly inadequate for handling flow from Canaan Gut. Either culvert enlargement or removal would significantly reduce flood levels in the area. Downstream of the culvert, the natural channel resumes with a significant carrying capacity. Although flooding in this downstream area is still a problem, it is not as severe as the upstream culvert portion. Therefore, since channel enlargement in the upper Mon Bijou area does appear to offer a potential solution to the flood problem being experienced, it was retained for more detailed consideration.

As noted earlier, streamflow diversion is practical where topography and other conditions permit the construction of bypass channels around problem areas. In the Mon Bijou area the more concentrated development is found in the Mon Bijou/Glynn residential area. The area surrounding the housing area is largely open farm land. While the topography can still be classified as rolling, it is similar to the housing area and could support a bypass diversion plan. By diverting flow from Canaan Gut and Little Fountain Gut away from Mon Bijou the flooding and associated damage could be greatly reduced. The CH2M Hill report noted earlier identified a diversion plan as a feasible solution to flooding in the Mon Bijou area. Therefore, it was retained for more detailed analysis.

Thus, of the possible measures initially considered, only evacuation of the flood plain, channel modification, and stream flow diversion appear to offer any potentially feasible solution to the flood problems at Mon Bijou. The "no action" alternative was also retained for comparative purposes as well as possible recommendation. The other possible measures were dropped from further consideration or combined as special features of those measures retained as noted above.

ALTERNATIVE PLANS

Based on the initial screening above, alternative plans were developed for those possible measures that were identified as being potentially feasible for implementation in the Mon Bijou area. The "no action" plan represents the without project conditions for the future should all of the other alternatives prove to be not implementable for economic,

environmental, institutional, or other reasons. Under this alternative periodic and devastating floods would continue to strike the area. From past experience, it is assumed that the accompanying cycle of periodic abandonment of the more severely damaged houses would follow significant flood events. As in the past, it is anticipated that reoccupation of the abandoned structures would occur during prolonged flood-free periods. Therefore, the flood damage potential is expected to remain for the current development in the flood plain. However, considering the unsuitable nature of the upper Canaan Gut Basin for development due to the steep terrain, any increase in flood levels due to increased runoff is unlikely. Also, with proper enforcement of flood plain zoning regulations, there should be only minimal increase in the overall damage potential of the area due to control of future development of flood-prone areas. Therefore, average annual flood damages are expected to continue at $442,150.

Evacuation of the flood plain could be used to reduce these damages by removing the flood-prone structures from the flood plain. Considering the type of construction, evacuation in the Mon Bijou/Glynn areas would involve the relocation of the occupants to another dwelling and the demolition and removal of the house. In Mon Bijou several levels of evacuation were analyzed based on frequency of flooding. Estimated benefits were based on the externalized costs resulting from flooding, i.e. those costs borne by non flood plain residents. Estimated implementation costs include the purchase of the structure and land, relocation of the residents, demolition of structure, and clearing and restoration of the site. Table 2 presents a summary of estimated costs and benefits for different levels of evacuation.

TABLE 2
FLOOD PLAIN EVACUATION

LEVEL	NUMBER OF STRUCTURES	EXTERNALIZED ANNUAL BENEFITS	ESTIMATED FIRST COSTS	ANNUAL COSTS	NET BENEFITS	BC RATIO
2-Yr	31	$248,120	$2,579,180	$245,370	$ 2,750	1.01
5-Yr	40	340,200	3,270,500	310,850	29,350	1.09
10-Yr	47	350,700	4,027,890	364,630	-13,930	0.96
25-Yr	64	355,320	5,114,080	485,470	-130,150	0.73

The above table indicates that the 2- and 5-year levels of evacuation are economically feasible. These would involve the removal of the more flood-prone houses in the Mon Bijou and Glynn areas. This would not reduce actual flooding in the area, only the damage sustained.

Channel modification could be used to reduce the actual flood levels in the Mon Bijou area thereby reducing damages resulting from these floods. In analyzing possible schemes for channel modification for the upper Mon Bijou area two approaches appeared feasible;

a. To replace the existing box culvert with a larger culvert and improve inflow and exit conditions, and

b. Restore the original channel by removing some houses and excavating a channel through the area.

To handle the flow from Little Fountain Gut a small diversion channel with bordering levee could be provided to divert water directly to the Canaan Gut Channel. This would eliminate the overland-flow flooding from this tributary. Benefits attributable to either of these two plans would be a direct result of reduced flooding in the area. Table 3 below shows the average annual benefits and costs for each plan. Channel modification in the lower part of the Mon Bijou/Glynn area was not economically feasible. Therefore, it was not included in any of the shown plans.

TABLE 3

CHANNEL MODIFICATION PLANS

PLAN	ANNUAL BENEFITS	ESTIMATED FIRST COSTS	ANNUAL COSTS	NET BENEFITS	B-C RATIO
Enlarged Culvert	$382,720	$3,675,000	$335,640	$47,080	1.14
Open Channel	$378,320	$3,623,450	$330,300	$48,020	1.15

As shown in Table 3 both plans represent economically feasible solutions to the flood problems by reducing flood levels in Mon Bijou.

In analyzing possible schemes for streamflow diversion at Mon Bijou, consideration was initially given to the diversion plan presented in the CH2M Hill report. This provides a bypass channel extending from Canaan Gut just upstream of Mon Bijou, around the north side of the housing area, intercepting Little Fountain Gut, and rejoining Canaan Gut downstream of the Glynn area at the beginning of Salt River. Several variations of the basic plan were analyzed which included different channel sizes and linings, levee diversions, drop structures, and instream detention ponds for water control. Included within these variations was the possible use of roller compacted concrete (RCC) which was evaluated to determine the feasibility of this measure based on its constructibility. This option was not found to be a viable alternative during the evaluation process and was discontinued. Table 4 below presents a summary of the economics for some of the plans considered. As noted in the table, only one bypass plan is considered to be economically feasible. Therefore, only that plan was retained for further consideration. The bypass plans were formulated in accordance with paragraph 3-4, b.(1) of ER 1105-2-20. The division levee was designed to the SPF level to prevent a catastrophic event should it be overtopped. Due to the extremely steep gradient, the bypass channels were designed for hydraulic integrity to prevent the loss of velocity controls by flows bypassing them out of bank. The existing drainage system through Estate Mon Bijou and Glynn is adequate to handle runoff from the drainage area downstream of the division with minimal damage. For levels of protection less than that provided by the considered bypass plans, a structure would be required through the diversion levee to allow flow to continue through the developed area. This would increase the costs of the diversion alternatives while reducing the benefits, therefore the plans did not consider these alternatives and the bypass plans are considered to be optimized as described above.

TABLE 4

CHANNEL BYPASS PLANS

PLAN	ANNUAL BENEFITS	FIRST COSTS	ANNUAL COSTS	NET BENEFITS	B-C RATIO
Concrete Bypass	$415,800	$8,225,000	$720,920	-305,120	0.6
Gabion Bypass (Completely lined)	$415,800	$4,950,000	$443,870	- 28,070	0.9
Earthen Bypass (w/sheet pile drop)	$415,800	$5,355,000	$476,700	- 60,900	0.9
Earthen Bypass (w/Gabion drop)	$415,800	$3,667,800	$338,000	$77,800	1.2

INITIAL EVALUATION

The alternative plans discussed above were evaluated to determine significant impacts and identify major areas of concern that would be useful in the development of detailed plans. Potential impacts were assessed in terms of anticipated economic, environmental, social, and other changes in the without project condition that would result from the implementation of the considered alternative. As discussed earlier, the "no action" plan represents the without project conditions for the future. Under this condition the present flooding would continue with average annual damages of $442,150. The economic well-being of the area would suffer because of this continuing damage. Given the availability of flood insurance, the monetary losses from flooding would be largely borne by persons outside the Mon Bijou area. This adversely affects economic activity at the territory and national level. Locally borne costs would continue to adversely affect the flood plain residents and local government agencies responsible for emergency duty and cleanup. Continued flooding would also discourage property improvement or upkeep thereby depressing normal affluence-related increases in economic levels for Mon Bijou.

Environmentally, continued "no action" would have negligible impacts on existing conditions. The Mon Bijou natural environment has been substantially altered by the previous activities of man. There are no present plans to alter this condition. Future development of the area would probably be characterized by the continued conversion of farm lands to residential and commercial areas. However, no significant or outstanding environmental attributes were noted in the immediate Mon Bijou area that would be affected by this continued growth. Aesthetically, the area would suffer adverse side effects from the flooding primarily due to the house and yard damage and deterioration or lack of upkeep during periods of abandonment.

Other significant impacts of continued no action would relate to the safety and overall well-being of the area residents. As discussed earlier, the area is subject to flash-flooding. This poses a continuing threat to life of the flood plain occupants. Although no loss of life has yet been

reported, the threat and potential are significant under the existing flood conditions. This constant threat would continue to have a demoralizing effect on the residents adversely affecting their general well-being.

The flood plain evacuation alternative would reduce the flood damages being experienced by removing the structures from the flood hazard area. Since most of the current damages are borne outside the flood plain, a reduction would be of widespread benefit. The costs associated with removal of these structures would also be borne by non-flood plain residents. This would be a widespread detriment. However, since the benefits exceed the costs for the 2- and 5-year levels of evacuation (Table 2), the overall effect would be beneficial. Locally, the construction effort would have a minor, temporary beneficial impact on the area.

Environmentally, evacuation would provide potentially beneficial though minor impacts for the area. Removal of the structures and replacement with green areas could have a beneficial effect if properly maintained. Assuming replacement property was required elsewhere, the net effect for the island would probably be negligible. There would be some minor temporary adverse effects associated with the construction effort. These should cease shortly after completion of construction.

Other impacts would be primarily related to the relocation of the residents. While the overall safety and well-being of those evacuated would be improved, there would be other varying effects that would depend on individual circumstances, e.g. movement away from friends or relatives, jobs, etc. and disruption of established neighborhood.

Channel modification would also reduce flood damages in the area. However, in this case, it would result from an actual reduction in flooding. This would be beneficial to both flood plain and non-flood plain residents. Costs of construction would adversely impact primarily non-area residents. However, as shown in Table 3, the benefits outweigh the costs. Therefore, the net impact would be beneficial. As with evacuation, there would also be some minor, temporary beneficial impacts on the local economy due to the construction effort.

The environmental effects of channel modification in the Mon Bijou area would be generally minor. As noted earlier, the original stream channel in the primary problem area has been replaced by a concrete culvert. The culvert modification plan would have temporary adverse impacts during construction. Otherwise, the constructed facility would be similar to the existing one. The open channel plan would restore an open stream channel through the area. It would have adverse impacts during construction. However, long-term impacts would tend to be beneficial due to the reestablishment of an open channel. Other impacts of channel modification would be primarily beneficial, related to the reduction in flooding, flood damage, and threat to life and safety.

Only one of the stream flow diversion plans was found to be economically feasible. This plan would involve the construction of a bypass channel around the northern side of the Mon Bijou and Glynn areas. This channel would be grass-lined and have 34 gabion-lined drop structures to control flow velocities in the channel. The bypass channel would begin just upstream of the Mon Bijou area and end at the Salt River just downstream of the Glynn area. This plan would reduce flood damages in the area by diverting the flood waters away from the developed areas. This reduction in flood damages would have a beneficial effect on area residents as well as the general economy. Construction costs would have an adverse effect on primarily non-flood plain residents. However, since the reduction in flood damages is greater than the costs required to achieve that reduction, the effect on the economy would be beneficial. Other economic impacts would be related to the minor, though temporary, beneficial impacts on the local economy due to the construction effort.

Environmentally, this alternative would have generally adverse, though minor impacts. Existing vegetation along the construction right-of-way would be destroyed. This would be replaced by a grassed area which would be periodically mowed. Other impacts would be minor.

Social impacts would be mainly related to the reduced flooding and improved safety and well-being of area residents. This would have a significant beneficial impact on local residents.

DETAILED PLANS

In reviewing the alternative plans discussed above, four main plans, in addition to the "no action" plan, appear to warrant a detailed investigation:

a. Flood plain evacuation;

b. Construction of new culvert through upper portion of Mon Bijou;

c. Channel modification through the upper portion only;

d. Channel diversion around the developed areas.

Since two economically feasible levels of evacuation exist, the economically optimum level, 5-year, was chosen for detailed analysis. The two upper portion only channel modification plans were both retained for detailed analysis due to their significantly different designs and economic feasibility.

The flood plain evacuation plan (plan A) would remove all structures within the 5-year flood plain. This involves 35 houses in Mon Bijou and five houses in the Glynn area (see plate 7). Implementation of this plan would require the purchase of the land and improvements from the then current owners. Relocation assistance would be provided to the occupants in accordance with the provisions of Public Law 91-646. When the structures are empty, all salvageable equipment would be removed and the structures demolished. The area would be cleaned and replanted as necessary to provide an acceptable appearance.

In all, this plan would initially cost about $3.27 million. On an annual basis, at 8-5/8% interest for 50 years, the total cost would be $310,850. Average annual flood damages would be reduced from $442,150 to $84,150. Annual benefits would be the externalized (national level) reduction in costs. This is approximated by the total flood damages eliminated ($358,000) less the costs borne by flood plain occupants ($11,300 for flood insurance premiums and $7,320 for deductible losses). Costs associated with administration ($800) are added in. The result amounts to $340,200 annually. This yields a net annual benefit of $29,350 and a benefit to cost ratio of 1.09.

The culvert enlargement plan (Plan B) actually would involve the construction of a new culvert adjacent to the existing culvert (see plate 8). The existing culvert would be left in place. This plan would include a diversion channel and levee to intercept flow from Little Fountain Gut and direct it to Canaan Gut. Also included would be two new concrete bridges with paved approaches, a debris basin, a gabion-lined approach channel, a 10-by-15-foot reinforced concrete box culvert 512 feet long with stilling basin, and a gabion-lined exit channel. A construction easement would be needed to install the box culvert while areas of the open channel, levee, and debris basin would have to be acquired. No relocation of houses or other structures would be required under this plan even though minor utility and street work would be required. Periodic maintenance would also be required to remove debris from the debris basin, maintain the gabion lining, and maintain the levee and access areas. It should be noted that this plan involves a high velocity (>20 feet per second) culvert. Therefore, the debris basin is very important to the proper functioning of the works.

In all, this plan would initially cost about $3.7 million. On an annual basis, at 8-5/8% interest for 50 years, the cost would be $335,640. Annual benefits would result from the reduction in flooding. Average annual damages would be reduced from $442,150 to $59,430 resulting in an annual benefit of $382,720. This yields a net benefit of $47,080 annually and a benefit to cost ratio of 1.14.

The open channel plan (Plan C) involves the reestablishment of an open channel through the upper Mon Bijou area. A channel would be excavated as shown on Plate 9. A diversion plan for Little Fountain Gut would be included to direct the flow to the new channel. Plan C would require the removal of six houses along the new channel right-of-way. These would be acquired, the occupants relocated, and the structures removed to permit construction of the channel. The main channel would be trapezoidal with a bottom width of 20 feet and side slopes of one vertical to two horizontal. The sides and bottom would be grassed to reduce erosion. Seven steel sheet pile drop structures would be provided to reduce velocities in the new channel reach. Each structure would lower the channel grade about six feet. The total length of the new channel would be about 1800 feet. Two new bridges would be required to span the new channel. One local street would be barricaded.

In all, this plan would initially cost about $3.6 million. On an annual basis, the cost would be $330,300. Annual benefits would result from the reduction in average annual flood damages from $442,150 to $59,430. Since six houses would be relocated, some damage reduction benefits would be lost due to externalization. Average annual benefits are thus estimated at $378,320. This would yield net benefits of $48,020 and a benefit to cost ratio of 1.15.

Plan D involves the construction of a 6,500-foot-long bypass channel around the northern side of Mon Bijou and Glynn. This channel would begin at the roadway upstream of the Mon Bijou area and travel through the undeveloped areas in an easterly direction. A levee on the southern side of the new channel would divert runoff into the new channel. The new channel and levee would also intercept water draining from Little Fountain Gut. This diversion channel would follow the natural ground slope through the existing dam which would be removed. It would then rejoin the Canaan Gut channel at the headwaters of the Salt River just downstream of Glynn. The diversion channel would be trapezoidal with a bottom width of 75 feet and a side slope of 3 horizontal to 1 vertical. Channel depth would vary with topography but generally range 8-12 feet. To control flow velocities in the channel, a series of 34 gabion-lined drop structures would be placed along the channel. Each would lower the water some 3-4 feet. The main channel would be grass lined between the drop structures. Two new bridges would be required for the channel as well as the removal of at least 3 houses in the lower portion of Glynn.

In all, this plan would cost about $3.8 million. On an annual basis, this would amount to $338,000. Annual benefits, which would result from a reduction in flooding would amount to $415,800. This would yield a benefit-cost ratio of 1.23 and net benefits of $77,800.

ASSESSMENT AND EVALUATION

In order to determine the most appropriate plan for implementation in the Mon Bijou area, the detailed plans presented above were evaluated in light of their overall accomplishments and effects. To facilitate comparison these were evaluated only in light of the net change to the without project conditions that would be experienced under the "no action" plan. Table 5 shows a summary comparison of the four detailed plans.

Selected Plan

TABLE 5
SUMMARY COMPARISON OF DETAILED PLANS

ITEM	PLAN A EVACUATION	PLAN B CONCRETE CULVERT	PLAN C OPEN CHANNEL	PLAN D DIVERSION CHANNEL
A. Plan Description				
1. Major Features	Removal of 40 houses from 5 year floodplain in Mon Bijou and Glynn area.	Construction of new culvert in upper portion of Mon Bijou.	Construction of an open channel through upper portion of Mon Bijou.	Construction of a new diversion channel around the northside of the area.
2. First Cost	$3,270,500	$3,675,000	$3,623,450	$3,667,800
B. Accomplishments				
1. Reduce flood Damage	Reduces damages to those houses removed.	Reduces flood damages in upper portion by reducing flood levels.	Reduces flood damages by reducing flood levels in upper portion.	Reduces flood damages by reducing flood levels in Mon Bijou and Glynn area.
2. Enhance Environment	Restores limited area to more natural condition.	No enhancement.	No enhancement.	No enhancement.
3. Enhance Recreation	No enhancement.	Reduces flooding in area.	Reduces flooding in area.	Significantly reduces flooding in area.
4. Reduce Flood Hazard	Reduces flood damage. Does not reduce hazard of flooding to remaining houses.	Reduces flood hazard by lowering flood levels.	Reduces flood hazard by lowering flood levels.	Reduces flood hazards by diverting flow.
5. Protect, Enhance Cultural Resources	No enhancement.	No enhancement.	No enhancement.	No enhancement.

TABLE 5
SUMMARY COMPARISON OF DETAILED PLANS

ITEM	PLAN A EVACUATION	PLAN B CONCRETE CULVERT	PLAN C OPEN CHANNEL	PLAN D DIVERSION CHANNEL
C. SIGNIFICANT IMPACTS:				
1. National Economic Development				
a. Annual Benefits	a. $340,200	a. $382,720	a. $378,320	a. $415,800
b. Annual Costs	b. $310,850	b. $335,640	b. $330,300	b. $338,000
c. Net Benefits	c. $ 29,350	c. $ 47,080	c. $ 48,020	c. $ 77,800
d. B-C Ratio	d. 1.09	d. 1.14	d. 1.15	d. 1.23
2. Environmental Quality				
a. Beneficial Impacts				
1) Manmade Resources	NI	Reduces flood damage along stream by reducing overall flood levels.	Reduces flood damage along stream by reducing overall flood levels.	Reduces flood damage along stream by reducing overall flood levels.
2) National Resources*	NI	NI	NI	NI
3) Air Quality*	NI	NI	NI	NI
4) Water Quality*	NI	NI	NI	NI
5) Fish and Wildlife	NI	NI	NI	NI
6) Archaeological and Historical Sturctures	NI	NI	NI	NI
7) Aesthetics*	Enhanced through removal of more frequently damaged homes.	Reduced flooding would encourage better upkeep of area.	Reduced flooding would encourage better upkeep of area.	Reduced flooding would encourage better upkeep of area.
8) Noise*	NI	NI	NI	NI

TABLE 5
SUMMARY COMPARISON OF DETAILED PLANS

ITEM	PLAN A EVACUATION	PLAN B CONCRETE CULVERT	PLAN C OPEN CHANNEL	PLAN D DIVERSION CHANNEL
b. Adverse Impacts				
1) Manmade Resources*	Removes 40 houses from area.	NI	Removes 6 houses from area.	Removes at least 3 houses from area.
2) Natural Resources*	NI	Minor removal of vegetation.	Minor removal of vegetation.	Minor removal of vegetation.
3) Air Quality*	Minor during construction.	Minor during construction.	Minor during construction.	Minor during construction.
4) Water Quality*	NI	Minor during construction.	Minor during construction.	Minor during construction.
5) Fish and Wildlife	NI	NI	NI	NI
6) Archeological and Historical Structures	NI	NI	NI	NI
7) Aesthetics*	Minor during construction.	Minor during construction.	Minor during construction.	Minor during construction.
8) Noise*	Minor during construction.	Minor during construction.	Minor during construction.	Minor during construction.
3. REGIONAL ECONOMIC DEVELOPMENT				
a. Beneficial Impact				
1) Tax Revenues*	NI	Minor increases due to reduced flooding.	Minor increases due to reduced flood losses.	Minor increases due to reduced flood losses.
2) Property Values*	NI	Minor increases due to reduced flooding.	Minor increases due to reduced flooding.	Minor increases due to reduced flooding.
3) Land Use	Changes existing use to use more compatible with flood hazard.	Reduces flooding of developed areas.	Reduces flooding of developed areas.	Reduces flooding of developed areas.

TABLE 5
SUMMARY COMPARISON OF DETAILED PLANS

ITEM	PLAN A EVACUATION	PLAN B CONCRETE CULVERT	PLAN C OPEN CHANNEL	PLAN D DIVERSION CHANNEL
4) Public Facilities*	NI	Reduced damage and disruption from flooding.	Reduced damage and disruption from flooding.	Reduced damage and disruption from flooding.
5) Public Services*	Reduced disruption from flooding.	Reduced disruption from flooding.	Reduced disruption from flooding.	Reduced disruption from flooding.
6) Regional Growth	NI	NI	NI	NI
7) Employment*	NI	Minor increase during construction.	Minor increase during construction.	Minor increase during construction.
8) Business and Industrial Activity*	NI	NI	NI	NI
9) Real Income Distribution	NI	NI	NI	NI
10) Displacement of Farms*	NI	NI	NI	NI
11) National Defense	NI	NI	NI	NI
b. Adverse Impacts				
1) Tax Revenues*	Removal of 40 houses from local tax base.	NI	NI	NI
2) Property Values*	Decreases value of property affected.	NI	NI	NI
3) Land Use	NI	NI	NI	NI
4) Public Facilities*	NI	Minor disruption during construction.	Minor disruption during construction.	Minor disruption during construction.
5) Public Services*	NI	NI	NI	NI

TABLE 5
SUMMARY COMPARISON OF DETAILED PLANS

ITEM	PLAN A EVACUATION	PLAN B CONCRETE CULVERT	PLAN C OPEN CHANNEL	PLAN D DIVERSION CHANNEL
6) Regional Growth	NI	NI	NI	NI
7) Employment*	NI	NI	NI	NI
8) Business and Industrial Activity*	NI	NI	NI	NI
9) Real Income Distribution	NI	NI	NI	NI
10) Displacement of Farms*	NI	NI	NI	NI
11) National Defense	NI	NI	NI	NI
4. OTHER SOCIAL EFFECTS				
a. Beneficial Impacts				
1) Displacement of People*	Reduces requirement for evacuation during floods	Reduces requirement for evacuation during floods	Reduces requirement for evacuation during floods	Reduces requirement for evacuation during floods.
2) Housing	Reduces physical damage from flooding.	Reduces physical damage from flooding.	Reduces physical damage from flooding.	Reduces physical damages from flooding.
3) Leisure Opportunities	Minor increase with more open areas.	NI	NI	NI
4) Community Cohesion*	NI	Minor enhancement due to reduced disruption from flooding.	Minor enhancement due to reduced disruption from flooding.	Minor enhancement due to reduced disruption from flooding.
5) Community Growth*	NI	Minor enhancement due to reduced flood potential.	Minor enhancement due to reduced flood potential.	Minor enhancement due to reduced flood potential.

TABLE 5
SUMMARY COMPARISON OF DETAILED PLANS

ITEM	PLAN A EVACUATION	PLAN B CONCRETE CULVERT	PLAN C OPEN CHANNEL	PLAN D DIVERSION CHANNEL
6) Health and Safety	Minor increase due to reduced flooding.	Minor increase due to reduced flooding.	Minor increase due to reduced flooding.	Minor increase due to reduced flooding.
b. Adverse Impacts				
1) Displacement of People*	Relocates 40 families from area.	NI	Relocate 6 families.	Relocate at least 3 families.
2) Housing	Decreases available housing in area.	NI	Removes 6 houses.	Removes at least 3 houses.
3) Leisure Opportunities	NI	NI	NI	NI
4) Community Cohesion*	Disrupts existing neighborhood.	NI	NI	NI
5) Community Growth*	NI	NI	NI	NI
6) Health and Safety	NI	NI	NI	NI
D. RESPONSE TO PLANNING CRITERIA				
1) Acceptability	Generally acceptable, but not strongly supported.	Generally acceptable.	Generally acceptable.	Generally acceptable and supported.
2) Completeness	Complete within itself requiring only periodic maintenance of evacuated areas.	Complete within itself requiring only periodic maintenance.	Complete within itself requiring only periodic maintenance.	Complete within itself requiring only periodic maintenance.
3) Effectiveness	Effective for reducing damage to those houses removed.	Effective for reducing damage.	Effective for reducing damages.	Most effective plan for reducing damages.
4) Efficiency	Potential benefits exceed costs.	Potential benefits exceed costs.	Potential benefits exceed costs.	Potential benefits exceed costs. Most efficient plan.

TABLE 5
SUMMARY COMPARISON OF DETAILED PLANS

ITEM	PLAN A EVACUATION	PLAN B CONCRETE CULVERT	PLAN C OPEN CHANNEL	PLAN D DIVERSION CHANNEL
E. SENSITIVITY				
1. RISK	Large floods can occur, however property subject to flooding is reduced.	Large floods can occur exceeding design capacity. Plan shoud still reduce flooding without failure.	Large floods can occur exceeding design capacity. Plan should still reduce flooding without failure.	Large floods can occur exceeding design capacity. Plan should still reduce flooding without failure.
2. UNCERTAINTY	Flood stages may be higher or lower for a particular event depending on hydrologic conditions at time.	Flood stages may be higher or lower for a particular event depending on hydrologic conditions at time. However, overall stages should be considerably lower.	Flood stages may be higher or lower for a particular event depending on hydrologic conditions at time. However, overall stages should be considerably lower.	Flows are diverted. Most flooding should be eliminated.

Note: NI - No or Negligible Impact
* - Denotes items specifically mentioned in Section 122 of PL 91-611.

Plan A - Evacuation

As noted earlier, this plan provides for the removal of 40 houses from the Mon Bijou/Glynn areas. This would remove all damageable property within the estimated 5-year flood plain and return the area to a semi-natural state with only low intensity use. This plan would meet the objectives of reducing flood damages by removing damageable property from the flood plain, enhancing the environment by restoring part of the flood plain to green areas, enhancing recreational opportunities by providing additional open areas for public use, and increasing overall safety by removing the more frequently flooded homes from the area. There are no known archeological or historical sites in the immediate area affected. Therefore, there would not be any contribution toward this objective.

Significant impacts of this plan include the effects on the NED account. Benefits to NED would be generated by the reduction in national costs of the losses attributed to flooding in the area. The current losses for the 40 houses to be removed are estimated at $359,620 annually. The removal costs necessary to achieve this benefit would be $3.3 million dollars initially, or $310,850 on an annual basis. Thus, the net effect on NED would be positive as indicated by the net benefit of $29,350 and a benefit to cost ratio of 1.09.

Beneficial environmental impacts of this plan, as noted in Table 5, would be primarily related to the restoration of the flood plain area through the removal of the existing development and creation of green areas. Since the areas created would not be very large and would be located between two residential areas, the overall beneficial impact would be minor. There would be minor improvement in air quality, water quality, fish and wildlife, and esthetics of the area due to the decreased human habitation. Adverse environmental impacts would mainly be both temporary and minor and associated primarily with the construction activities generated by this plan. These temporary adverse impacts would be characterized by a decrease in air quality and esthetic quality as well as an increase in noise level during the removal of the houses. One significant non-temporary adverse impact that would result from the implementation of this plan is the adverse impact on manmade resources due to the removal of the 40 houses.

Beneficial impacts on Regional Economic Development (RED) would be associated with the reduction in flood damages due to changing current land use patterns and with the minor increase in construction-related employment during implementation of this plan. Adverse impacts on RED would be related to the removal of 40 houses from the area tax roles and the decrease in economic value of the land affected.

Beneficial social effects would be related to the increase in area available for recreation and an increase in the safety and well-being of the area residents resulting from the removal of the more frequently flooded houses from the area. Adverse impacts would be related to the permanent displacement of 40 families from the area and the removal of 40 houses from the community, thus disrupting the current neighborhood.

The implementability of this plan is indicated by its response to certain criteria, i.e., acceptability, completeness, effectiveness, and efficiency. This plan is not the most desirable plan from the local viewpoint due to the large acquisition of houses involved and the change of developed, privately owned land to non-developed, publically owned land. The plan is complete within itself providing the benefits as stated for the level of evacuation specified. It does not offer any improvement for the remaining houses in the 100-year flood plain. It is however, dependent on sponsorship by the local government. This plan is effective in reducing the flood damages as stated. It does not alter the level of flooding, only the flood damage experienced. Since those houses evacuated are permanently removed from the hazard area, this plan is the most effective in assuring future damages are eliminated for these structures. This plan is not the most economically efficient plan in that it does not provide the maximum net benefits. It does, however, provide the maximum net benefits of all the evacuation plans considered.

The sensitivity of this plan can be measured in terms of risk and uncertainty. Risk can be represented by the probability that the plan will function as proposed and produce the results predicted. Uncertainty is an indication of the unknown items that cannot be predicted but may occur and cause unanticipated results. In Mon Bijou the risks associated with Plan A are those related to the houses remaining in the flood plain. These houses would still be susceptible to periodic flooding. However, this risk is neither increased or decreased by implementation of Plan A. The uncertainty of Plan A relates both to the unknown parameters generating the floods and the specific impacts on individuals who are relocated. Regarding the unknown factors related to flooding, the expected flood levels are based on anticipated average conditions. However, for any specific event those conditions may vary considerably generating either higher or lower flood levels. Since the stream is normally dry and not gaged, there is no correlation data other than randomly observed high water marks. However, given the overland flow nature of the flooding in Mon Bijou covering a rather wide area, significant variations in flood levels are not anticipated. Therefore, the expected levels as presented, should be representative of the flooding probable in the area.

The specific impacts on individuals who would be relocated are difficult to assess without a very detailed study and personal interview. Also, such impacts tend to be very time-dependent with the severity of the impact varying with the personal situation at time of implementation. Therefore, there is a large unknown factor involved that produces considerable uncertainty in this area. However, if this plan is selected for implementation, special consideration and arrangements could be made to lessen all such impacts.

Plan B - Culvert Enlargement

This plan would involve building a new, larger culvert through the upper Mon Bijou area as described earlier. This plan would meet the objective of reducing flood damages by lowering expected flood levels in the area. It

would increase safety in the area by reducing the flooding of inhabited areas. However, this plan would not enhance the environment or recreation opportunities of the area. Any protection of historical or cultural resources would be incidental, related only to the reduction in flood levels in the area.

Significant impacts of this plan on the NED account include the beneficial effects which would result from the reduction in average annual flood damages. These would amount to $382,720 annually. Adverse effects would result from the cost of implementation of this plan. The first cost of this plan would be $3.7 million which would yield an annual cost of $335,640. The net effect on NED would be positive and amount to $47,080 annually with a benefit to cost ratio of 1.14.

Environmental impacts would be mainly adverse though minor. Some beneficial effects could be expected related to the protection of the manmade resources of the area. However, most of the remaining impacts would be adverse resulting from the construction activity. This would generate temporary adverse impacts on noise, air quality, and esthetics during the construction phase. Long-term, minor adverse impacts on esthetics and wildlife could be expected from the creation of the debris basin and diversion channel for Little Fountain Gut.

Regional economic development (RED) impacts would be beneficial, though minor. These would mainly stem from the improved economic conditions of the area related to the reduction in flood losses. There would be a minor increase in tax revenue due to reduced deductions for casualty loss as well as a probable increase in property values. There would also be beneficial impacts related to a reduction in expenditures for repair of public facilities damaged by flooding, as well as a reduction in costs for similar public services. During the construction phase there would also be a minor, though temporary, increase in employment opportunities. Adverse impacts would be generated by the local costs of implementation of this plan and the temporary disruption of public facilities and services during the construction phase.

Other social effects (OSE) would be mainly beneficial. These would relate to the reduction in flooding which would reduce the requirement for emergency evacuation and the associated community disruption as well as improve the overall health, safety, and general well-being of the community as a whole.

As with Plan A, the implementability of this plan can be assessed by ascertaining its response to certain criteria; namely, acceptability, completeness, effectiveness, and efficiency. Plan B is generally acceptable to the local interests as a means of reducing flooding and associated damage in the area. It is complete within itself for achieving the results stated requiring only periodic maintenance of the channel work and debris basin. It is an effective means of reducing flooding and associated damage by achieving an 86% reduction in damage. It is an efficient means of reducing damages in that benefits exceed costs.

In examining the sensitivity of this plan, it should be noted that because of the hydraulic change, flood levels are lowered. This results in a decrease in the risk for flooding of the houses in the area. However, there is still the risk that large floods will occur, perhaps larger than the design capacity of Plan B. Also, for any given event, flood levels may be slightly higher or lower than predicted levels. However, the overall design should maintain its integrity and contribute to a significant reduction in overall flood levels even though some residual flooding could still be expected. Therefore, there is some remaining risk associated with exceeding the design capacity of Plan B. At that point, excess flow would again be uncontrolled overland flow and flood the Mon Bijou area.

A similar rationale can be applied to the uncertainty associated with Plan B related to variations in hydrologic conditions at time of event occurrence. Under Plan B, flood profiles would still be lower than existing conditions. Other items of uncertainty relate to the condition of the modification at time of occurrence. A lack of maintenance of the diversion channel or debris basin could result in higher flood levels than design. However, under almost any condition, flood levels would still be lower than existing.

Plan C - Open Channel

This plan would require excavating a new channel through the Mon Bijou area, in effect restoring the natural drainageway. By restoring the drainageway, this plan would lower flood levels in the area thereby meeting the objectives of reducing flood damages and improving the safety and well-being of area residents. There would also be some minor enhancement of the area's environment resulting from restoration of the channel area. No provisions would be included for enhancing recreational opportunities primarily due to a lack of local interest. As with Plan B, any protection of historical or cultural resources would be incidental resulting from reduced flooding in the area.

Significant impacts of this plan are similar to Plan B. Beneficial NED effects could be expected from reduced flooding in the area. These would amount to an estimated $378,320 annually. Adverse impacts would result from the cost of implementation which would amount to a $3.62 million first cost or an annual cost of $330,300. This yields net annual benefits of $48,020 and a benefit to cost ratio of 1.15.

Environmental impacts of this plan would mainly be related to the construction activity and the restoration of the open channel area. Beneficial impacts could be expected due to the restoration of the channel area which would create a greenway through the housing area. There would also be a minor reduction in overall noise level and minor improvement in esthetic quality due to the replacement of a part of the developed area with an uninhabited greenway. Adverse impacts could be expected during the construction period which would be temporary and minor. There would be some degradation of air quality and esthetic quality during the construction activity as well as an increase in overall noise level. These would be similar to Plan B.

Regional Economic Development impacts under this plan would be similar to Plan B. There would be beneficial impacts related to the reduced flooding and improved economic conditions in the study area. Adverse impacts would be related to the costs of implementation on local financial resources and the impacts related to the relocation of six houses. However, overall impacts should be beneficial.

Other social effects would be a mixture of Plans A and B. Beneficial impacts would result from the reduced flooding which would reduce the need for emergency evacuation and enhance safety, area housing, and community cohesion. Adverse impacts would result from the displacement of those living in the houses to be removed from the area. This would cause some disruption of the community and create hardships on those directly affected.

The implementability of this plan is also similar to Plan B. Plan C is generally acceptable to local interests even though, as with Plan A, there is concern over removable of the six houses. Plan C is complete within itself in that it will reduce flooding and flood damages in the Mon Bijou area once implemented. Other than minor maintenance, it does not require additional action to achieve estimated results. Plan C is an effective method for reducing flood damages achieving an 85% reduction in average annual flood damage.

The sensitivity of Plan C also reflects a combination of that noted for Plans A and B. As noted for Plan B, the risk associated with Plan C is considerably less than the risk under existing conditions. Flood levels which cause damage are still possible under Plan C. However, the probability of their occurrence for any given level of flooding is significantly reduced. The uncertainty of Plan C is also reflected in the unknown conditions related to flooding and flood levels as well as specific impacts on those persons relocated. The uncertainty related to flood levels would be less than Plan B due to the decreased dependent on maintenance of the debris basin and high velocity channel. Also, the uncertainty related to humanistic impacts would be considerably less than Plan A due to the significant decrease in number of houses affected.

Plan D - Diversion Channel

This plan would require excavating a new channel around the Mon Bijou and Glynn areas to divert flood water away from the existing development. All flows from Canaan Gut and Little Fountain Gut that enter the upper portion of Mon Bijou would be diverted by levee and channel works north of the area. This plan would therefore greatly reduce the flooding potential of the area thus meeting the objectives of reducing flood damages and improving the safety and well-being of area residents. Due to the construction effort and creation of the new channel, this plan would not provide any

enhancement of the natural environment. However, the human environment would be significantly improved by the reduction in flooding. Again, no provisions would be included for enhancing local recreational opportunities. Also, any protection or enhancement of historical or cultural resources would be incidental resulting from reduced flooding in the area.

Significant economic impacts of this plan are similar to Plan C. Beneficial NED effects could be expected from reduced flooding in the area. These would amount to $415,800 annually. Adverse impacts would result from the cost of implementation which would amount to almost $3.6 million first cost or an annual cost of $338,000. This would yield a net beneficial effect of $77,800 and a benefit to cost ratio of 1.23.

Environmental impacts of this plan would be mainly related to the construction activity along the bypass route. Existing vegetation would be destroyed and replaced with an altered landscape and periodically maintained channel and right-of-way. There would also be minor adverse effects associated with the construction activity. These would relate to the temporary degradation of air quality, increased noise level, and impaired esthetics of the area. This should cease following completion of construction.

Regional Economic Development impacts under this plan would be similar to Plan C though somewhat more beneficial. The reduced flooding and improved economic conditions of the area would have a beneficial impact on the local economy and financial resources. The costs of project implementation would adversely affect local area financial resources. However, as with NED, the net effect should be beneficial.

Other social effects would be related to the reduction in flooding which would improve the safety and general well-being of the area residents. The reduction in flooding would also tend to allow an improvement in the community by allowing normal appreciation and property improvements. This plan would beneficially impact more people than any of the other plans considered and avoid most of the adverse effects of the relocation plans.

The implementability of Plan D is similar to Plan C. Plan D is acceptable to local interests and strongly supported as the most appropriate method for reducing flood damages. It is complete within itself producing the estimated flood damage reduction without requiring additional action. Only periodic maintenance would be required to insure proper functioning of the work. Plan D is the most effective and efficient means for reducing flood damages by achieving a 94% reduction in damages and the greatest net benefits.

The sensitivity of Plan D reflects the factors noted before. The risk associated with Plan D are considerably less than that noted for any other plans. Since all flood waters would be diverted around most of the development, much of the flood risk is virtually eliminated. Only an extremely rare event (exceeding SPF) may produce some residual flood damage. The uncertainty associated with Plan D is considerably less than that of the other plans since flood waters would be diverted rather than just lowered.

TRADE-OFF ANALYSIS

In the above evaluation, the impacts of the various plans were summarized. In order to arrive at the optimum plan for the Mon Bijou area, an analysis of the relative differences in the above plans is necessary. Then, either the best plan from those considered could be selected for implementation, or the most beneficial features of the various plans could be combined to form a new alternative which maximizes the beneficial effects while minimizing the adverse effects.

In reviewing the four detailed plans considered above, Plan A was shown to provide significant beneficial effects in reducing flood damages in the area through the removal of the flood prone property. Also, there are beneficial, though not significant, impacts on the local area environment through the removal of the houses and creation of green belts. However, there are also adverse impacts on the human resources and community due to the removal of the homes from the area and the relocation of these residents. Plan B provided a similar beneficial impact on the reduction in flood damages. However, it does not provide any improvement of the existing natural environment nor does it generate the adverse social effects noted above from relocating people. Plan C, likewise, provides a similar beneficial economic effect by reducing flood damages. However, it also provides some enhancement of the environment by the reestablishment of the open channel and green way through the area. This is done at the expense of the local community cohesion by removing some houses from the area, although the impact is far less significant than Plan A. Additionally, Plan C, like Plan B does nothing for flooding in the lower Mon Bijou and Glynn areas.

Plan D has a similar beneficial, though significantly greater impact on the economy, due to the protection of a larger area and thus, a greater reduction in flood damages. It does not provide any enhancement to the environment. Its social impacts are mainly beneficial resulting from the reduction in flooding. There would still be some minor adverse impacts associated with the relocation of at least 3 houses. However, this is considerably less than either Plan A or C.

In analyzing these plans and their relative impacts some trade-offs between Plans A, B, and C may be possible to achieve either a more environmentally oriented or socially oriented goal. However, trade-offs between Plan D and the others do not appear warranted since the features of Plan D fall generally outside the directly affected area of the other plans and since implementation of Plan D would completely obviate the need for any other flood reduction work. Therefore, no trade-offs are considered warranted for Plan D. Likewise, since Plans A, B, and C represent different methods of reducing flood damages with other impacts solely dependent on the method used to reduce damages, trade-offs between those plans are not considered warranted.

IDENTIFICATION OF THE NED PLAN

Consistent with Federal guidelines for water resource development, the plan yielding the greatest economic benefits in excess of economic costs, consistent with protection of the environment, is designated as the NED plan. Based on the above comparative analysis, Plan D is shown to yield the greatest net benefit for the area. This plan also achieves these results in a manner consistent with protecting the resources of the area. Therefore, Plan D is designated as the NED plan.

PLAN SELECTION

In reviewing the above assessment and evaluation of the four plans, as summarized on Table 5, it becomes apparent that Plan D provides a significant reduction in flooding of the area while minimizing the disruption of the community. As such, it generates overall beneficial effects related to the reduction in flooding and associated damages. While Plan A achieves a similar reduction in flood damage and thus a similar beneficial effect, it also requires the removal of 40 houses which significantly increases the adverse impacts associated with relocation on the community and its residents. Plan B also achieves a similar significant reduction in flooding and flood damages. However, it does not require any relocations. Therefore, its adverse effect on the community and its residents are minimized. However, with Plan B, as noted earlier, there is a higher risk and uncertainty level than with Plan C and D due to the nature of the design, dependence on maintenance, and capacity limitation of the improvement. Plan C, likewise, achieves a significant reduction in flood damages. However, this plan, like Plan B, does nothing for flooding in the lower Mon Bijou and Glynn area.

From an economic standpoint, all four plans are feasible solutions to the flood problems. Also, given the relative range of net annual benefits ($29,350 to $77,800), all four plans achieve similar economic efficiency. However, since Plan D does yield the highest net benefits, it has been designated as the NED plan.

In light of the above evaluation and assessment and in accordance with current planning guidance Plan D, the NED plan, is designated as the selected plan. It achieves the highest net economic benefits while minimizing adverse impacts. Also, it represents a significant improvement in the area as compared to the without project condition that would be experienced under the "no action" plan.

THE SELECTED PLAN

PLAN DESCRIPTION

As noted earlier, Plan D, diversion channel, involves the construction of a bypass channel around the Mon Bijou and Glynn area. The proposed plan would be located as shown on Plate 2. The main channel would have a grass-lined trapezoidal section with a bottom width of 75 feet and side slopes of

one vertical to three horizontal. The channel work would extend some 6,500 feet beginning downstream of the Glynn area and extending around the north side of the developed area to just above Mon Bijou. Thirty-four gabion drop structures would be provided to reduce velocities and control the stream gradient through the area. Two new bridges would be required along the new channel to maintain existing traffic routes. A levee would be provided on the upstream end to divert water into the new channel.

Right-of-way requirements for this plan include the removal of at least three houses from the area. These are located in the lower Glynn area. The occupants would be given assistance in finding replacement housing elsewhere under the provisions of Public Law 91-646. The houses would be demolished after acquisition. Additional easements would be required where the construction right-of-way crossed parts of other properties.

DESIGN AND CONSTRUCTION

The design capacity of the bypass channel is based on the 10 year discharge at the lower end of the Mon Bijou area, some 3,370 cubic feet per second. This discharge is carried throughout the 6,500 feet length for velocity and flow profile determination. At the upper end of the diversion, the design flow is in excess of a 100 year event due to the smaller basin. Local inflows increase the discharge for a particular event as the flow travels downstream. However, since the diversion crosses into another drainage area that does not rejoin the Canaan Gut/Salt River channel until at a point below the developed area, this effect will not alter the basic performance of the channel in diverting the flow.

Based on the flow, soil conditions, and type of channel, a design maximum discharge velocity was set to establish channel dimensions. For the design, a discharge velocity of about 6 feet per second was used. This would provide a channel with a 75-foot bottom width, 3 to 1 side slopes, and a 6 foot flow depth. Since the flow in the channel is intermittent, depending directly on rainfall, vegetative cover in the channel should be well established. Also, the short duration of flows should minimize the time of potentially scouring flows. Therefore, under these conditions scour should be minimal.

In order to control velocities in the stream channel, drop structures will be required. The bypass channel drops about 120 feet over its 6,500-foot length. Since flow will be intermittent and of short duration, gabion-lined drop structures were selected to provide flow control and grade change. In all, some 34 structures would be provided, each producing a 3-4 foot drop. Overland flow from Little Fountain Gut will enter the main channel between drop structures 28 and 29 (Sta. 56+00 and 57+00). The channel reach between the drop structures would be lined with a gabion mattress for a length of about 200 feet. Details of a typical drop structure are shown on plate 3.

At the upper end where the bypass channel joins Canaan Gut a levee would be constructed to help divert flow from the existing channel into the new channel. This levee would extend along the new channel for about 400 feet to insure diversion of Canaan Gut runoff. This levee would be constructed to contain the Standard Project Flood with adequate freeboard. A typical section is shown on plate 3.

As noted earlier this plan also includes the construction of 2 new bridges. The first would be at Canaan Road near the upstream end of the diversion. The other would be on a local street near the lower end of the Glynn area as shown on plate 2.

If authorized and following completion of any necessary revisions to the basic design, detailed plans and specifications would be prepared for bid solicitation and construction. Construction would be accomplished under contract with supervision by the Corps of Engineers. It is estimated that the project could be completed in 12 months.

A detailed cost estimate for the proposed plan is provided in table 6. All work is based on July 1987 price levels, utilizing the FY-88 discount rate of 8-5/8% to determine an annualized cost.

OPERATION AND MAINTENANCE

Operation and maintenance of the proposed project would require only periodic grass cutting of the channel area and occasional repair of any eroded or damaged areas. There is no requirement for onsite operation nor is any permanent machinery involved, other than during construction. In addition to mowing, the project would be inspected on an annual basis and also following significant events to evaluate performance and condition.

ACCOMPLISHMENTS

As noted earlier, this plan would reduce flooding and associated damage in the Mon Bijou area. It would enhance the overall health, safety, and general well-being of the area residents. It achieves the national goals of maximizing contributions to NED consistent with protection of the environment.

The overall impacts of this plan on area attributes and resources are noted on table 5. In summary, there would be a net positive effect on the NED account due to the excess of benefits over costs resulting in a benefit-cost ratio of 1.2. There would also be a minor adverse effect on the EQ account due to the construction of the bypass channel. The net effect on the RED account would also be positive due to the reduced flooding and improved economic condition of the area. And, there would be a net positive effect on the OSE account due to the increased safety and well-being of Mon Bijou residents.

TABLE 6

PROPOSED PLAN
COST ESTIMATE

Item	Unit	Quantity	Unit Cost	Total Cost
Channel Work				
Mobilization/Demob	Job	1	L.S.	$ 20,000
Excavation	C.Y.	285,000	2.50	712,500
Levee Construction	C.Y.	1,500	1.25	1,875
Clearing and Grubbing	Acre	25	1500	37,500
Grassing	Acre	10	1500	15,000
Gabion Control Structure	C.Y.	8,500	90	765,000
Inlet Modifications	Job	1	L.S.	63,500
Building Removal	Job	3	2000	6,000
Subtotal				$1,621,375
Contingencies (20%)+				324,275
Contract Price				$1,945,650
Engineering and Design/S&A (18%)+				350,150
Subtotal				$2,295,800
Relocations and Alterations				
Bridges		2	L.S.	$ 605,000
Utilities			L.S.	25,000
Subtotal				$ 630,000
Contingencies (20% +)				125,000
Subtotal				$ 755,000
Lands and Damages				
Right-of-way and Easements				$ 307,500
Residential acquisitions				150,000
PL 91-646				31,500
Administrative Costs (10% +)				47,500
Subtotal				$ 536,500
Contingencies (15% +)				80,000
Subtotal				$ 617,000
TOTAL INITIAL COST				$3,667,800
INTEREST DURING CONSTRUCTION				150,000
TOTAL INVESTMENT COST				$3,817,800
Annual Costs				
Interest & Amortization (8 5/8% for 50 years)				$ 334,600
Maintenance				3,400
TOTAL				$ 338,000

CULTURAL RESOURCES

A cultural resources survey was conducted of the proposed project area, defined as a corridor approximately 61 meters wide and 2,016 meters long (Cultural Resources Survey: Mon Bijou, St. Croix, V.I., 1984) (See Plate 10). This work was accomplished in accordance with the National Historic Preservation Act of 1966, as amended (PL 89-665); the Archeological and Historic Preservation Act, as amended (PL 93-291); and Executive Order 11593; and was coordinated with the State Historic Preservation Officer (SHPO).

The results of the survey indicate that although the project does include a section of the Upper Salt River Archeological District of the National Register of Historic Places, it will not adversely affect any known prehistoric sites. However, two sites - Glynn and the Lebanon Dam Site - are located adjacent to the channel and must be carefully avoided during all phases of construction. In addition, a depression area that may be a significant resource was located during the survey, west of the Estate Lebanon stock pond. Given the proximity of known National Register sites to the project area and the identification of a possible cultural resource within the corridor, the SHPO concurs with the survey report's recommendation for archeological monitoring during construction (letter dated January 25, 1984). A monitor will be present during construction to ensure that significant sites are not adversely impacted. The construction contractor will clean the depression area (previously identified as a potential site) of stones to allow the monitor access to examine this area and determine if it is a significant site. Some concern also exists regarding indirect impacts from water discharged by the proposed channel. Since the water level and velocity will not be increased by the proposed project, no adverse effects to downstream sites due to channel construction and operation are anticipated.

MITIGATION REQUIREMENTS

As discussed above and noted earlier, the selected plan does not adversely impact any significant environmental resource in the area. Thus, no mitigation plan is required. However, there are known archeological sites in the area and care must be taken to avoid adversely impacting these sites. At present, there are no known sites that would be adversely affected. However, if during construction, sites are uncovered by the above mentioned monitor appropriate action will be taken as specified in 36 CFR 800 "Protection of Historic Properties".

OTHER CONSIDERATIONS

As noted earlier, Executive Order 11988 requires Federal agencies to recognize significant values of flood plains and to consider public benefits that would be realized from restoration or preservation of flood plains. The four criteria cited earlier provide the basis for determining overall plan compliance with the order. In this regard, it is noted that the flood

plain in the project area has been greatly altered by the housing development. While the proposed plan is within the flood plain, it is considered to be the only practical alternative for implementation. It also actually reduces the extent of the flood plain. In this regard, its overall effect is to reduce the hazards and risks associated with floods and thus minimize the impacts of floods on safety, health, and the general well-being of the area.

In view of these effects and findings, the proposed plan is considered to be in full compliance with Executive Order 11988. Additionally, since there are no wetlands in the proposed area, the provisions of Executive Order 11990 regarding protection of wetland areas, are not considered applicable to the proposed plan.

PLAN IMPLEMENTATION

INSTITUTIONAL REQUIREMENTS

This final report is to be forwarded for further review within the Corps of Engineers. When and if approved, the project would be placed on the national list of projects awaiting funding. When funds become available, plans and specifications would be prepared, local interests would be asked to sign formal agreements, and a contract then advertised and awarded to perform the work. Once rights-of-way and easements are provided, construction would be commenced under supervision of the Corps. Following completion of construction, all project works would be transferred to the local interests for operation and maintenance.

DIVISION OF RESPONSIBILITIES AND COST SHARING

The implementation of the proposed plan is a joint endeavor by local and Federal interests. Thus, responsibilities for implementation are shared by each. The Federal Government, through the Corps of Engineers, would be the lead agency in plan implementation. As such, the Corps would be responsible for all design work and engineering, preparation of all necessary contract documents, contract award, supervision of construction, and assuring project completion. However, prior to implementation, local interests must enter into an agreement with the United States in accordance with Section 103(j) of the Water Resources Development Act WRDA) of 1986 (PL 99-662). Generally, they must agree to provide all lands, easements, rights-of-way, relocations, highway bridge alterations, and certain other costs associated with the project, as well as operate and maintain the project when complete as specified in a Local Cooperation Agreement. The Act further modified the cost-sharing requirements. Table 7 below shows the cost-sharing requirements for the proposed plan under the present cost-sharing arrangements. It should be noted that all costs for operation and maintenance are a local responsibility. Section 103(m) of the Act reduces the non-Federal cost-share of a flood control project under an "ability to pay" determination. Guidelines for this determination were derived from 33 CFR Part 241 contained in the Federal Register of September 23, 1987.

The Benefits Based Floor (BBF) of 30 percent and Efficiency Factor (EF) of 1 were utilized as specified in the referenced guidelines. Also, Section 1156 of the WRDA of 1986 waives certain cost-sharing requirements up to $200,000 for any one project. These cost sharing determinations are reflected in the table below. The local sponsor has expressed the financial capability to meet the non-Federal obligations as shown in table 7 and as specified in the Local Cooperation Agreement (LCA).

TABLE 7

PROPOSED PLAN

COST SHARING

Item	Total	Federal	Non-Federal
Channel Work	$2,295,800	$2,295,800	-
Relocations	755,000	-	$ 755,000
Land and Damages	617,000	-	617,000
TOTAL	$3,667,800	$2,295,800	$1,372,000
5% Non-Federal Contribution		- 183,400	+ 183,400
Subtotal		$2,112,400	$1,555,400
25% Minimum Contribution			917,000
50% Maximum Contribution			1,833,900
Adjustment for Min. or Max.		0	0
Subtotal		$2,112,400	$1,555,400
Section 103(m) Adjustment		+ 455,000	- 455,000
Subtotal		$2,567,400	$1,100,400
Section 1156 Adjustment		+ 200,000	- 200,000
TOTAL FIRST COST		$2,767,400	$ 900,400

PUBLIC INVOLVEMENT

Throughout preparation of this report close coordination has been maintained with the local sponsor, the Public Works Department of the Government of the U.S. Virgin Islands, and with other governmental offices, elected officials, special interest groups, and individual citizens. On May 29, 1987, the Corps distributed the Draft Detailed Project Report for review and comment. A list of those receiving the draft report is provided below:

Federal Agencies

Environmental Protection Agency
National Marine Fisheries Service
Department of Agriculture (SCS)

Federal Agencies (Continued)

National Park Service
Federal Highway Administration
U.S. Fish and Wildlife Service
U.S. Geological Survey

Territorial Agencies

Governor of the U.S. Virgin Islands
Virgin Islands Port Authority
Department of Conservation and Cultural Affairs
Virgin Islands Public Relations Office
Department of Commerce
Department of Public Works
Department of Agriculture
Director of Tourism
Virgin Islands Housing Authority
Virgin Islands Urban Renewal Board
State Historic Preservation Officer
Office of Coastal Zone Management
Virgin Islands Planning Office

On June 30, 1987, a Public Workshop was held at the John H. Woodson Junior High School adjacent to the Mon Bijou community on St. Croix. The purpose for the workshop which was sponsored by the Public Works Department, was for the Corps to present a summary of the flood problems at Mon Bijou and to provide a discussion of the study findings and recommendations. Approximately 60-65 people were in attendance at the meeting which provided an opportunity for the attendees to ask Corps representatives, as well as Public Works officials, specific questions related to local concerns and issues of the proposed project.

These concerns focused on the residents' desire to implement flood reduction measures without delay. The need for safety precautions was expressed as several residents were fearful of children playing within short proximity of the proposed bypass canal. The requirement for continued upkeep and maintenance was similarly stressed.

The meeting which received local press and television coverage was well received by local residents who have long endured disastrous flooding which threatened lives and property. The local sponsor has agreed to fulfill the requirements of local cooperation as stated within the Local Cooperation Agreement between the Department of the Army and the Government of the U.S. Virgin Islands. This Letter of Intent and other pertinent correspondence can be found in Appendix G of this report.

CONCLUSIONS

Based on the analyses presented earlier and the input provided by others, Plan D, construction of a bypass diversion channel around the Mon Bijou area, appears to be in the best overall public interest and the most

feasible plan for implementation. This plan meets designated criteria for participation by the Federal Government in improvements for flood control. It also conforms to the guidelines for Federal water resource project development as provided under Principles and Guidelines. There are no more economical plans identified that address the primary study objectives and achieve a significant reduction in flood damages for the area. The impacts of the proposed plan are deemed beneficial overall and the plan is considered to be in full compliance with all pertinent environmental statutes as well as other Federal laws and directives regarding water resource project development.

For these reasons and in view of the comments received from other interested parties, Plan D was determined to be the best plan for implementation.

RECOMMENDATIONS

Therefore, I recommend that the selected plan described in this report for flood control at Estate Mon Bijou on the island of St. Croix, U. S. Virgin Islands, be authorized for Federal implementation under Section 205 of the 1948 Flood Control Act, as amended, with such modifications as in the discretion of the Chief of Engineers may be advisable at a presently estimated Federal first cost of $2,767,400 subject to cost sharing and financing arrangements satisfactory to the President and the Congress.

This recommendation is made with the provision that, prior to implementation, local interests will, in addition to the general requirements of law for this type of project, agree to:

a. Provide, during the period of construction, an amount equal to not less than 25 percent of total projects costs for flood control, at least 5 percent of which will be cash. The Virgin Islands shall receive a waiver of $200,000 of its required cost-sharing requirements as specified by Section 1156 of Public Law 99-662. This waiver is applicable to the 5 percent contribution and additional cash contributions as may be required. The amount to be provided shall include the value or cost of all lands, easements, right-of-way, and utility and facility alteration and relocations necessary for construction and subsequent maintenance of the project including suitable borrow and dredged material disposal areas, as may be determined by the Chief of Engineers.

b. Provide all lands, easements and rights-of-way, including suitable disposal areas as determined by the Chief of Engineers, necessary for construction and maintenance of the project.

c. Accomplish all relocations and alterations of structures, utilities, highways, railroads, bridges (other than railroad bridges and approaches), sewers, and related and special facilities determined to be necessary for construction of the project;

d. Hold and save the United States free from damages due to the construction or operation and maintenance of the project, except for damages due to the fault or negligence of the United States or its contractors.

e. Maintain and operate all the works after completion in accordance with regulations prescribed by the Secretary of the Army.

f. Publicize flood plain information in the area concerned and provide this information to zoning and other regulatory agencies for their guidance and leadership in preventing unwise future development in the flood plain and in adopting such regulations as may be necessary to prevent unwise future development and to ensure compatability with protection levels provided by the project;

g. To the extent of its powers, prescribe and enforce regulations to prevent obstruction of or encroachment on the project that would reduce the level of protection it affords or that would hinder operation and maintenance;

h. Assume full responsibility for all project costs in excess of the Federal cost limitation of $5,000,000;

i. Fulfill the requirements as specified by the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Public Law 91-646) approved 2 January 1971; and

j. Comply with Section 601 of Title VI of the Civil Rights Act of 1964 (Public Law 88-352) and Department of Defense Directive 5500.11 issued pursuant thereto and published in Part 300 of Title 32, Code of Federal Regulations, in connection with construction, operation, maintenance, and rehabilitation of the project.

The recommendations contained herein reflect information available at this time and current Departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national civil works construction program nor the perspective of higher levels within the Executive Branch. Consequently, the recommendations may be modified before they are approved for implementation.

Robert L. Herndon
Colonel, Corps of Engineers
District Engineer

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
P. O. BOX 4970
JACKSONVILLE, FLORIDA 32232-0019

REPLY TO
ATTENTION OF

CESAJ-PD-ES

ESTATE MON BIJOU, ST. CROIX, U.S. VIRGIN ISLANDS FLOOD CONTROL STUDY

FINDING OF NO SIGNIFICANT IMPACT

I have reviewed the planning document and the Environmental Assessment of the planned action. These documents reflect pertinent data obtained from cooperating Federal agencies having jurisdiction by law and/or special expertise and from the interested public. The concerns applicable to whether or not this project would significantly affect the human environment are addressed in those documents and are summarized below.

a. No wildlife habitats, wildlife concentrations, or environmental properties that sustain and enrich human life would be significantly degraded.

b. Archeological surveys and coordination with the SHPO provided a suitable plan for protecting and preserving cultural resources in the project area.

c. No threatened or endangered species' existence would be jeopardized, and no critical habitats would be adversely affected.

I find, based on the above summary, the planned action will not significantly affect the quality of the human environment and does not require an Environmental Impact Statement.

DATE: 17 December 1987

Robert L. Herndon
Colonel, Corps of Engineers
District Engineer

ENVIRONMENTAL ASSESSMENT

ESTATE MON BIJOU, ST. CROIX, V.I., FLOOD CONTROL STUDY

DECEMBER 1987

1.00 Project Location: A 2.5-square-mile watershed area containing a residential community about 5 miles west of Christiansted in north-central St. Croix, U.S. Virgin Islands. See the attached location maps.

2.00 Purpose and Need for Project: The Mon Bijou area and the watershed to the east, Glynn area, are flow-through areas between Blue Mountain and Mount Eagle to the west and Salt River Bay to the northeast. The flow-through water is normally contained in Canaan Gut (drains Blue Mountain and Mount Eagle) and Little Fountain Gut from elevations exceeding 1,000 feet m.s.l. in the mountains through the Mon Bijou/Glynn areas, with elevations ranging from 80 to 200 feet m.s.l., to sea level in Salt River Bay. Intense rainstorms in the mountains cause sudden high-volume runoff towards the east through Canaan Gut. These flash floods have overflowed into the Mon Bijou area three times in the 5 years preceding 1980. These overflows inundate over 90 private homes and cause extensive damage. Some provision is needed to contain and drain these flash floods that will remove this threat to human life and private property.

3.00 Project Plans Coordination: The following agencies were consulted concerning control measures contemplated, endangered and threatened species, environmental concerns, cultural concerns, and fish and wildlife values: U.S. Fish and Wildlife Service (FWS), U.S. Department of Agriculture, U.S. National Marine Fisheries Service (NMFS), U.S. Environmental Protection Agency (EPA), the U.S. Virgin Islands Planning Office, and the U.S. Virgin Islands Department of Conservation and Cultural Affairs.

4.00 Flood-Control Alternatives:

4.01 Nonstructural Alternatives.

a. NS-1. Without condition (No Action) Alternative: This alternative would allow the periodic flash floods to continue causing damage to private and commercial property in the project area. This alternative would not meet the study's objective of determining an economical method for containing and drawing off the periodic flash flood waters; therefore, it is unacceptable.

b. NS-2. Relocation of houses from the flood-prone areas. This alternative is not feasible because a replacement community for the moved houses with streets and utilities located outside the flood plain would be required, and such activities would greatly increase project costs.

c. NS-3. Establishment of local government flood plain regulations (zoning ordinances, building codes, and restrictions). This alternative would only prevent flood damages to future homes. The existing homes, and people living in those homes, would still be subject to periodic flash flooding. This alternative is, therefore, not feasible.

d. NS-4. Flood warning, temporary flood evacuation, and other emergency planning would not be an effective response to flash flooding; therefore, this alternative would not be feasible.

e. NS-5. Flood proofing the existing homes: Raising the homes is not feasible because of their type of construction (slab-on-grade). Ring levees or walls cannot be guaranteed to be overflow or damage-and-collapse proof. Ring levees or walls would not protect people and property caught outside during a flash flood. This alternative is, therefore, not feasible.

f. NS-6. Relocate residents. This alternative would require the purchase, at fair market value, of both lots and buildings, and it would require compliance with PL 91-646 (Uniform Relocation Assistance and Real Property Acquisition Policies of 1970). The total cost of relocating all of the families currently living in this flood-prone area into flood-safe and adequate dwellings would be acceptable. This alternative does offer a potentially feasible plan for reducing flood damage.

4.02 Structural Alternatives (see plates 2, 8, and 9 in the main report).

a. S-1. Construction of a grass-lined bypass channel with gabion-lined drop structures north of the flood-prone areas. This alternative would provide a bypass for flash-flood waters to the north of the flood-prone areas. It appears to be feasible from pertinent economical, engineering, environmental, and historical and cultural concerns. This alternative is the recommended plan.

b. S-2. Construction of a bypass channel north of the flood-prone areas with the addition of a storage area and dam located at the site of an existing, but relatively small, pond. This alternative appears feasible from engineering and environmental viewpoints; however, dam construction would significantly add to project costs, dam construction could damage historical and cultural resources (see paragraph 5.03-Lebanon Dam) located on the south side of the considered dam site, and the storage area is not necessary to accomplish the desired flood control.

c. S-3. Construction of a bypass channel north of the flood-prone areas with the addition of a leveed detention area at the downstream end of the channel. This alternative appears feasible from engineering and environmental viewpoints, but it does not appear feasible from historical, cultural, and economic viewpoints. The area being considered for the detention area contains four clusters of aboriginal sites dating back to 100 A.D. The area has been nominated for inclusion in the National Register of Historic Places and appears to be a valuable archaeological resource. This

alternative would provide downstream storage and recreation potential; however, this additional storage capacity does not appear to be necessary to solve the flooding problem.

d. S-4. Construction of a bypass channel with the addition of an upstream storage area and a downstream detention area (Alternatives S-2 and S-3 combined): This alternative would be feasible from engineering and environmental viewpoints, but the reservations listed in paragraphs b and c above would still apply.

e. S-5. Construction of a bypass channel through Mon Bijou along an existing drainage ditch route with one entrance channel from the north, one entrance channel from the west, and a debris basin between the entrance channels and the bypass channel. This alternative would provide a rapid bypass for flash-flood waters through the center of the flood-prone areas, and it is feasible from the economic, environmental, and engineering viewpoints. This alternative's location is believed to be in an area of high cultural resource sensitivity, therefore, it has the potential of destroying valuable historic and cultural resources.

5.00 Environmental Impacts:

5.01 The project area has the following ecological characteristics. The vegetation is wholly upland grasses and large trees such as Flamboyan (Delonix regia), Thorn scrub (Acacia), gumbo-limbo (Bursera simaruba), mango (Mangitera indica), and tamarindo (Tamarindus indica). There are no wetlands in the area of considered flood-control activities. The Salt River Bay, northeast of the project area, has valuable mangrove and salt pond wetland areas. This wetland area receives the freshwater runoff from the project area but would not be adversely affected by any of the contemplated alternatives. There are no significant habitats, wildlife concentrations, or other valuable environmental characteristics in the project area.

5.02 No critical habitats or threatened and endangered species occur in the project area. The U.S. Fish and Wildlife letter of June 17, 1987 (copy in the correspondence section of the Detailed Project Report) completes the requirements of Section Seven of the Threatened and Endangered Species Act.

5.03 The Virgin Islands State Historical Preservation Officer (SHPO) notified the Corps by letter dated 10 December 1982 (copy included in the correspondence section of the Detailed Project Report) of the requirement for a systematic archaeological survey for any selected construction plan. A cultural resources survey (copy on file in the Jacksonville District Office) of the S-1 plan corridor concluded that only insignificant effects on two of the area's prehistoric archaeological sites (labeled Glynn 1 and Lebanon Dam on the cultural resources location map) could be expected as a result of the recommended plan. The recommended plan includes a preconstruction survey of a potential archaeological site (depression west of

the existing pond). Effects on any significant cultural or archaeological resources uncovered during construction would be avoided, or unavoidable damage to such resources would be mitigated. Plans S-2, S-3, and S-4 could cause significant damage at the Glynn 1 site and/or at the Lebanon Dam site. A cultural resources survey has not been performed for Plan S-5, and the SHPO has identified the Plan S-5 route as an area of high cultural resource sensitivity. A survey would be performed for S-5 if it is selected. The selected plan (S-1) is in full compliance with the National Historic Preservation Act of 1966, as amended, for the current stage of planning. The State Historical Preservation Office has offered to assist in project monitoring for the protection of significant deposits located near the proposed channel's corridor and to evaluate possible secondary effects on cultural resources located downstream of the proposed construction area.

5.04 Puerto Rico Coastal Management Program. This study is consistent with the approved Virgin Islands CZMP, because the planned work and flood control effects would not occur in the Virgin Islands Coastal Zone.

5.05 Flood Plain Management.

(a) The selected plan would occur in a flood plain.

(b) There are no practicable alternatives to the selected plan, and the selected plan cannot occur outside the flood plain.

(c) A Public Notice to notify all interested agencies and the general public in the study area of the necessity for implementing the Selected Plan in the subject flood plain and to request views and comments will be sent out before commitment of resources for this work.

(d) The planned action would prevent the flooding of the residential and commercial areas in and around Estate Mon Bijou, and no significant adverse impacts have been identified. No natural and beneficial flood plain values would be lost.

(e) No development as a result of flood control in the study area is anticipated.

(f) No adverse impacts will occur; therefore, no method to minimize adverse impacts will be required.

(g) The Selected Plan is the most responsive to the study's objective of providing economical flood control without causing significant environmental damage, and it is consistent with the objectives of Executive Order 11988 on Flood Plain Management.

5.06 Protection of fish and wildlife resources. The Contractor shall keep construction activities under surveillance, management, and control to minimize interference with, disturbance to, and damage to fish and wildlife resources. Species that require specific attention along with measures for

their protection will be listed by the Contractor prior to the beginning of construction operations.

5.07 The relationships of plans to environmental protection statutes and other environmental requirements are shown in Table 1. The U.S. Soil Conservation Service states that this proposal will not adversely affect prime or unique agricultural lands; therefore, this proposal does not require evaluation for compliance with the Analysis of Impacts on Prime and Unique Farmland.

6.00 The agencies consulted during the preparation of this document are listed below:

Director
Office of Federal Activities
EPA, Region II
26 Federal Plaza
New York, New York 10278-0012

Area Supervisor
National Marine Fisheries Service
Environmental Assessment Branch
3500 Delwood Beach Road
Panama City, Florida 32407-7403

Director, Caribbean Area
Soil Conservation Service, USDA
GPO Box 4868
San Juan, Puerto Rico 00936

Superintendent
Virgin Islands National Park
National Park Service
Post Office Box 806
St. Thomas, Virgin Islands 00801-0806

Territorial Representative
Federal Highway Administration
U.S. Federal Building, Room 114
Veterans Drive
St. Thomas, Virgin Islands 00801

Chief
Environmental Impacts Branch
U.S. Environmental Protection Agency
26 Federal Plaza, Room 400
New York, New York 10278-0001

Honorable Alexander A. Farrelly
Governor of the Virgin Islands of the United States
Office of the Governor
Charlotte Amalie, St. Thomas, Virgin Islands 00801

Executive Director
Virgin Islands Port Authority
Post Office Box 597
St. Thomas, U.S. Virgin Islands 00801-0597

Office of the Commissioner
Department of Conservation and Cultural Affairs
179 Altona & Weigunst
Charlotte Amalie, St. Thomas, U.S. Virgin Islands 00801

Director, Public Relations Office
Government of the U.S. Virgin Islands
St. Thomas, U.S. Virgin Islands 00801

Commissioner
Virgin Islands Department of Commerce
Post Office Box 1692
St. Thomas, U.S. Virgin Islands 00801-1692

Commissioner of Public Works
Government of the U.S. Virgin Islands
Post Office Box 4400
St. Thomas, U.S. Virgin Islands 00801

Regional Director
U.S. Fish and Wildlife Service
75 Spring Street Southwest
Atlanta, Georgia 30303-3309

Field Supervisor
U.S. Fish and Wildlife Service
Caribbean Field Office
Post Office Box 491
Boqueron, Puerto Rico 00622-0491

Virgin Island Housing Authority
Post Office Box 979
St. Thomas, U.S. Virgin Islands
00801-0979

Chief, Caribbean District, WRD
U.S. Geological Survey
GPO Box 4424
San Juan, Puerto Rico 00936

Executive Director
Virgin Islands Urban Renewal Board
Post Office Box 2295
St. Thomas, U.S. Virgin Islands 00801

Mr. William Tobias
Division of Fish and Wildlife
Box 1878, Frederiksted
St. Croix, U.S. Virgin Islands 00840

Director
Virgin Islands Planning Office
Chinnery Building
129-133 Sub-Base
St. Thomas, U.S. Virgin Islands
00801-5000

Mr. O'Neal A. Abel
Assistant Commissioner
Department of Public Works
Post Office Box H, Christiansted
St. Croix, U.S. Virgin Islands 00820

Assistant Commissioner
Department of Agriculture
Post Office Box 82
St. Thomas, U.S. Virgin Islands
00801-0082

Director of Tourism
Post Office Box 1692
St. Thomas, U.S. Virgin Islands
00801-1692

San Juan Area Office
U.S. Army Corps of Engineers
ATTN: SAJPG
400 Fernandez Juncos Avenue
San Juan, Puerto Rico 00901-3299

State Historic Preservation Officer
Virgin Islands Planning Office
Division for Archeology & Historic
Preservation
Chinnery Building
129-133 Sub-Base
St. Thomas, U.S. Virgin Islands
00801-5000

Mr. Benjamin Nazario, P.E.
Director
Coastal Zone Managment Division
Department of Conservation and
Cultural Affairs
179 Altona & Weigunst
Charlotte Amalie, St. Thomas,
U.S. Virgin Islands 00801

Mr. Gabriel St. Surin
Special Assistant
Department of Public Works
Government of the U.S. Virgin Islands
Post Office Box 4400
St. Thomas, U.S. Virgin Islands 00801

6.01 A scoping letter (dated September 5, 1984) and a copy of the Draft Report and Environmental Assessment with cover letter (dated May 29, 1987) were sent to the addressees listed in section 6.00. Copies of the letters of response are in appendix G of the main report.

6.02 Issues raised by letters of response and the Corps' responses are addressed below.

(a) U.S. Environmental Protection Agency (EPA) letter dated October 18, 1984: Any effect on wetlands as a result of this project will require application of 404(b)(1) Guidelines.

Corps' response: No wetland areas will be affected by the alternative plans being considered.

(b) EPA letter dated August 13, 1987:

1. Information should be provided to support the conclusion that the Salt River Bay mangrove and salt pond wetlands will not be adversely affected.

Corps' response: The Salt River Bay wetland area now receives the fresh-water runoff that flows through the project area through the existing channels (Canaan Gut and Little Fountain Gut) and, when the drainoff water volume exceeds these channels' capacity, overland through Mon Bijou. The proposed flood control measures will only remove the requirement for the water to flow overland through Mon Bijou. No significant change in the volume of water flowing to the wetland will occur, and the only possible change in fresh water quality entering the wetland area would be a reduction in the amount of domestic pollution picked-up enroute to the wetland area.

2. The clearing of lower channels leading into Salt River Bay should be added to the plan as requested in the EPA July 21, 1982 letter.

Corps' response: The study of any action unrelated to containing and draining flood waters from the Estate Mon Bijou area would be beyond the scope of this study and, therefore, cannot be added to the plan.

3. Destruction of soil retention vegetation should be prevented.

Corps' response: No vegetation outside the selected plan's channel alignment and immediate work areas would be significantly damaged.

4. Pre-historic sites at Glynn I and Lebanon Dam should not be disturbed.

Corps' response: A cultural resources survey of the selected plan's channel alignment concluded only insignificant effects on Glynn I and Lebanon Dam would be expected as a result of the plan.

7.00 Conclusion: This project will not cause a significant impact on the human environment, because there are no significant habitats, wildlife concentrations, or other valuable environmental characteristics in the path of the selected channel route or close enough to be affected by the necessary construction activities. An Environmental Impact Statement will not be required for this project.

TABLE 1

RELATIONSHIP OF PLANS TO ENVIRONMENTAL PROTECTION STATUTES AND OTHER ENVIRONMENTAL REQUIREMENTS
ESTATE MON BIJOU, ST. CROIX, V.I., FLOOD CONTROL STUDY, 1987
Selected Plan: Construction of a Bypass Channel - Plan S-1

	Plan S-1	Plan S-2	Plan S-3	Plan S-4	Plan S-5
Federal Statutes					
Archeological and Historic Preservation Act, as amended, 16 U.S.C. 469, et seq.	Full	Full	Full	Full	Non [1/]
Clean Air Act, as amended, 42 U.S.C. 1857h-7, et seq.	Full	Full	Full	Full	Full
Clean Water Act, as amended, (Federal Water Pollution Control Act) 33 U.S.C. 1251, et seq.	Full	Full	Full	Full	Full
Coastal Zone Management Act, as amended, 16 U.S.C. 1451, et seq.	N/A	N/A	N/A	N/A	N/A
Endangered Species Act, as amended, 16 U.S.C. 1531, et seq.	Full	Full	Full	Full	Full
Estuary Protection Act, 16 U.S.C. 1221, et seq.	N/A	N/A	N/A	N/A	N/A
Federal Water Project Recreation Act, as amended, 16 U.S.C. 4601-(12), et seq.	N/A	N/A	N/A	N/A	N/A
Fish and Wildlife Coordination Act, as amended, 16 U.S.C. 661, et seq.	Full	Full	Full	Full	Full
Land and Water Conservation Fund Act, as amended, 16 U.S.C. 4601 - 4601-11, et seq.	Full	Full	Full	Full	Full
Marine Protection, Research, and Sanctuaries Act, 33 U.S.C. 1401, et seq.	N/A	N/A	N/A	N/A	N/A
National Environmental Policy Act, as amended, 42 U.S.C. 4321, et seq.	Full	Full	Full	Full	Full
National Historic Preservation Act, as amended, 16 U.S.C. 470a, et seq.	Full	Full	Full	Full	Full
Rivers and Harbors Act, 33 U.S.C. 401, et seq.	N/A	N/A	N/A	N/A	N/A
Watershed Protection and Flood Prevention Act, 16 U.S.C. 1001, et seq.	N/A	N/A	N/A	N/A	N/A
Wild and Scenic Rivers Act, as amended, 16 U.S.C. 1271, et seq.	N/A	N/A	N/A	N/A	N/A
Executive Order, Memoranda, etc.					
Floodplain Management (E.O. 11988)	Full	Full	Full	Full	Full
Protection of Wetlands (E.O. 11990)	N/A	N/A	N/A	N/A	N/A
Analysis of Impacts on Prime and Unique Farmlands (CEQ Memorandum, 11 Aug 80)	N/A	N/A	N/A	N/A	N/A

NOTES: For each item listed enter one of the following:

a. Full Compliance. Having met all requirements of the statute, E.O., or other environmental requirements for the current stage of planning (either preauthorization of postauthorization).
b. Partial Compliance. Not having met some of the requirements that normally are met in the current stage of planning. Partial compliance entries should be explained in appropriate places in the report and/or EA and referenced in the table.
c. Noncompliance. Violation of a requirement of the Statute, E.O., or other environmental requirement. Noncompliance entries should be explained in appropriate places in the report and/or EA and referenced in the table.
d. Not applicable. No requirements for the Statute, E.O., or other environmental requirement for the current stage of planning.

[1/] A cultural resources survey has not been performed for the S-5 route; however, a survey would be performed if this alternative route is selected.

BONNE ESPERANCE

BETSYS JEWEL

CANAAN

Mount Eagle

Blue Mountain

HERMITAGE

LITTLE FOUNTAIN

LEBANON HILL 7

WINDSOR

CONCORDIA

COUNTRY DAY SCH.

GLYNN

MON BIJOU

MARY'S FANCY

COLQUOHOUN

BONNE ESPERANCE

V.I. GOV'T GUEST HOUSE

COBLE

FREDENSBORG

N

Scale in Feet

0 1,000

LOCATION OF SELECTED PLAN

CARIBBEAN SEA

SAINT CROIX ISLAND

LOCATION MAP

ADOPTED FROM REPORT BY CH2M HILL, "A FLOOD DAMAGE MITIGATION PLAN FOR THE U.S. VIRGIN ISLANDS", JUNE 1979.

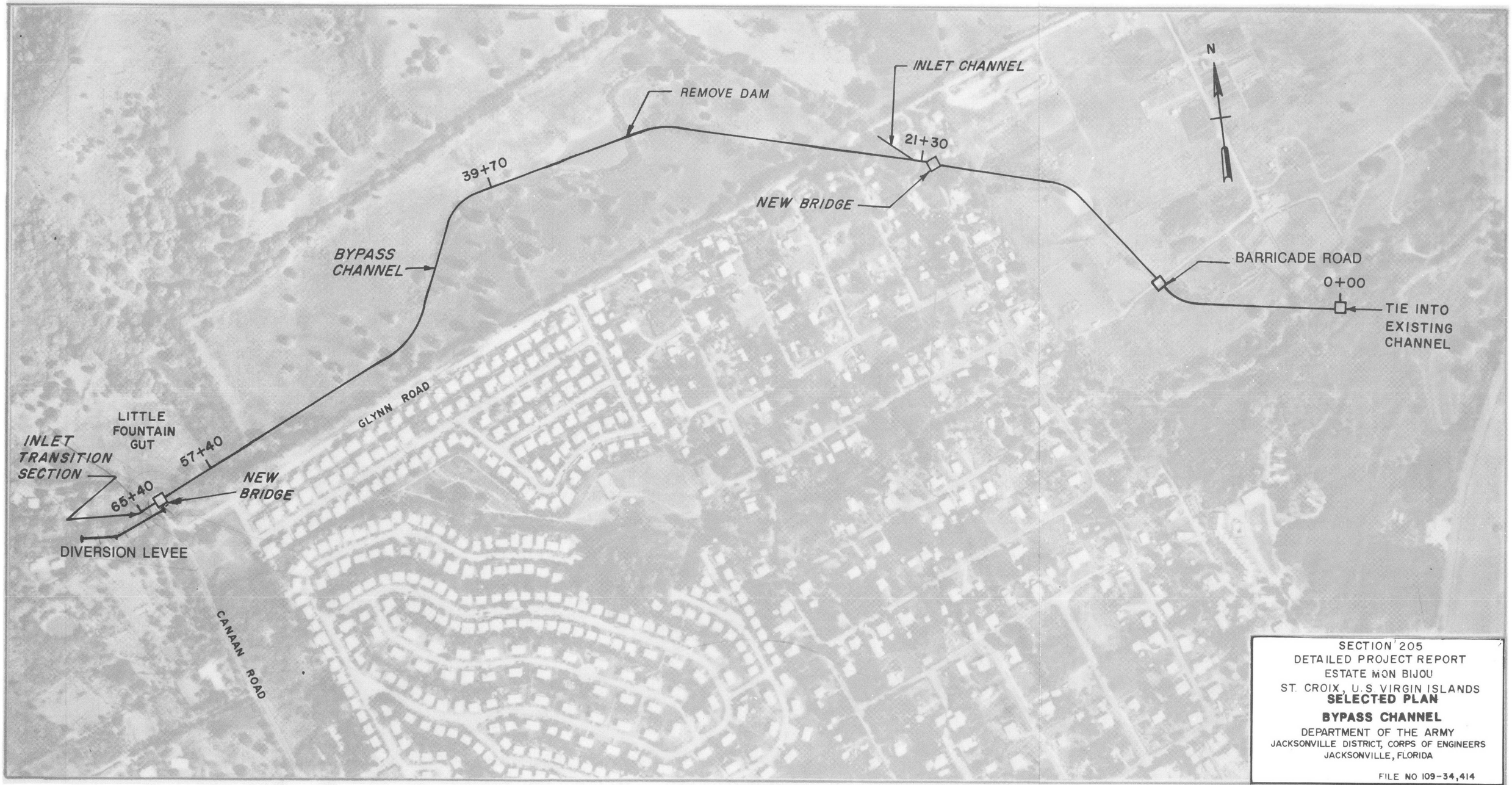
SECTION 205
DETAILED PROJECT REPORT
ESTATE MON BIJOU
ST. CROIX, U.S. VIRGIN ISLANDS

STUDY AREA

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA

FILE NO. 109-34,414

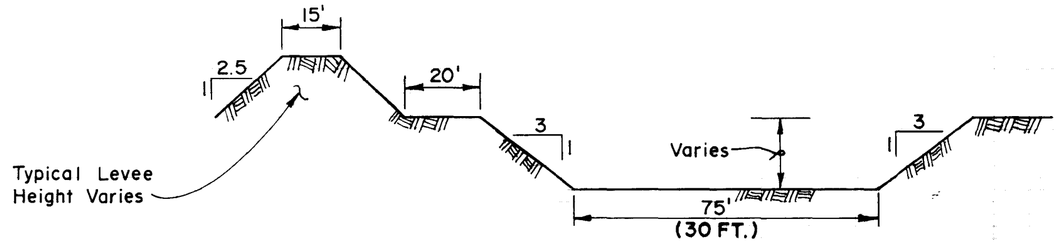
PLATE 1



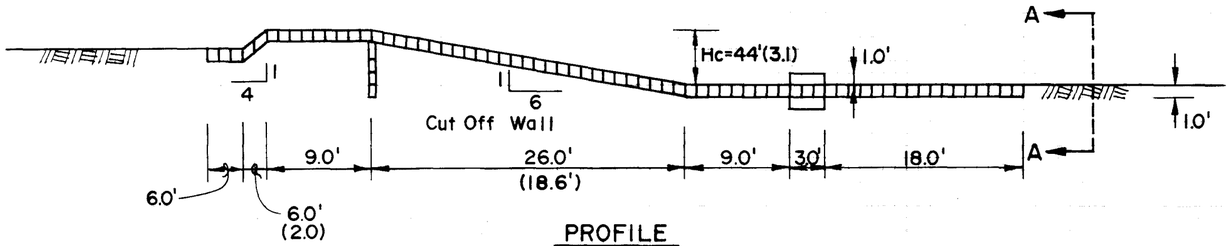
SECTION 205
DETAILED PROJECT REPORT
ESTATE MON BIJOU
ST. CROIX, U.S. VIRGIN ISLANDS
SELECTED PLAN
BYPASS CHANNEL
DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA

FILE NO 109-34,414

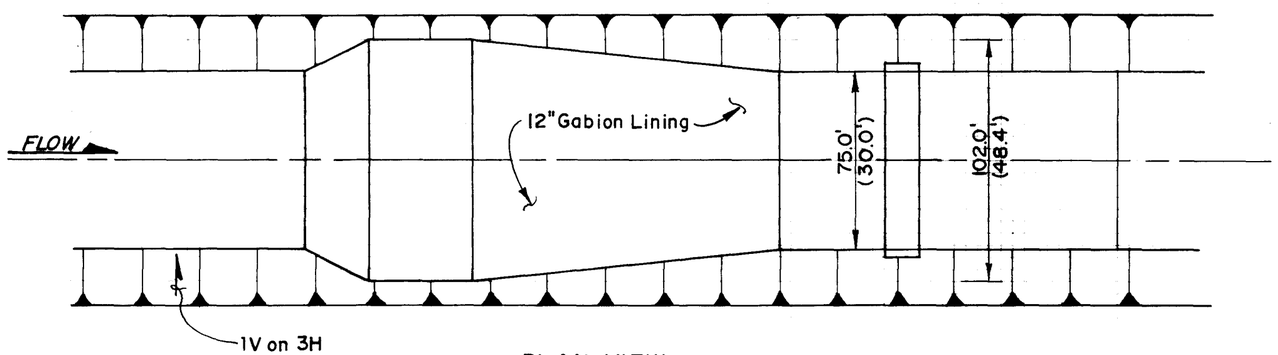
PLATE 2



SECTION A-A



PROFILE



PLAN VIEW

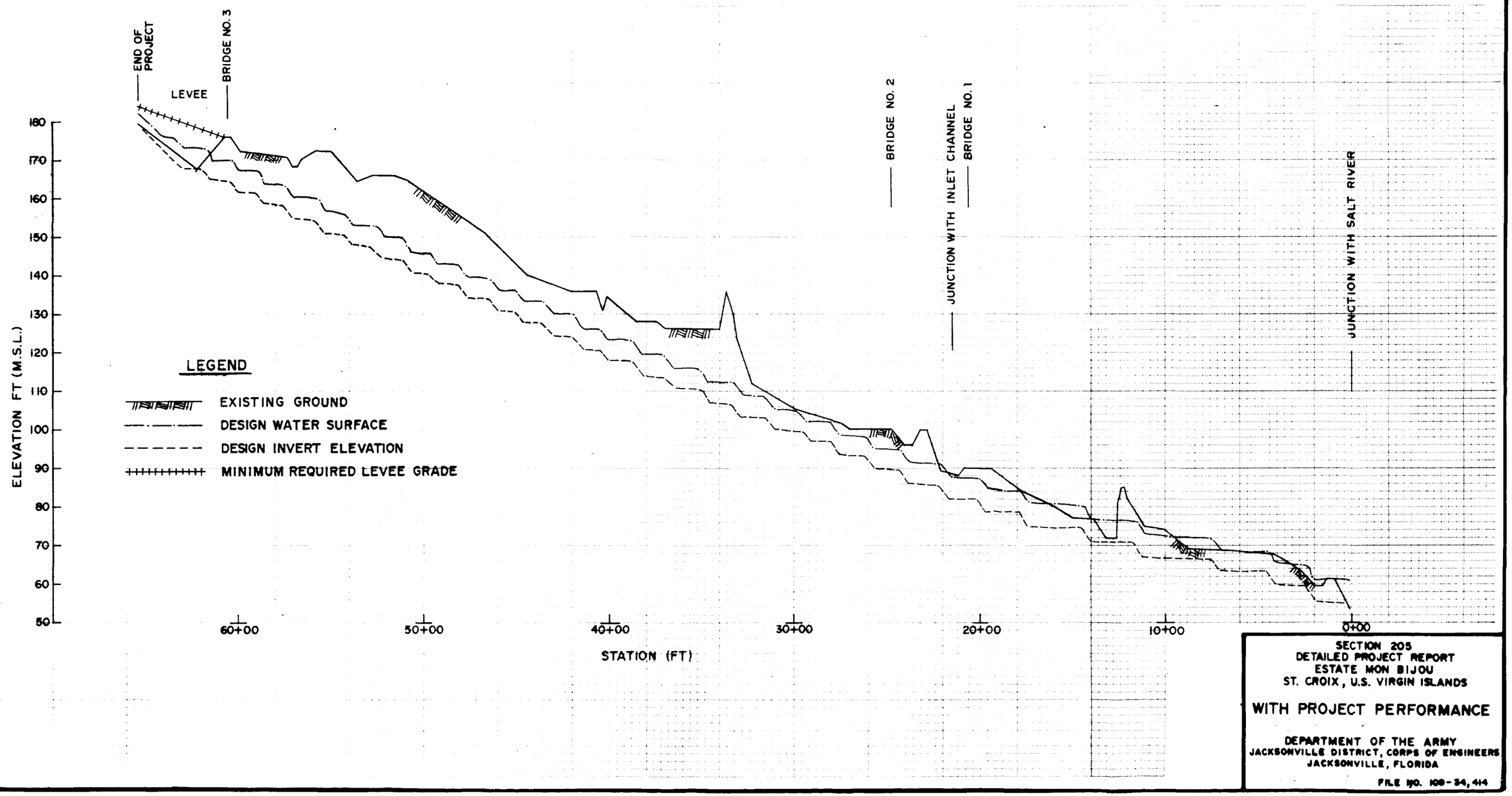
NOTE:
DIMENSIONS IN PARENTHESES CORRESPOND TO INLET CHANNEL DROP STRUCTURE NO. 34

SECTION 205
DETAILED PROJECT REPORT
ESTATE MON BIJOU
ST. CROIX, U.S. VIRGIN ISLANDS

PLAN DETAILS

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA

FILE NO. 109-34,414



SECTION 205
DETAILED PROJECT REPORT
ESTATE MON BIJOU
ST. CROIX, U.S. VIRGIN ISLANDS

WITH PROJECT PERFORMANCE

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA

FILE NO. 100-34,414

PLATE 4

BONNE ESPERANCE

BETSYS JEWEL

CANAAN

Mount Eagle

Blue Mountain

LITTLE FOUNTAIN

LEBANON HILL 7

WINDSOR

CONCORDIA

COUNTRY DAY SCH

GLYNN

MARY'S FANCY

MON BIJOU

BONNE ESPERANCE

V.I. GOV'T GUEST HOUSE

HERMITAGE

COLQUOHOUN

COBLE

FREDENSBORG

N

Scale in Feet

0 1,000

LOCATION OF SELECTED PLAN

CARIBBEAN SEA

SAINT CROIX ISLAND

N

LOCATION MAP

ADOPTED FROM REPORT BY CH2M HILL, "A FLOOD DAMAGE MITIGATION PLAN FOR THE U.S. VIRGIN ISLANDS", JUNE 1979.

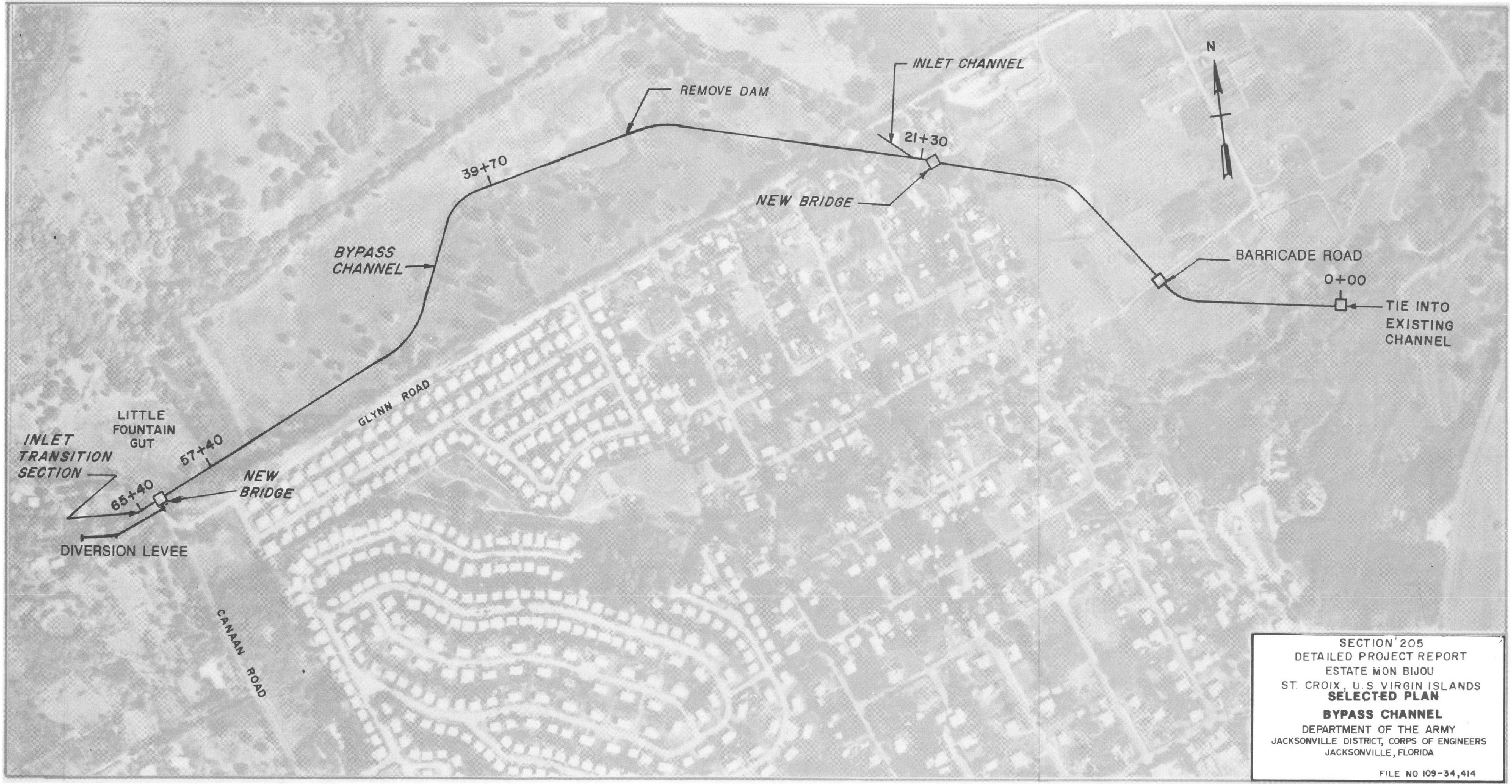
SECTION 205
DETAILED PROJECT REPORT
ESTATE MON BIJOU
ST. CROIX, U.S. VIRGIN ISLANDS

STUDY AREA

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA

FILE NO. 109-34,414

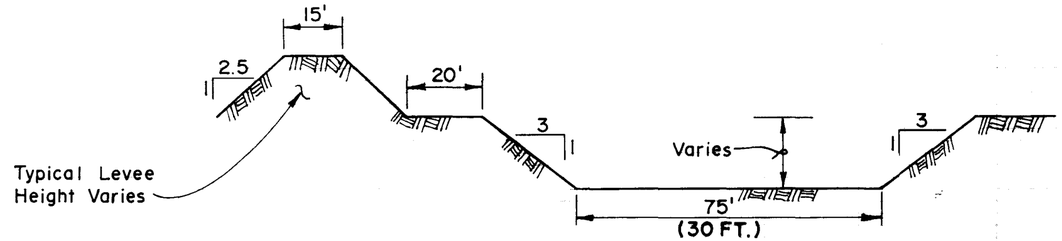
PLATE 1



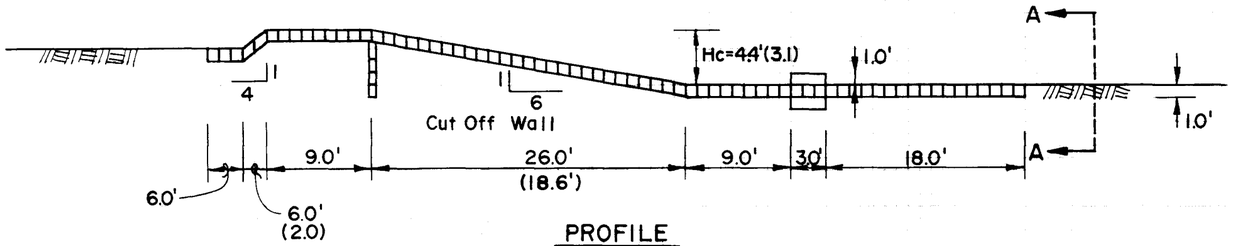
SECTION 205
DETAILED PROJECT REPORT
ESTATE MON BIJOU
ST. CROIX, U.S. VIRGIN ISLANDS
SELECTED PLAN
BYPASS CHANNEL
DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA

FILE NO 109-34,414

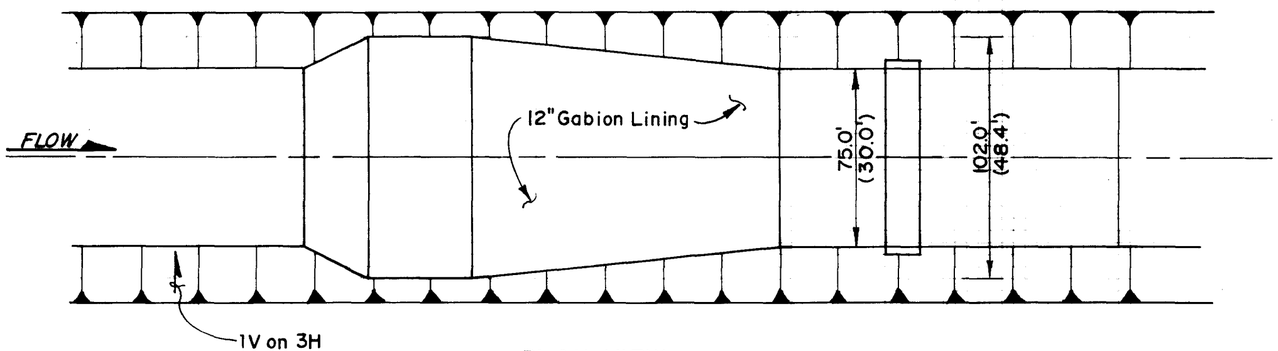
PLATE 2



SECTION A-A



PROFILE



PLAN VIEW

NOTE:
DIMENSIONS IN PARENTHESES CORRESPOND TO INLET CHANNEL DROP STRUCTURE NO.34

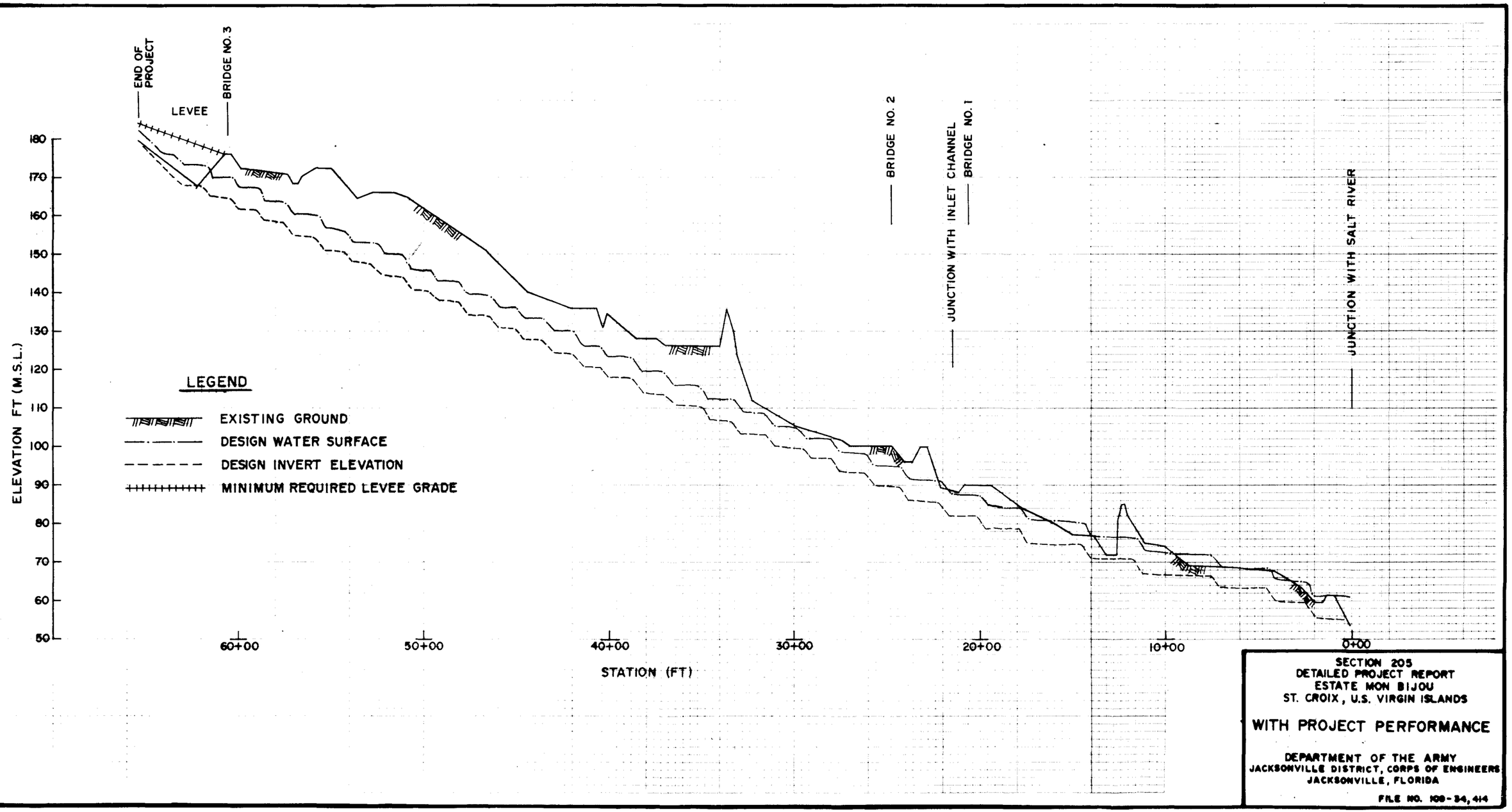
SECTION 205
DETAILED PROJECT REPORT
ESTATE MON BIJOU
ST. CROIX, U.S. VIRGIN ISLANDS

PLAN DETAILS

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA

FILE NO. 109-34,414

PLATE 3



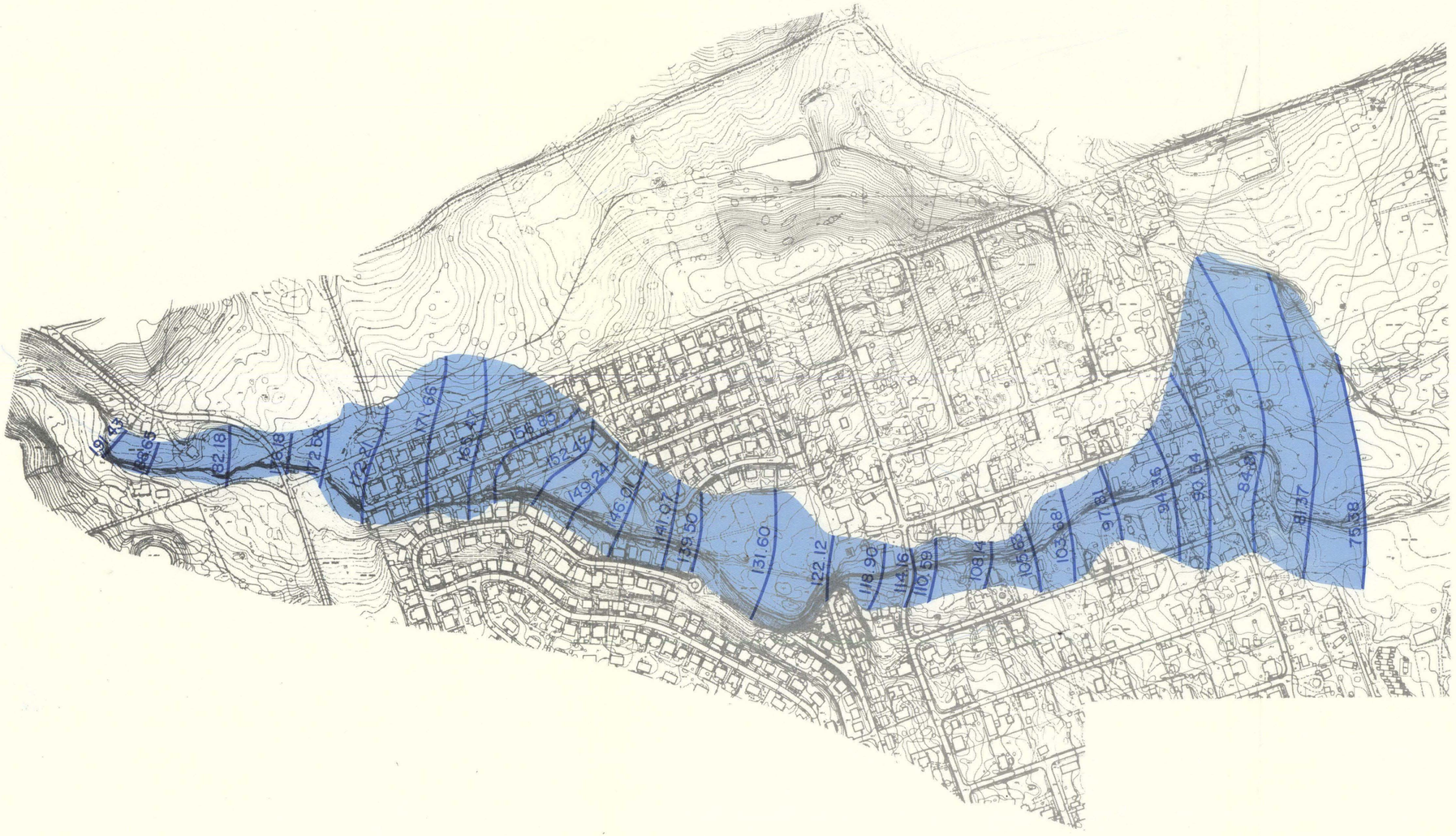
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DETAILED PROJECT REPORT
ESTATE MON BIJOU
ST. CROIX, U.S. VIRGIN ISLANDS

WITH PROJECT PERFORMANCE

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA

FILE NO. 100-34,414

PLATE 4



LEGEND

FLOODED AREA

40.2 WATER SURFACE ELEVATION, FT., M.S.L.

WATER SURFACE CONTROL

N

GRAPHIC SCALE

200' 0 200' 400'

SECTION 205
DETAILED PROJECT REPORT
ESTATE MON BIJOU
ST. CROIX, U.S. VIRGIN ISLANDS

APPENDIX A
FLOODED AREA MAP

EXISTING CONDITIONS
100-YEAR

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
JACKSONVILLE FLORIDA

D.O. FILE NO. 109-34,414

PLATE 5



LEGEND

FLOODED AREA

WATER SURFACE ELEVATION, FT., M.S.L.

WATER SURFACE CONTROL

N

GRAPHIC SCALE

200' 0 200' 400'

SECTION 205
DETAILED PROJECT REPORT
ESTATE MON BIJOU
ST. CROIX, U.S. VIRGIN ISLANDS

APPENDIX A
FLOODED AREA MAP

WITH PROJECT
100-YEAR

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
JACKSONVILLE FLORIDA

D.O. FILE NO. 109-34.414

PLATE 6



SECTION 205
DETAILED PROJECT REPORT
ESTATE MON BIJOU
ST. CROIX, U.S. VIRGIN ISLANDS

ALTERNATIVE PLAN
NONSTRUCTURAL PLAN

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA

FILE NO 109-34,414

PLATE 7



SECTION 205
DETAILED PROJECT REPORT
ESTATE MON BIJOU
ST. CROIX, U.S. VIRGIN ISLANDS

CONCRETE CULVERT

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA

FILE NO 109-34,414

PLATE 8

PLATE 9

SECTION 205
DETAILED PROJECT REPORT
ESTATE MON BIJOU
ST. CROIX, U.S. VIRGIN ISLANDS
OPEN CHANNEL UPPER END
DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA
FILE NO 189-34,414



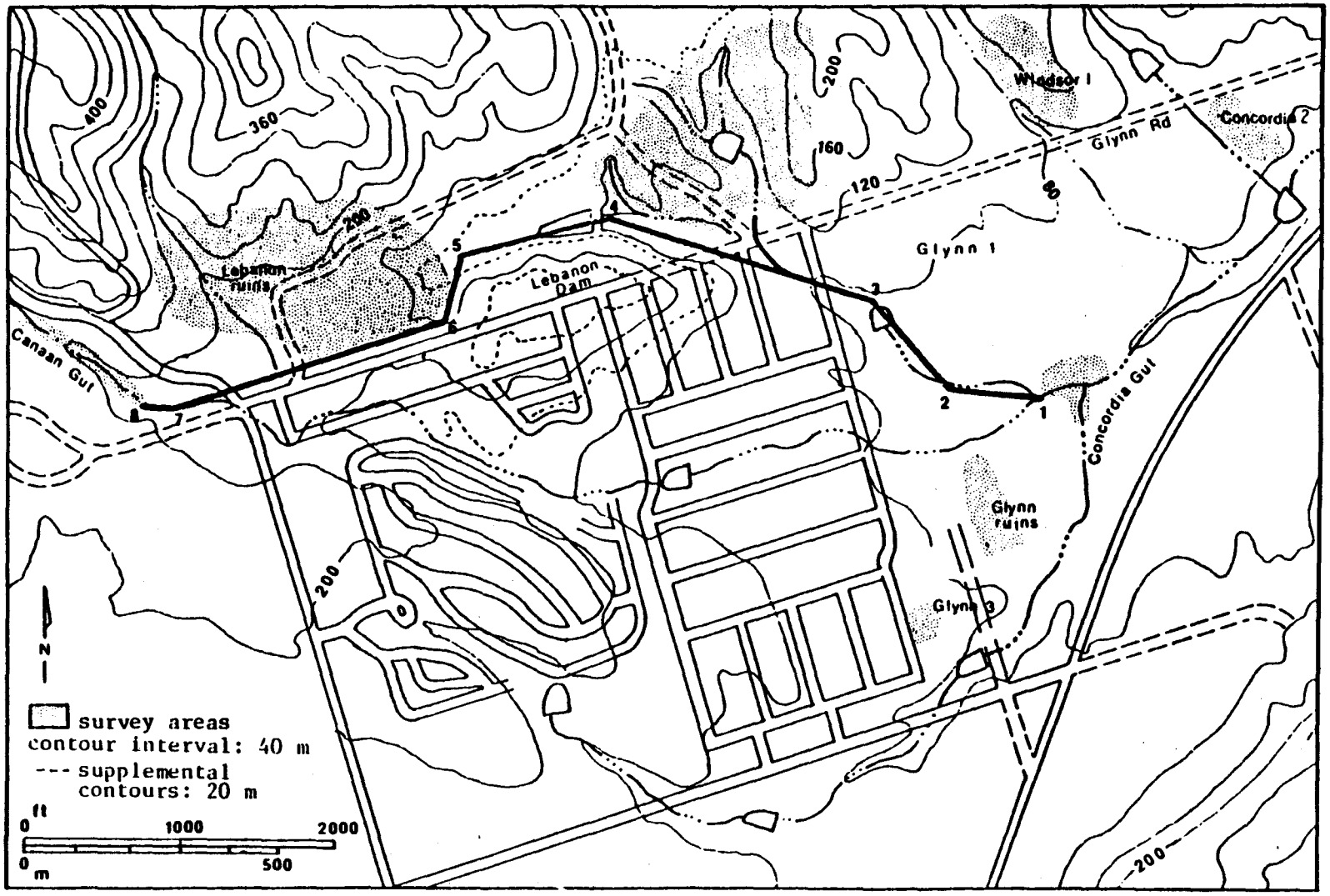


PLATE 10

CULTURAL RESOURCES

DETAILED PROJECT REPORT

SUPPORTING DATA

FOR

MON BIJOU

ST. CROIX, VIRGIN ISLANDS

The supporting data for the Mon Bijou study is arranged into Appendices based on subject matter. Each appendix furnishes detailed information on the technical aspects of the studies conducted and the plans considered. The Appendices are arranged in the following order:

A - HYDROLOGY AND HYDRAULICS
B - GEOTECHNICAL AND MATERIALS
C - RECREATION ASSESSMENT
D - ENGINEERING, DESIGN, AND COST ESTIMATES
E - ECONOMIC ANALYSIS
F - CULTURAL RESOURCES
G - LOCAL COOPERATION AND PUBLIC INVOLVEMENT

SECTION 205 DETAILED PROJECT REPORT

ESTATE MON BIJOU

ST. CROIX, U.S. VIRGIN ISLANDS

APPENDIX A

HYDROLOGY - HYDRAULICS

SECTION 205 DETAILED PROJECT REPORT
ESTATE MON BIJOU
ST. CROIX, U.S. VIRGIN ISLANDS

APPENDIX A
HYDROLOGY - HYDRAULICS

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A. INTRODUCTION

1. This appendix presents the basic hydrologic data and studies which were conducted to define the hydraulics of Salt River and its main tributaries at Mon Bijou, St. Croix, under existing conditions and with various flood protection plans in place.

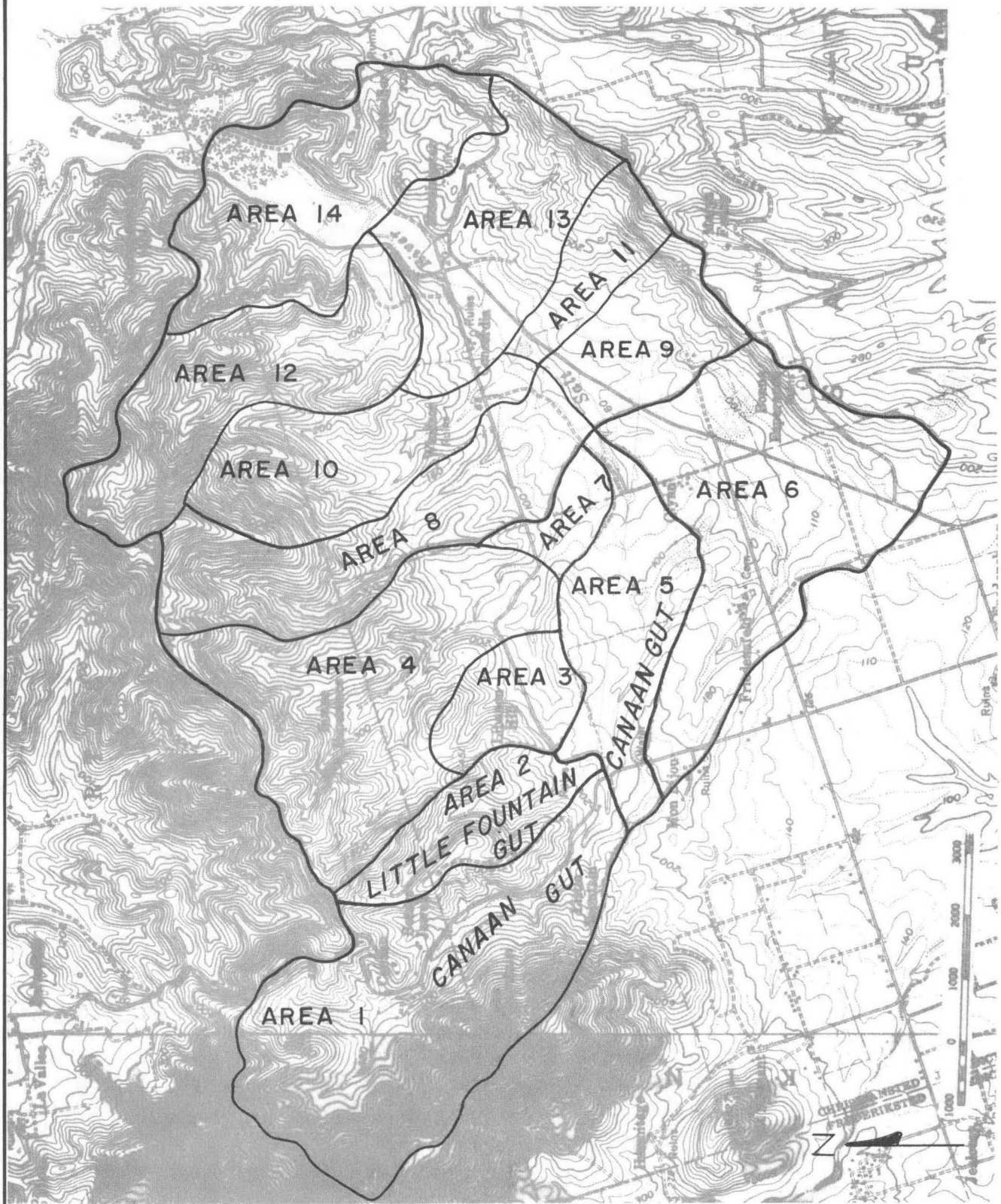
B. HYDROLOGY

2. Watershed Description. Mon Bijou is located in north central St. Croix, U.S. Virgin Islands, at the foot of Canaan Gut in the upper end of Salt River Basin. Canaan Gut collects runoff from 440 acres on the steep eastern slopes of Blue Mountain. This small watershed drops 1,000 feet in elevation over a length of 1.6 miles. The lateral slopes of Canaan Gut's V-shaped basin are even-steeper; averaging about 35 percent. Canaan Gut begins to fan out into a floodplain just above Mon Bijou where it is joined by a smaller but similar watershed known as Little Fountain Gut. Together they comprise a drainage area above Mon Bijou of less than 1 square mile. Through Mon Bijou and below, Canaan Gut collects another 0.3 square miles of drainage area. About 1 mile below Mon Bijou, Canaan Gut is joined by two other tributaries. The total drainage area at this junction is 2.45 square miles. Figure A-1 delineates the drainage basin and subbasins in the study area.

3. Previous Hydrologic Studies. A report entitled, "A Flood Damage Mitigation Plan for the U.S. Virgin Islands," dated April 1981, was prepared by CH2M Hill, an engineering firm in Gainesville, Florida. The report was prepared for the Disaster Preparedness Office of the Governor of the Virgin Islands. In part, the report contains a detailed hydrologic evaluation of Salt River Basin, with a view towards providing a bypass channel around Mon Bijou.

4. A report entitled, "Flood Insurance Study U.S. Virgin Islands, Island of St. Croix," dated April 1980, was prepared by the firm Tippets-Abbett-McCarthy-Stratton (TAMS) under contract with the Federal Emergency Management Agency. The study includes a detailed hydrologic evaluation of the Salt River Basin.

5. Unit Hydrograph Analysis. Hydrology of the Mon Bijou area involves the determination of peak rates of supercritical flow from small basins of less than 1 square mile with basin slopes of up to 35 percent. There are no data upon which to calibrate a rainfall-runoff model; nor are there any synthetic method specifically designed for flash flood analysis in the Virgin Islands. In past studies of small basins in Puerto Rico and the Virgin Islands, numerous synthetic methods have been used. Several of these methods were reviewed and the U.S. Soil Conservation Service (SCS) small watershed approach was selected. The SCS method has widespread acceptance and use and has the advantage over some of the other methods, in that it was developed for small drainage areas. Hydrologic computations were performed with the



MON BIJOU

SALT RIVER

DRAINAGE BASIN

FIGURE A-1

use of HEC-1 flood hydrograph package. Flood routings were accomplished by the modified puls option of HEC-1 from discharge-storage data produced by HEC-2 backwater profiles. Table A-1 lists the hydrologic parameters for subbasins in the Salt River basin.

TABLE A-1

Summary of Hydrologic Parameters

Subbasin	DA (sq.mi.)	L (mi.)	Basin Slope %	Lag Minutes	SCS Curve #
#1 Canaan Gut	.70	1.6	35.0	16	83
2 Little Fountain Gut	.16	.95	31.0	11	84
3 Lebanon Hill	.12	.50	20.0	9	81
4 Bonne Esperance	.54	1.23	37.0	13	82
5 Lower Canaan Gut	.27	1.08	7.8	27	80
6 Friedensfeld	.59	1.48	9.5	36	78
7	.07	.40	2.8	22	78
8	.36	1.46	20.0	22	80
9	.18	.53	5.2	21	76
10	.29	1.29	20.0	20	79
11	.11	.59	8.8	19	74
12	.38	1.42	26.0	20	78
13	.34	.66	6.5	26	72
14	.43	.53	30.0	17	72

6. Rainfall Losses. Rainfall losses were accounted for by the SCS curve number procedure using antecedent moisture condition II. Curve numbers varied between 80 and 84 in the upper basin above Mon Bijou and from 72 to 80 below the project area.

7. Design Rainfall. Six-hour design rainfall for 2-year to SPF were estimated from isohyetal maps in Weather Bureau Technical Paper No. 42, (TP-42), "Generalized Estimates of Probable Maximum Precipitation and Rainfall Frequency Data for Puerto Rico and Virgin Islands." TP-42 contains isohyetal maps for duration from 30 minutes to 24 hours. Technical Paper No. 25 (TP-25) "Rainfall Intensity-Duration-Frequency Curves" was used to distribute the design rainfall into 5-minute increments. TP-25 gives rainfall frequency down to 5-minute intervals for various rainfall stations in the United States and San Juan, Puerto Rico. The depth duration of the design storm for the peak 1 hour was patterned after the gauge at San Juan, Puerto Rico. The distribution of the 5-minute intervals were arranged in a critical 11, 9, 7, 5, 3, 1, 2, 4, 6, 8, 10, 12 order. Table A-2 lists peak rainfall rates for various return periods.

TABLE A-2

Peak Rainfall-Frequency at Mon Bijou

	Return Period (years)						
Duration	2	5	10	25	50	100	SPS
5-minute	.32	.42	.51	.62	.72	.81	1.26
1-hour	2.0	2.6	3.1	3.8	4.4	5.0	7.7
6-hour	3.6	4.7	5.7	6.9	8.0	9.0	14.0

8. Results. Table A-3 lists the discharge frequency at two locations along Canaan Gut. Also shown are the results of the two previous studies. The TAMS study used the same SCS small watershed method with SCS curve number techniques. The primary different between the TAMS study and the analysis in this report is in the rainfall distribution and time intervals. TAMS used 30-minute computation intervals compared to a 5-minute computation interval used in this study. The study by CH2M Hill used an empirical lag equation (Lag = $.65A^{.403}$), and 10-minute computation intervals. The lag equation compared reasonably well with the SCS method on all but the extremely steep subbasins.

TABLE A-3

Summary and Comparison of Discharges (CFS)

At Confluence of Canaan Gut and Little Fountain Gut, DA = 0.86 sq. mi.

	10-year	50-year	100-year	SPF
This study	1,830	2,840	3,270	5,390
TAMS	1,441	2,538	3,150	NA
CH2MHill	1,700	2,390	2,790	NA

At Bottom of Canaan Gut DA = 2.45 sq. mi.

	10-year	50-year	100-year	SPF
This study	4,110	6,560	7,605	12,803
TAMS	NA	NA	NA	NA
CH2MHill	3,650	5,330	6,280	NA

Note: NA means Not Available.

C. HYDRAULICS

Existing Conditions.

9. Study Area. The study area consists of the 4,400-foot reach of Canaan Gut and Salt River which passes through the residential areas of Glynn and Mon Bijou. The primary cause of flooding in the residential area is due to construction infringement into, and in some areas total elimination of, the natural floodway of Salt River. The principal hydraulic feature in the area is a 700-foot-long, 4-foot by 6-foot concrete box culvert in the west end of Mon Bijou. This culvert is the sole means of conveying flows from upstream runoff through the area. The limited capacity of the culvert is usually further reduced by debris blockage. As a result, flood flows sweep over the low culvert headwall into the streets and houses of Mon Bijou before reentering the natural watercourse downstream. Flooding is further aggravated by the minimal capacity of a 2-foot by 4-foot highway culvert located about 200 feet upstream of the residential area and by runoff from Little Fountain Gut, a tributary, to the north passing uncontrolled over the main highway into houses and streets in the northwest portion of Mon Bijou.

10. Hydraulic Model. Water surface profiles were developed for existing conditions using the Hydrologic Engineering Center HEC-2 Computer Program "Water Surface Profiles." This program was developed to calculate subcritical and supercritical water surface profiles in natural or manmade channels of any cross section for steady gradually varied flow. The computational procedure is based on the solution of the one dimensional energy equation. This method applies Bernoullis Theorem for the total energy at each cross section and uses Manning's formula to determine the frictional head loss between cross sections. This procedure is generally known as the Standard Step Method.

11. Development of the Model. The HEC-2 hydraulic model was formed using 19 cross sections from aerial topography flown in January 1983. The topography had a scale of 1 inch equals 50 feet with 2-foot contour intervals. Mean high water of 0.2 feet, msl, was used as a starting condition in Sugar Bay at the mouth of Salt River. Manning "n" values were calibrated from the flood of October 8, 1977, which was estimated to be a 25-year flood in the study area. Verified Manning's "n" values varied from 0.055 to 0.095 for the main channel and 0.100 to 0.300 for overbank areas. This model was then used to develop 2-, 5-, 10-, 25-, 50-, and 100-year and Standard Project Flood Profiles using hydrologic data previously discussed. The existing condition hydraulic profiles are shown on plate A-1 and flooded areas are shown on plates A-2, 3, and 4 for the 10 year, 100 year, and Standard Project floods, respectively.

Hydraulic Design Criteria.

12. General. Hydraulic design criteria and procedures used herein are in accordance with standard engineering practice and applicable provisions of Corps Engineering Manuals and the Waterways Experimental Station "Hydraulic Design Criteria" relative to design and construction of Civil Works Projects.

Engineering criteria adopted to meet special local conditions are in accordance with that previously approved for similar projects.

13. Design Water Surface Profiles. The most significant factor affecting design criteria of the water surface profiles is that Estate Mon Bijou lies directly in the path of the Salt River watercourse with minimal capacity for flood flow conveyance in the culvert under the development. Because of this, primary consideration was given to diversion plans to minimize impacts on local residences, highways, bridges, and utilities.

14. Channel Characteristics. The below listed criteria were used in the analysis of various plans involving channel modification.

a. Starting conditions. Flow downstream of the study area is predominantly subcritical. The starting condition for downstream considerations was an elevation of 0.18 feet, msl, in Sugar Bay, which is the mean high tide, with back water computations extending upstream to the junction of the bypass design with the natural channel.

b. Cross Sections. The most efficient hydraulic section was used to convey flows in-bank for the design flood within geologic constraints of side slope stability, maximum allowable velocities and maximum depth of economic excavation.

c. Transitions. Transitions would be provided at all changes in channel geometry.

d. Roughness Coefficient. Manning's "n" values of 0.013, 0.030, and 0.035 were used for concrete, gabion, and earthen sections, respectively.

e. Alignment. The design alignment would minimize the required real estate acquisitions and conform to minimum radius criteria outlined in "Hydraulic Design of Flood Control Channels," EM 1110-2-1601.

f. Superelevation. Invert banking would be provided for all curved concrete channels in conjunction with spiral transitions to insure flow stability and minimize the total rise in water surface between the channel center line and outside wall.

g. Freeboard. A minimum freeboard allowance of 1 foot above the design water surface elevation was used as a basis of setting the top of channel elevation.

h. Stilling Basin. The stilling basins were designed to contain the change of flow regimen. Hydraulic design of the stilling basins conform with standard design criteria and procedures established in Engineering Manuals EM 1110-2-1601, "Hydraulic Design of Flood Control Channels," EM 1110-2-1602, "Hydraulic Design of Reservoir Outlet Structures," and EM 1110-2-1603, "Hydraulic Design of Spillways."

i. Bridges. Bridges were analyzed to insure acceptable flow characteristics in terms of acceptable net velocities, flow stability, and flow depth. In areas of subcritical flow, piers having semicircular nose and tail were designed to not restrain this net flow area by more than 10 percent. In areas having supercritical flow, bridges were required to be full span. Bridge low chord was set to be a minimum of 1-foot above the design water surface elevation.

j. Debris Basin. A leveed debris basin would be required at the upstream end of the project for concrete channel alternatives. For this study, the required basin was sized based on a drainage area proportion compared to those used for the Portugues and Bucana Project in Ponce, Puerto Rico. Detailed designs of debris basins would include consideration that a major flood event could occur almost any time of the year and annual sediment yields could reach the project in one event with little or no sediment the remainder of the year. Consideration would also be given to sediment gradation to insure that gravels and cobbles would not damage concrete lining and stilling basins.

k. Sheet Pile Drop Structures. The 12 drop structures used in the earthern bypass alternative plan were designed in accordance with criteria set forth in EM 1110-2-1601, Hydraulic Design of Flood Control Channels, Appendix III, plate 43. This criteria was limited to design head of 6 feet for sheet pile weir construction in accordance with procedures used for grade stabilization structures in the Tennessee Tombigbee project. Sheet pile CIT type drop structures having a height of 10 feet were considered as an alternative plan; however, the total initial cost of $5,100,000 was not economically justified.

l. Inlet Structures. Inlet structures would be provided for some alternatives at existing inflow points. These structures would consist of corrugated metal pipe culverts with stoplog risers to control inflow into the canal. The structures would be designed to convey runoff during a 10-year storm with entrance and exit losses totaling 1.69 times the velocity head and barrel friction based on Manning's formula with an "n" value of 0.024.

m. Gabion Drop Structures. The 34 gabion drop structures used in the proposed plan were designed in accordance with criteria set forth in ETL 1110-2-194, Gabion Channel Control Structures.

Hydraulic Design of Alternative Plans.

15. General. Of the four plans presented in the plan formulation portion of the main report, three structural plans and one nonstructural plan were found to be implementable. Hydraulic design considerations of the four plans follow.

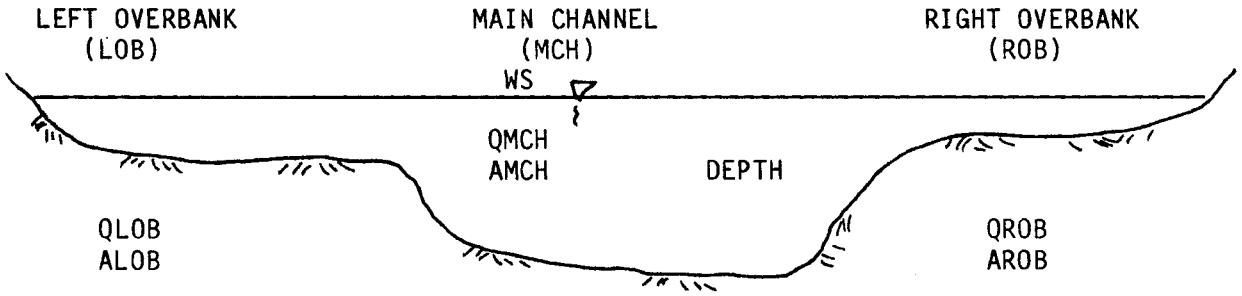
16. Nonstructural Plan. This plan consists of purchasing those residential properties located within the 5-year flood plain and relocating the residents elsewhere. Use of this measure would reduce flood damages to the most often flooded residences. However, flooding will continue. Flow velocities and water depths, after project implementation, in the overbank areas and near the channel are of great concern, therefore, HEC-2 computer model analysis for a variety of flood flows in these areas were performed and the results are presented in table A-4. The primary consideration in applying steady flow theory to the calculation of water surface profiles in natural rivers involves converting hydraulic parameters, which are distributed across complex sections, into averages. The flow velocity, which is required to apply the energy equation, must be a representative average velocity for each cross section. The theory is applied by subdividing each cross section into separate portions, or subsections, as shown in Figure A-2. The velocity within each subsection (V in FPS) is equal to the discharge (Q in CFS) divided by the area (A in square feet). For example, the velocity in the right overbank (ROB) area is equal to QROB/AROB. Average velocities and water depths from several cross sections of the study area were taken from the HEC-2 model output and are shown in table A-4. These are an indication of average velocities and water depths in the overbank areas.

TABLE A-4

AVERAGE DEPTH AND VELOCITIES FOR NONSTRUCTURAL PLAN

Sector	Cross Section From	To	Frequency Flood	Average Depth Overbank (Ft.)	Average Velocity Overbank (FT/S)	Average Velocity Near Channel
1 - D/S Glynn	11.20	12.20	2 Yr	0.30	0.05	4.40
			10 Yr	2.20	0.40	6.50
			100 Yr	3.10	0.50	8.00
2 - Glynn	12.20	14.10	2 Yr	0.20	0.05	5.80
			10 Yr	1.80	0.10	7.20
			100 Yr	2.90	0.10	9.00
3 - Glynn to Park	14.10	15.10	2 Yr	0.10	0.04	5.70
			10 Yr	1.80	0.10	8.50
			100 Yr	3.00	0.10	10.50
4 - U/S Glynn	15.10	17.02	2 Yr	0.10	0.04	7.20
			10 Yr	1.70	0.10	10.30
			100 Yr	4.70	0.10	13.50

FIGURE A-2
DISTRIBUTION OF DISCHARGE AND FLOW AREA (A)
AT A CROSS SECTION



17. Concrete Culvert Plan. This plan considered passing flood flows through the western part of Mon Bijou and would limit flood protection to the most damage prone area. In order to minimize impacts on local real estate, a channel design was based on slope controlled supercritical flow in a rectangular section. The channel would be about 1,125 feet long including a stilling basin near the downstream end and a gabion channel transition back to natural stream conditions. The covered concrete section would be about 461 feet long. A debris basin was located upstream of Mon Bijou in such a manner as to include runoff from Canaan Gut, the mainstream, and also Little Fountain Gut, a tributary north of the study area. The debris basin would keep rocks and abrasive material from entering the concrete channel and would serve as a check dam to insure stable conditions entering the concrete channel.

18. Partial Bypass. This plan included constructing a bypass channel parallel to the main north road and then through the residential area of Mon Bijou. The bypass would be about 2,300 feet long using a trapezoidal gabion-lined channel, designed for velocity control and using single, and double staged sheet pile drop structures. This plan would also require a standard project flood levee to protect the northern part of the Mon Bijou area.

19. 'Earthen Bypass With Gabion Drop Structures. This plan considered a bypass channel north of the residential areas of Mon Bijou and Glynn using a trapezoidal earthen channel designed for velocity control and using 34 gabion drop structures.

Proposed Plan.

20. Channels.

a. Main Channel. The main channel would be about 6,500 feet long and have a trapezoidal grass-lined section with a 75-foot bottom width. At the downstream end, the channel would transition to natural stream conditions. A summary of hydraulic design data for the main channel is shown in table A-5 and a profile is shown on Plate A-5.

b. Inlet Channel. This inlet channel would be about 350 feet long and have a trapezoidal grass-lined section with a 30-foot bottom width. A summary of hydraulic design data is shown in table A-6.

c. Little Fountain Gut Inflow. Overland flow from Little Fountain Gut will enter the main channel between drop structures No. 28 and No. 29. The channel reach between the drop structures would be lined with gabion mattress. This channel reach would be about 200 feet long.

21. Gabion Drop Structures. Thirty-three gabion drop structures were used along the bypass channel and one drop structure for the drainage Area No. 4 inlet channel in order to minimize channel erosion by controlling the effective gradient. These 34 structures were sized to pass the design discharge

with the concurrent design headwater and tailwater elevations. The 33 bypass channel structures would have a crest length (L) of 101 feet and a crest height (Hc) of 4.39 feet. Plate 3 of the main report shows a plan detail of the gabion drop structures. A crest height (Hc) of 4.39 feet was selected in order to have a total head loss (H) of 3.0 feet at this structure. Reference is made to plate 2 and 3 of ETL 1110-2-194, a unit discharge (q) of 30 cfs/foot will correspond to a gross head on crest (H) of 4.5 feet. From plate 2, tailwater depth (h) relative to crest is equal to 1.5 feet (H- H). Then, with a tailwater depth of 5.89 feet minus (h) it will give an (Hc) of 4.39 feet. The remaining drop structure for the Area 4 inlet channel was scaled down as indicated in parentheses on plate 3 of the main report.

22. Bridges. Bridge sizes were developed to insure hydraulic efficiency based on net area provided below the design water surface elevation. Bridges in subcritical flow areas were designed to have a semi-circular nose and tail on piers. A summary of hydraulic design data for bridges is provided on table A-7.

TABLE A-5
SUMMARY OF HYDRAULIC DESIGN DATA FOR CHANNELS

Station	Width(FT)	Water Surface Elevation (FT. MSL)	Invert (FT) MSL	Side Slopes Left 1 on-	Side Slopes Right 1 on-	VELOCITY (FT/S)	DEPTH (FT)	DISCHARGE (CFS)	LINING	COMMENTS
0+00	75	60.8	54.9	3	3	6.1	5.9	3,371	Grass	Junction w/Salt River
2+00	75	61.1	55.2	3	3	6.1	5.9	3,371		Tailwater Drop Structure # 1
2+60	75	64.6	58.7	3	3	6.1	5.9	3,371		Headwater Drop Structure # 1
4+00	75	66.0	60.1	3	3	6.1	5.9	3,371		Tailwater Drop Structure # 2
4+60	75	69.0	63.1	3	3	6.1	5.9	3,371		Headwater Drop Structure # 2
7+00	75	69.2	63.3	3	3	6.1	5.9	3,371		Tailwater Drop Structure # 3
7+60	75	72.2	66.3	3	3	6.1	5.9	3,371		Headwater Drop Structure # 3
11+20	75	73.0	67.1	3	3	6.1	5.9	3,371		Tailwater Drop Structure # 4
11+80	75	76.0	70.1	3	3	6.1	5.9	3,371		Headwater Drop Structure # 4
14+00	75	77.0	71.1	3	3	6.1	5.9	3,371		Tailwater Drop Structure # 5
14+60	75	80.0	74.1	3	3	6.1	5.9	3,371		Headwater Drop Structure # 5
17+40	75	81.0	75.1	3	3	6.1	5.9	3,371		Tailwater Drop Structure # 6
18+00	75	84.0	78.1	3	3	6.1	5.9	3,371		Headwater Drop Structure # 6
19+60	75	84.2	78.3	3	3	6.1	5.9	3,371		Tailwater Drop Structure # 7
20+20	75	87.2	81.3	3	3	6.1	5.9	3,371		Headwater Drop Structure # 7

Table Continued
Next Page

TABLE A-5
SUMMARY OF HYDRAULIC DESIGN DATA FOR CHANNELS
(Continued)

Station	Width(FT)	Water Surface Elevation (FT. MSL)	Invert (FT) MSL	Side Slopes Left 1 on-	Right 1 on-	VELOCITY (FT/S)	DEPTH (FT)	DISCHARGE (CFS)	LINING	COMMENTS
20+60	75	87.2	81.3	3	3	6.1	5.9	3,371	Grass	Bridge No. 1
21+60	75	87.4	81.5	3	3	6.1	5.9	3,371		Tailwater Drop Structure # 8
22+20	75	90.4	84.5	3	3	6.1	5.9	3,371		Headwater Drop Structure # 8/ Junction W/ Inlet Channel
23+80	75	91.4	85.5	3	3	6.1	5.9	3,371		Tailwater Drop Structure # 9
24+40	75	94.0	88.1	3	3	6.1	5.9	3,371		Headwater Drop Structure # 9
24+80	75	94.5	88.6	3	3	6.1	5.9	3,371	Grass	Bridge No. 2
25+60	75	95.0	89.1	3	3	6.1	5.9	3,371		Tailwater Drop Structure # 10
26+20	75	98.0	92.1	3	3	6.1	5.9	3,371		Headwater Drop Structure # 10
27+60	75	98.2	92.3	3	3	6.1	5.9	3,371		Tailwater Drop Structure # 11
28+00	75	101.2	95.3	3	3	6.1	5.9	3,371		Headwater Drop Structure # 11
29+20	75	102.0	96.1	3	3	6.1	5.9	3,371		Tailwater Drop Structure # 12
29+80	75	105.0	99.1	3	3	6.1	5.9	3,371		Headwater Drop Structure # 12
31+00	75	105.2	99.3	3	3	6.1	5.9	3,371		Tailwater Drop Structure # 13

TABLE A-5
SUMMARY OF HYDRAULIC DESIGN DATA FOR CHANNEL
(Continued)

Station	Width(FT)	Water Surface Elevation (FT. MSL)	Invert (FT) MSL	Side Slopes Left 1 on-	Right 1 on-	VELOCITY (FT/S)	DEPTH (FT)	DISCHARGE (CFS)	LINING	COMMENTS
31+60	75	108.2	102.3	3	3	6.1	5.9	3,371		Headwater Drop Structure # 13
32+80	75	109.0	103.1	3	3	6.1	5.9	3,371		Tailwater Drop Structure # 14
33+40	75	112.0	106.1	3	3	6.1	5.9	3,371		Headwater Drop Structure # 14
34+60	75	112.2	106.3	3	3	6.1	5.9	3,371		Tailwater Drop Structure # 15
35+20	75	115.2	109.3	3	3	6.1	5.9	3,371		Headwater Drop Structure # 15
36+40	75	116.0	110.1	3	3	6.1	5.9	3,371		Tailwater Drop Structure # 16
37+00	75	119.0	113.1	3	3	6.1	5.9	3,371		Headwater Drop Structure # 16
38+00	75	119.2	113.3	3	3	6.1	5.9	3,371		Tailwater Drop Structure # 17
38+60	75	122.2	116.3	3	3	6.1	5.9	3,371		Headwater Drop Structure # 17
40+00	75	123.0	117.1	3	3	6.1	5.9	3,371		Tailwater Drop Structure # 18
40+60	75	126.0	120.1	3	3	6.1	5.9	3,371		Headwater Drop Structure # 18
41+40	75	126.1	120.2	3	3	6.1	5.9	3,371		Tailwater Drop Structure # 19
42+00	75	129.1	123.2	3	3	6.1	5.9	3,371		Headwater Drop Structure # 19
43+00	75	130.0	124.1	3	3	6.1	5.9	3,371		Tailwater Drop Structure # 20
43+60	75	133.2	127.1	3	3	6.1	5.9	3,371		Headwater Drop Structure # 20

TABLE A-5
SUMMARY OF HYDRAULIC DESIGN DATA FOR CHANNEL
(Continued)

Station	Width(FT)	Water Surface Elevation (FT. MSL)	Invert (FT) MSL	Side Slopes Left 1 on-	Right 1 on-	VELOCITY (FT/S)	DEPTH (FT)	DISCHARGE (CFS)	LINING	COMMENTS
44+60	75	133.2	127.3	3	3	6.1	5.9	3,371		Tailwater Drop Structure # 21
45+20	75	136.2	130.3	3	3	6.1	5.9	3,371		Headwater Drop Structure # 21
46+00	75	136.2	130.3	3	3	6.1	5.9	3,371		Tailwater Drop Structure # 22
46+60	75	139.2	133.3	3	3	6.1	5.9	3,371		Headwater Drop Structure # 22
47+60	75	139.5	133.6	3	3	6.1	5.9	3,371		Tailwater Drop Structure # 23
48+20	75	142.5	136.6	3	3	6.1	5.9	3,371		Headwater Drop Structure # 23
49+20	75	142.7	136.8	3	3	6.1	5.9	3,371		Tailwater Drop Structure # 24
49+80	75	145.7	139.8	3	3	6.1	5.9	3,371		Headwater Drop Structure # 24
50+60	75	146.0	140.1	3	3	6.1	5.9	3,371		Tailwater Drop Structure # 25
51+20	75	149.0	143.1	3	3	6.1	5.9	3,371		Headwater Drop Structure # 25
52+20	75	150.0	144.1	3	3	6.1	5.9	3,371		Tailwater Drop Structure # 26
52+80	75	153.0	147.1	3	3	6.1	5.9	3,371		Headwater Drop Structure # 26
53+80	75	153.2	147.3	3	3	6.1	5.9	3,371		Tailwater Drop Structure # 27

TABLE A-5
SUMMARY OF HYDRAULIC DESIGN DATA FOR CHANNEL
(Continued)

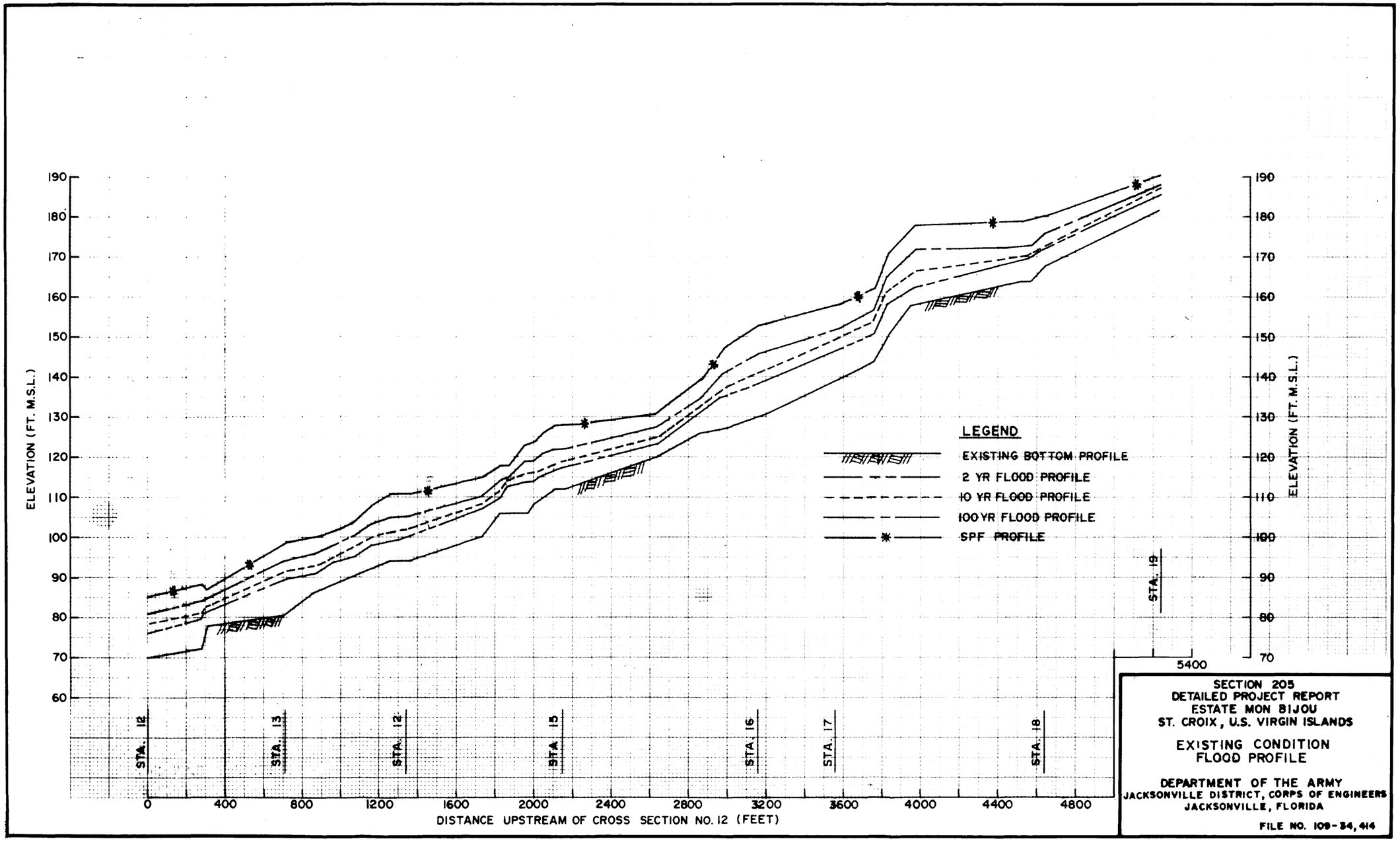
Station	Width(FT)	Water Surface Elevation (FT. MSL)	Invert (FT) MSL	Side Slopes Left 1 on-	Right 1 on-	VELOCITY (FT/S)	DEPTH (FT)	DISCHARGE (CFS)	LINING	COMMENTS
54+40	75	156.2	150.3	3	3	6.1	5.9	3,371		Headwater Drop Structure # 27
55+40	75	156.5	150.6	3	3	6.1	5.9	3,371		Tailwater Drop Structure # 28
56+00	75	159.5	153.6	3	3	6.1	5.9	3,371	Gabion	Headwater Drop Structure # 28
57+00	75	160.2	154.3	3	3	6.1	5.9	3,371	Gabion	Tailwater Drop Structure # 29
57+60	75	163.2	157.3	3	3	6.1	5.9	3,371		Headwater Drop Structure # 29
58+60	75	163.7	157.8	3	3	6.1	5.9	3,371		Tailwater Drop Structure # 30
59+20	75	166.7	160.8	3	3	6.1	5.9	3,371		Headwater Drop Structure # 30
60+00	75	167.0	161.1	3	3	6.1	5.9	3,371		Tailwater Drop Structure # 31
60+60	75	170.0	164.1	3	3	6.1	5.9	3,371		Headwater Drop Structure # 31/ Bridge No. 3
61+40	75	170.2	164.3	3	3	6.1	5.9	3,371		Tailwater Drop Structure # 32
62+00	75	173.2	167.3	3	3	6.1	5.9	3,371		Headwater Drop Structure # 32
63+00	75	173.5	167.6	3	3	6.1	5.9	3,371		Tailwater Drop Structure # 33
63+60	75	176.5	170.6	3	3	6.1	5.9	3,371		Headwater Drop Structure # 33
64+60	75	177.0	171.1	3	3	6.1	5.9	3,371		Transition to Natural Stream

TABLE A-6
SUMMARY OF HYDRAULIC DESIGN DATA FOR INLET CHANNELS

Station	Width(FT)	Water Surface Elevation (FT. MSL)	Invert (FT) MSL	Side Slopes Left 1 on-	Right 1 on-	VELOCITY (FT/S)	DEPTH (FT)	DISCHARGE (CFS)	LINING	COMMENTS
23+00	30	91.4	87.4	3	3	7.0	4.0	1,179	Grass	Junction with Main Channel
23+75	30	91.8	87.8	3	3	7.0	4.0	1,179	Grass	Tailwater Gabion Control Structure No. 34
24+00	30	94.3	90.3	3	3	7.0	4.0	1,179	Grass	Headwater Gabion Control Structure No. 34
25+25	30	94.9	90.9	3	3	7.0	4.0	1,179	Grass	Upstream Terminus & Transition to Natural Stream

TABLE A-7
SUMMARY OF HYDRAULIC DESIGN DATA FOR BRIDGES

Bridge Name	Station (Ft.)	Design WSEL (FT. MSL)	Design Q (CFS)	Max. Allow Vel. Thru Bridge (FT/S)	Min. Reqd. Low Chord	APPROACH CHANNEL			Min. Area Reqd. Thru Bridge (FT^2)
						Bottom Width (FT)	Bottom Elev. (FT. MSL)	Side Slopes	
No. 1	20+60	87.20	3,371	6.00	88.20	75.0	81.30	1 on 3	506
No. 2	60+60	170.00	3,371	6.00	171.00	75.0	164.10	1 on 3	506



SECTION 205
DETAILED PROJECT REPORT
ESTATE MON BIJOU
ST. CROIX, U.S. VIRGIN ISLANDS

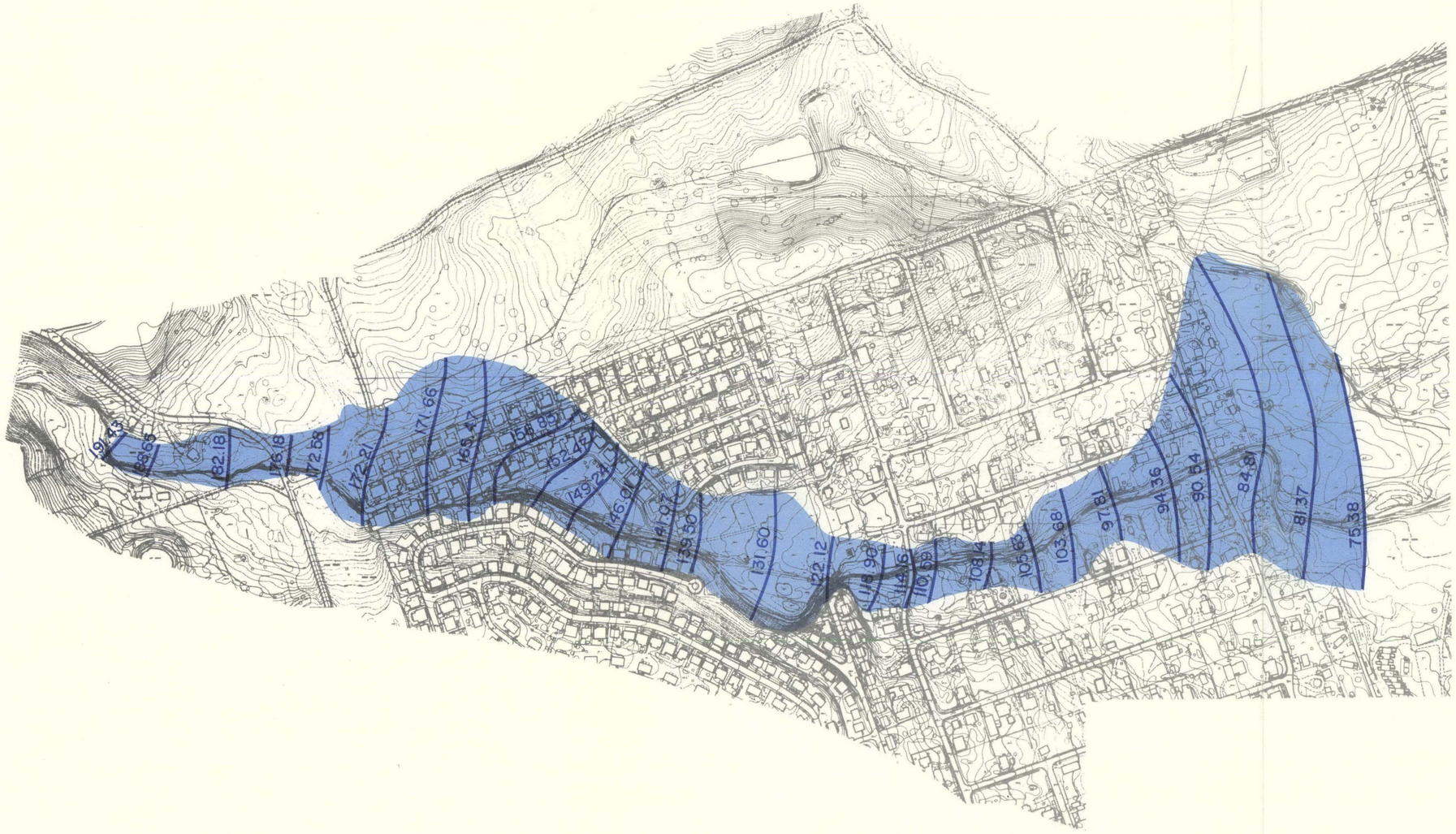
EXISTING CONDITION
FLOOD PROFILE

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA

FILE NO. 109-34,414

PLATE A-1


1900
1806
700
1348
4956
1452
1434
1284
1000
1029
1530
1530
1530



LEGEND

FLOODED AREA

40.2 WATER SURFACE ELEVATION, FT., M.S.L.

WATER SURFACE CONTROL

N

GRAPHIC SCALE

200' 0 200' 400'

SECTION 205
DETAILED PROJECT REPORT
ESTATE MON BIJOU
ST. CROIX, U.S. VIRGIN ISLANDS

APPENDIX A
FLOODED AREA MAP

EXISTING CONDITIONS
100-YEAR

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
JACKSONVILLE FLORIDA

D.O. FILE NO. 109-34,414

PLATE A-3



LEGEND

FLOODED AREA

40.2 WATER SURFACE ELEVATION, FT., M.S.L.

WATER SURFACE CONTROL

N

GRAPHIC SCALE

200' 0 200' 400'

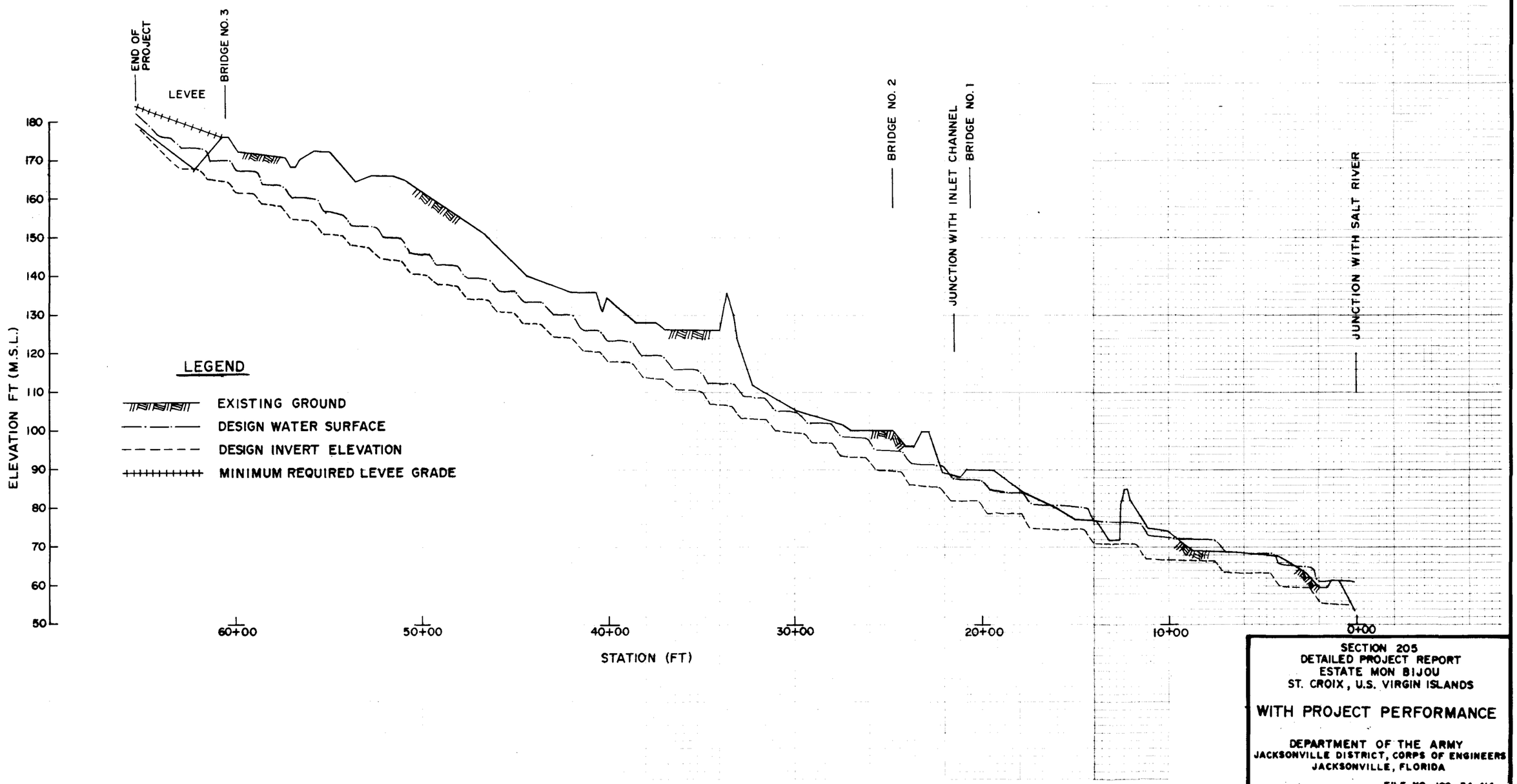
SECTION 205
DETAILED PROJECT REPORT
ESTATE MON BIJOU
ST. CROIX, U.S. VIRGIN ISLANDS

APPENDIX A
FLOODED AREA MAP
EXISTING CONDITIONS
SPF

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
JACKSONVILLE FLORIDA

D.O. FILE NO. 109-34.414

PLATE A-4



SECTION 205
DETAILED PROJECT REPORT
ESTATE MON BIJOU
ST. CROIX, U.S. VIRGIN ISLANDS

WITH PROJECT PERFORMANCE

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA

FILE NO. 109-34,414

PLATE A-5

SECTION 205 DETAILED PROJECT REPORT

ESTATE MON BIJOU

ST. CROIX, U.S. VIRGIN ISLANDS

APPENDIX B

GEOTECHNICAL AND MATERIALS

SECTION 205 DETAILED PROJECT REPORT
ESTATE MON BIJOU
ST. CROIX, U.S. VIRGIN ISLANDS

APPENDIX B
GEOTECHNICAL AND MATERIALS

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A. INTRODUCTION

1. This appendix presents the geotechnical investigations and tests which were conducted to define the geotechnical conditions at Mon Bijou, St. Croix, U.S. Virgin Islands.

B. LOCATION AND PHYSIOGRAPHY

2. The island of St. Croix is the largest of the three U.S. Virgin Islands. The island is 23 miles long from east to west and from 1 to 6 miles wide. The areal extent is given as 80 square miles. The bank on which the island stands is, however, 35 miles long and in places, 20 miles wide. Location and vicinity maps are shown on plate B-1.

3. The hills of St. Croix are composed largely of igneous rock and rise abruptly from the northern shore (highest point is Mt. Eagle, 1,165 ft.). The hills give way to fertile rolling lands, lagoons, and beaches to the south. The mean annual temperature of St. Croix is 74 °F and has an average rainfall of 45.7 inches yearly.

C. GEOLOGIC HISTORY

4. The Virgin Islands and their bank continue the geology of Puerto Rico for another 100 miles eastward to the point where the Antillean geanticline is pinched off and the Anegada fault trough goes down to a maximum depth of 7,120 feet. Forty miles to the southeast, the limestone-covered Caribbes begin. To the south of the Virgin bank, and between it and St. Croix, is a fault trough 28 miles in width, and about 15,000 feet deep at its maximum. The island of St. Croix, with its bank, is about 35 miles long; it is an isolated part of the Antillean geanticline, both island and bank having the same northeast-southwest trend (about N. 70 °E.). The strike of the rocks on the Virgin bank, however, has two different trends, that of the late Cretaceous being northwest-southeast, while the Younger Series trends about east-west.

5. The basement of the Virgin and St. Croix islands is a very thick mass of essentially volcanic materials like that of Puerto Rico; it has thin fossil zones that are of late Cretaceous (Gosau) time, and younger intrusives, all of which are more or less intensely folded and faulted. The dioritic intrusives are most common in the eastern islands. The older formations together make up the Mount Eagle series. Epeirogenic elevation in Eocene time amounted in the west to 750 feet, with a further rise of 500 feet in the early Oligocene; toward the east these elevations descend rapidly.

6. Unconformably over the old basement rocks on the southern side lies the Kingshill series of marine sediments having a thickness of at least 600 feet and representing the time from the middle Oligocene into the middle Miocene. Their deposition was followed by renewed epeirogenic elevation combined with block faulting on a tremendous scale. This differential movement began late

in the Miocene and endured through most or all of Pliocene time, bringing on the present geography and the overdeepened submarine topography. See plate B-2 for a regional geologic map.

D. INVESTIGATIONS PERFORMED

7. Core Borings. Eighteen (18) core borings (CB-VIM-1 thru CB-VIM-18) were drilled along the proposed bypass alignment plan. The borings were drilled to depths of 20-35 feet. The unconsolidated materials and softer rock were sampled by standard penetration tests (1-3/8-inch I.D. x 2-inch O.D. split spoon with 140-pound hammer falling 30 inches). Rock was sampled using 4- x 5 1/2-inch diamond bits. All materials recovered from core borings (exclusive of samples used for testing) were placed in core boxes, sealed, and stored at the Corps of Engineers' San Juan Area Office. Core boring locations are shown on plate B-4 with core boring drilling logs shown on plates B-5 through B-30.

8. Materials Encountered. Materials encountered consisted of layers of firm to very stiff silts (ML, MH), firm to hard clays (CL, CH), firm to very dense sands (SM, SC) and firm to very dense silty, clayey gravels (GM, GC). All borings terminated before encountering hard rock. Plate B-50 shows soil profile along the proposed levee and channel alignments.

9. Groundwater. Groundwater was encountered in borings immediately upstream, downstream and east of the in-place earthen dam located approximately midway of the bypass alignment plan. The groundwater was generally 8-12 feet below the ground surface and followed ground surface contours. The groundwater table fluctuates; therefore, groundwater elevations shown on the borings are only indicative of conditions at the time the borings were taken.

10. Laboratory Testing. Laboratory tests (visual classification, moisture content, atterburg limits, and gradation analysis) were performed on representative samples of overburden materials. Laboratory tests results and gradation curves are shown on plate B-31 through B-49.

E. SOILS ENGINEERING ANALYSES AND CONSIDERATIONS

11. Levee.

a. Levee Foundation.

(1) Materials. The materials along the proposed levee alignment appear suitable for levee foundation materials. The levee will be founded on firm to very dense sands and gravels and very stiff silts.

(2) Dewatering. No dewatering of the levee foundation is anticipated.

b. Levee Fill Materials. The levee will be constructed of those materials required to be excavated from the channel. The excavated materials will consist of firm to very stiff silts (ML, MH), firm to hard clays (CL, CH), firm to very dense sands (SM, SC), and firm to very dense silty, clayey gravels (GM, GC). Moisture contents for the excavated material ranges between 6% to 51%, however, the majority of the silty clayey materials are within, or close to, maximum moisture-compaction limits which are 19% (ML), 17% (CL), 36% (MH), and 25% (CH). These materials should be suitable for levee fill materials. Levee fill materials will be required to be compacted to 95 percent of standard maximum density.

c. Levee Design Slopes.

(1) Stability Analyses. Slope stability analyses were performed for a levee-foundation section in conjunction with a channel excavation section at boring CB-VIM-2. Slopes at this location were considered to be typical levee slopes. Material shear strengths used were based on material type and blow counts from standard penetration tests. Slopes were analyzed for end of construction conditions. Flooding conditions are of short duration with steady seepage conditions and slope saturation with rapid drawdown condition unlikely to occur; therefore, stability analyses for these conditions were not performed. Slopes were analyzed for both wedge and circular arc failures (UTEXAS2 Computer Program). Factor of safety obtained was 4.51 (end of construction conditions). Slope stability analyses indicate stable levee slopes of 1V to 2.5H. Levee slope stability analyses are shown on plate B-51.

(2) Slope Protection. Gabions (12" thick) will provide slope protection in the vicinity of the drop structures. Seeding and natural grass, which takes over quickly, should provide adequate slope protection for all other slopes.

d. Levee Consolidation - Settlement. The maximum height of the levee will be approximately 4 feet with levee materials compacted to 95 percent of standard maximum density and constructed on firm to very stiff foundation materials, therefore, little to no consolidation-settlement is expected during and after levee construction.

12. Channel.

a. Channel Excavation. Maximum channel excavation depth will be approximately 30 feet. Channel excavation materials will consist of firm to very stiff silts (ML, MH), firm to hard clays (CL, CH), firm to very dense sands (SM, SC), and firm to very dense silty, clayey gravels (GM, GC). Groundwater is generally below channel excavation grade exclusive of the in-place earthen dam area. No rock excavation will be required. Excavation of materials can be made with conventional excavation equipment.

b. Channel Design Slopes. Slope stability analyses were performed for channel excavation sections near borings CB-VIM-6 and CB-VIM-11. Slopes at these locations were considered to be the critical and maximum channel excavation slopes. Material shear strengths used were based on material type and blow counts from standard penetration tests. Slopes were analyzed for end of construction stability conditions. Flooding conditions are of short duration with steady seepage conditions and slope saturation with rapid drawdown conditions unlikely to occur; therefore, stability analyses for these conditions were not performed. Slopes were analyzed for both wedge and circular arc failures (UTEXAS2 Computer Program). Factors of safety obtained were 2.29 (end of construction) at boring CB-VIM-6 and 1.52 (end of construction) at boring CB-VIM-11. Slope stability analyses indicate stable excavation slopes of 1V to 3H. Excavation slope stability analyses are shown on plates B-52 and B-53.

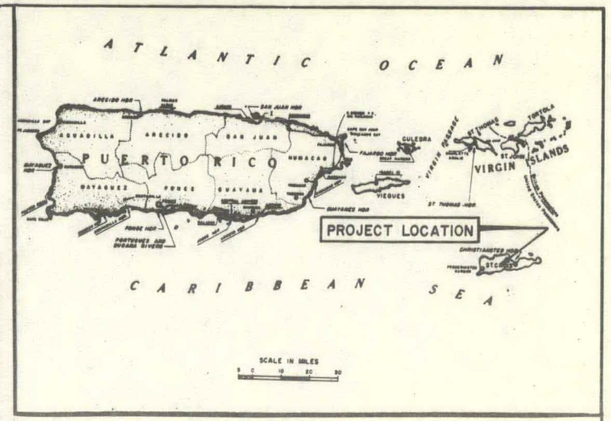
13. Gabion Drop Structures.

a. Foundation Materials. Foundation materials for the gabion drop structures along the proposed bypass alignment plan are of sufficient density to provide adequate structure support. The gabions should be underlain by filter fabric to prevent intrusion and piping of fine foundation material from beneath and into the gabion drop structures.

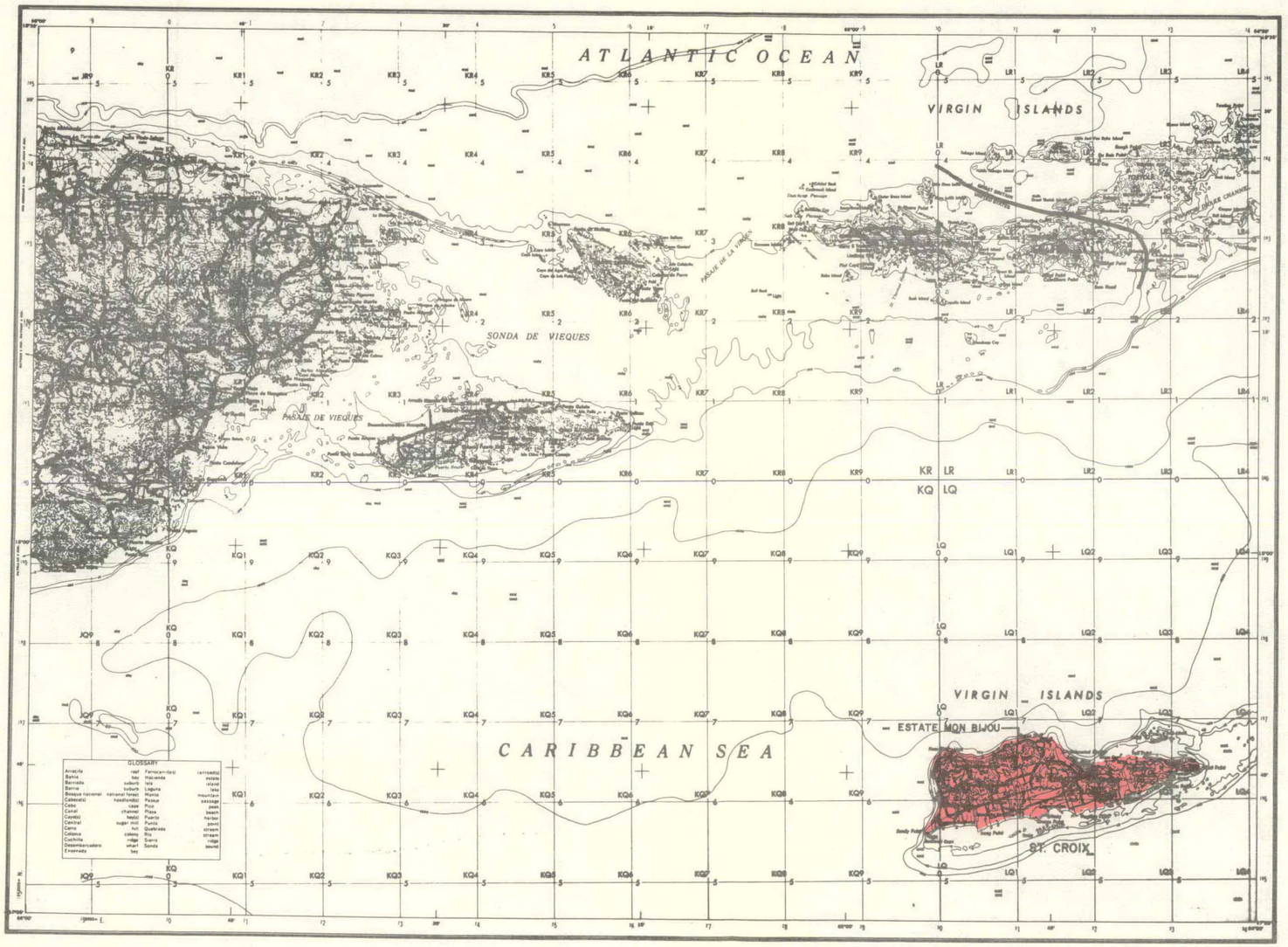
b. Gabion Fill. Fill for gabion drop structures should be stone having a unit weight of 165 pcf (SSD) well graded between 4 inches and 8 inches (Guide Spec. CW-02541). It is anticipated local quarries which produce concrete aggregate will be able to provide suitable gabion fill materials.

14. Bridges.

The local sponsor is responsible for all permanent bridge crossings. No temporary bridges should be needed during construction.



LOCATION MAP



VICINITY MAP

SCALE IN MILES

5 0 5

N

SECTION 205
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ESTATE MON BIJOU
ST. CROIX, U.S. VIRGIN ISLANDS

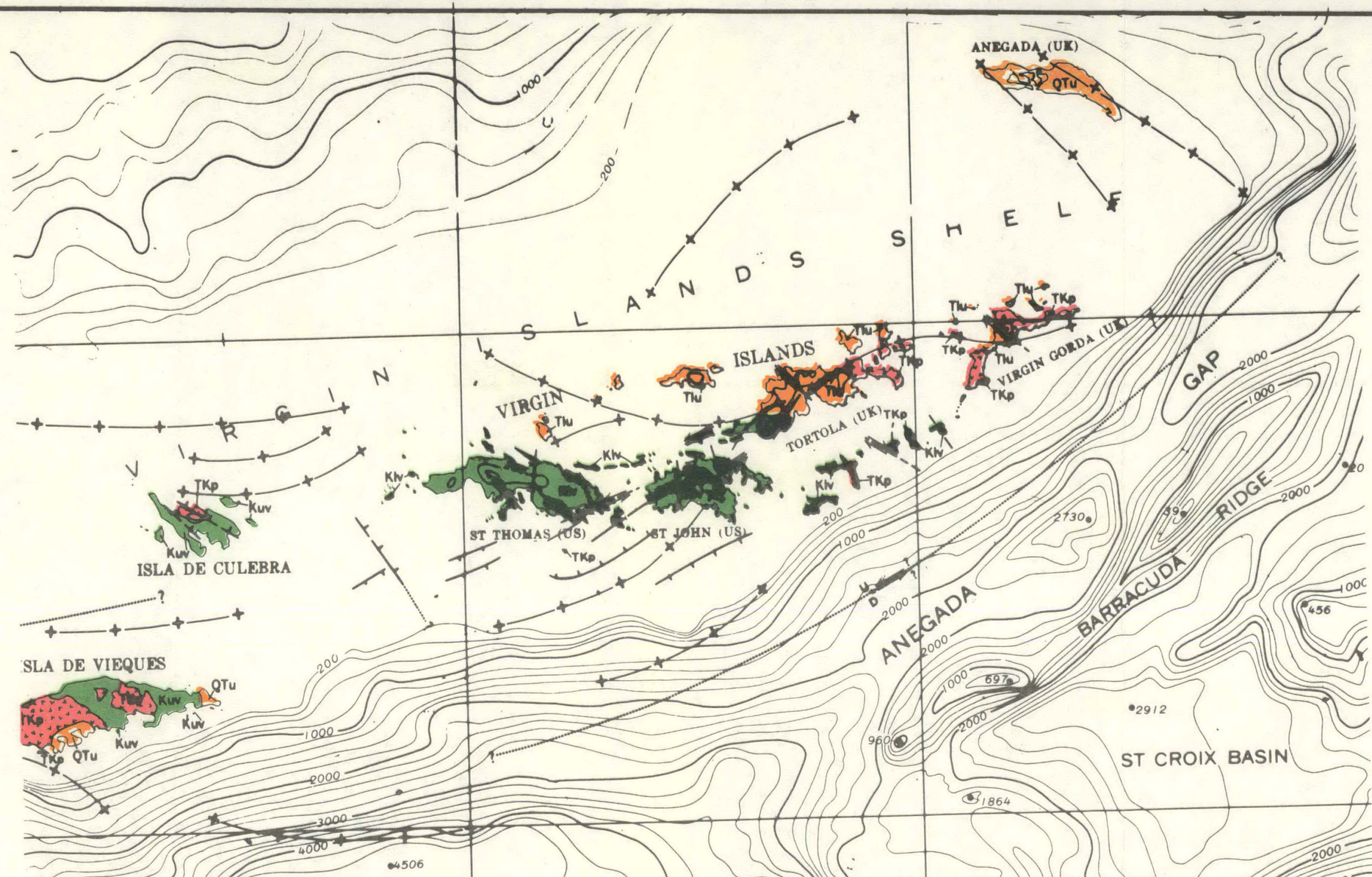
APPENDIX B

VICINITY AND LOCATION MAPS

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS. OF ENGINEERS
JACKSONVILLE, FLORIDA

D.O. FILE NO. 109-34,414

PLATE B-1



NOTE:

FOR LEGEND SEE PLATE B-3

SECTION 205
DETAILED PROJECT REPORT
ESTATE MON BIJOU
ST. CROIX, U.S. VIRGIN ISLANDS

APPENDIX B

REGIONAL GEOLOGIC MAP

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA

FILE NO. 109-34,414

PLATE B-2

EXPLANATION

TERTIARY AND QUATERNARY

Oligocene to Holocene

QTu

Sedimentary deposits, undivided

Marine limestone, calcarenite, sandstone, shale, marl, chalk, sand, and clay; and alluvial, landslide, beach, dune, swamp, marsh, and reef deposits

TERTIARY

Paleocene to Eocene

Tku

Sedimentary and volcanic rocks, undivided

In Puerto Rico; siltstone, sandstone, conglomerate, algal limestone, lava, tuff, largely deposited in a marine environment, may include some plutonic and hydrothermally altered rocks and some strata of Cretaceous age; in Virgin Islands, mainly quartz-andesite and augite-andesite breccia and tuffaceous sandstone and breccia

Tkp

Plutonic rocks

In Puerto Rico, Vieques, and Culebra, largely granodiorite and quartz diorite, some diorite, quartz porphyry, gabbro, and some amphibolite; in Virgin Islands, predominantly tonalite, some welded tuff, pegmatite, lamprophyre dikes, and diabase; believed to have been emplaced during Late Cretaceous, Paleocene, and Eocene

CRETACEOUS

Upper Cretaceous

Kuv

Volcanic and sedimentary rocks, undivided

Tuffaceous sandstone, siltstone, breccia, and conglomerate, lava, tuff, some limestone and mudstone; largely deposited in a marine environment; may include some hydrothermally altered rocks and some strata of Paleocene and (or) Eocene age

Ks

Serpentinite

Serpentinized peridotite (?); probably emplaced during the Early or early Late Cretaceous

Lower Cretaceous

Klv

Volcanic and sedimentary rocks, undivided

Tuff, tuffaceous breccia, some sandstone, siltstone, and limestone; in Puerto Rico, lava, lava breccia, some amphibolite and hydrothermally altered rocks; in Virgin Islands, keratophyre and spilite flows, volcanic wackes, augite-andesite breccia, radiolarite, and some conglomerate; largely deposited in a marine environment; may include some strata of Late Cretaceous age

---

Contact

Dashed where uncertain

U / D .... ?

Major fault involving basement movement

Solid in submarine areas based on seismic data. Dashed where extrapolated; dotted where speculated based on topography and magnetic gradients and trends; queried where doubtful or inferred. D or ticks, indicate downthrown side; U, upthrown side; arrows show direction of apparent strike-slip movement; teeth on upper plate of thrust fault

..... ?

Minor fault in sedimentary cover

Not believed to involve basement. Solid in submarine areas based on seismic data. Dashed where extrapolated; dotted where speculated; queried where doubtful or inferred. Ticks indicate downthrown side

Fault zone

Zone of numerous down-to-basin faults along insular margin of Muertos Trough; fault pattern uncertain

Axial trace of fold

Dashed where extrapolated; direction of plunge indicated where known; arrows denote dip of sedimentary horizons away from crest

Monoclinal flexure

Inferred trend of monocline involving sub-bottom horizons of Venezuelan basin along south margin of Muertos Trough

Positive magnetic anomaly

Trend of residual magnetic anomaly greater than +150 gammas

SECTION 205
DETAILED PROJECT REPORT
ESTATE MON BIJOU
ST. CROIX, U.S. VIRGIN ISLANDS

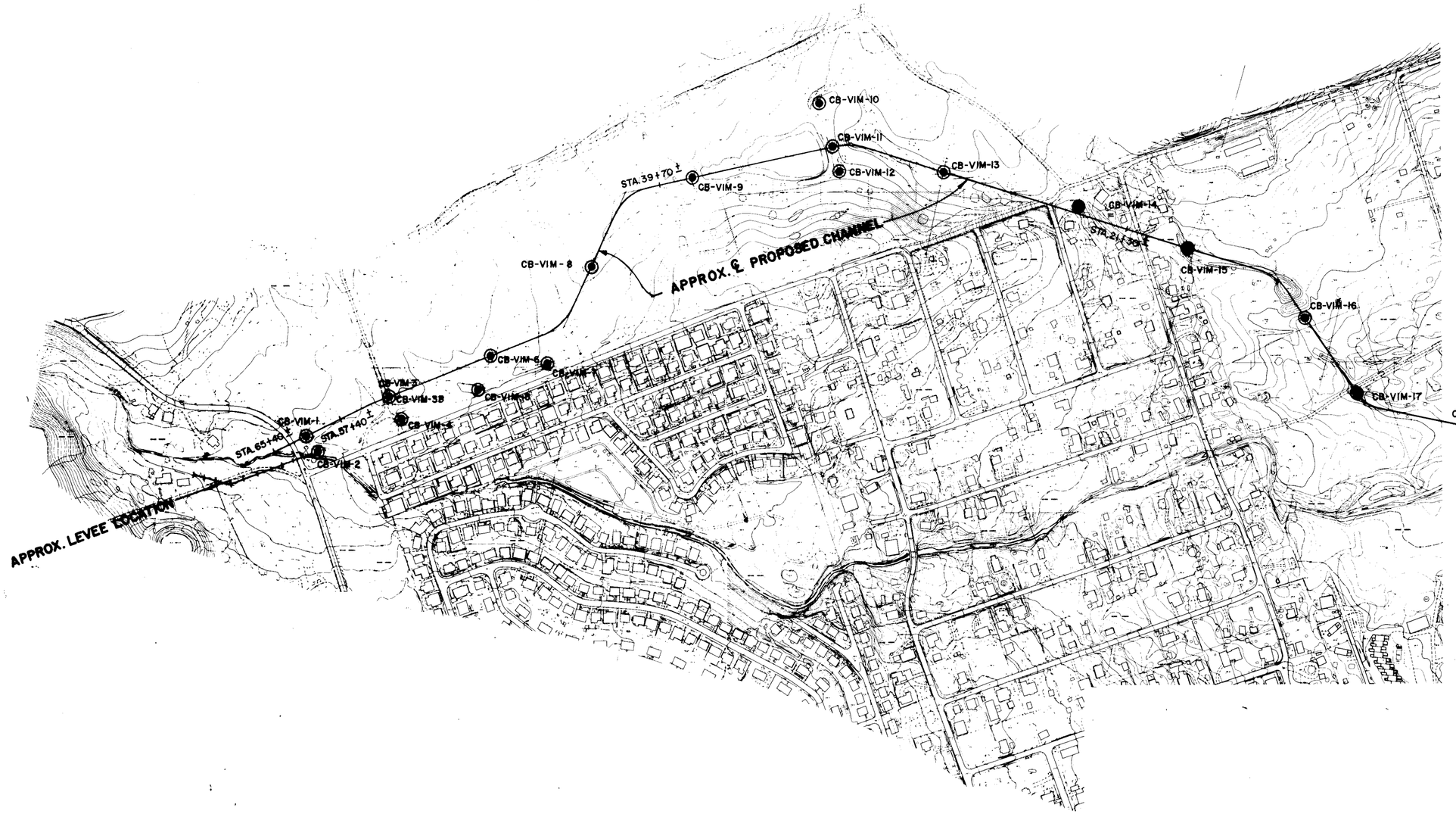
APPENDIX B

LEGEND - REGIONAL GEOLOGIC MAP

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA

FILE NO. 109-34,414

PLATE B-3



LEGEND

CB-VIM-2 — CORE BORING LOCATION AND NUMBER

++++ — PROPOSED LEVEE LOCATION AND ALIGNMENT

——— — PROPOSED CHANNEL LOCATION AND ALIGNMENT

NOTE:

1. FOR CORE BORING DRILLING LOGS SEE PLATES B-5 THRU B-30.
2. FOR PLAN-SOIL PROFILE, SEE PLATE B-50.

SECTION 205
DETAILED PROJECT REPORT
ESTATE MON BIJOU
ST. CROIX, U.S. VIRGIN ISLANDS

APPENDIX B

CORE BORINGS LOCATION MAP

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA

D.O. FILE NO. 109-34,414

PLATE B-4

Hole No. CB-VIM-1

DRILLING LOG	DIVISION: SOUTH ATLANTIC	INSTALLATION: JACKSONVILLE DISTRICT	SHEET 1 OF 1 SHEETS

1. PROJECT: ESTATE MON BIJOU, ST. CROIX, V.I.
2. LOCATION (Coordinates or Station): X = 1,072,428 Y= 73,625
3. DRILLING AGENCY: GEO CIM, INC.
4. HOLE NO. (As shown on drawing title and file number): CB-VIM-1
5. NAME OF DRILLER: FLOR RIVERA
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: Greater than 20 ft.
8. DEPTH DRILLED INTO ROCK: No rock drilled
9. TOTAL DEPTH OF HOLE: 20 ft.
10. SIZE AND TYPE OF BIT: SPLIT SPOON SAMPLER (2 ft.
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: CME 45B (Hollow stem auger drilling)
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 13; UNDISTURBED
14. TOTAL NUMBER CORE BOXES: 1- For plastic jars
15. ELEVATION GROUND WATER: Not encountered
16. DATE HOLE: STARTED 10-24-83; COMPLETED 10-24-83
17. ELEVATION TOP OF HOLE: 175.61 ft.
18. TOTAL CORE RECOVERY FOR BORING: 72% %
19. SIGNATURE OF INSPECTOR: Guillermo Abudo

ELEVATION ft. a	DEPTH ft. b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	Blows	N	W	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
175.61	0		SILT, some clay, some rock fragments, trace fine sand, dark yellowish brown. (ML)	16" / 89%	1	4, 5, 5	10	14.3	N=N-value W=water content in %.
174.11	1.5		ROCK FRAGMENTS, subangular to subrounded, some fine sand, little silt, light olive brown. (GC) *	15" / 83%	2	6, 9, 8	17	11.5	140# hammer with 30" drop used on 2 ft. long split spoon (1-3/8" ID x 2" OD)
	4.5			14" / 78%	3	7, 8, 11	19	9.7	
				15" / 83%	4	13, 19, 15	34	9.2	
				14" / 78%	5	15, 19, 32	41	9.6	
	7.5		*Unified Soils Classification symbol and legend reflect lab test data results.	15" / 83%	6	31, 19, 18	37	8.8	
166.61	9		Silty CLAY, little fine sand, hard, yellowish brown mixed olive dark brown stains, trace rock fragments (CL).	18" / 100%	7	9, 11, 17	28	45.3	
	10.5			6" / 33%	8	14, 18, 23	41	18.5	
				9" / 50%	9	9, 16, 18	34	13.3	
	13.5			8" / 44%	10	12, 14, 17	31	16.7	
160.61	15		ROCK FRAGMENTS, some silty clay lumps, little fine sand, medium, light olive brown (GC).	12½" / 69%	11	10, 17, 21	38	15.8	
	16.5			11" / 61%	12	12, 16, 27	43	18.3	
				19" / 79%	13	16, 42, 18, 65	83	12.5	
155.61	20								

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. (TRANSLUCENT)

PROJECT: ESTATE MON BIJOU, ST. CROIX, USVI | HOLE NO. CB-VIM-1

PLATE B-5

Hole No. CB-VIM-2

DRILLING LOG	DIVISION: SOUTH ATLANTIC	INSTALLATION: JACKSONVILLE	SHEET 1 OF 1 SHEETS
1. PROJECT: ESTATE MON BIJOU, ST. CROIX, USVI		10. SIZE AND TYPE OF BIT: (1-3/8"IDx2"OD split spoo	
2. LOCATION (Coordinates or Station): X= 1,072,484 Y = 73,574		11. DATUM FOR ELEVATION SHOWN (USM or MSL): MSL	
3. DRILLING AGENCY: GEO CIM, INC.		12. MANUFACTURER'S DESIGNATION OF DRILL: CME-45B Hollow stem auger drilling	
4. HOLE NO. (As shown on drawing title and file number): CB-VIM-2		13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: DISTURBED 13 / UNDISTURBED	
5. NAME OF DRILLER: FLOR RIVERA		14. TOTAL NUMBER CORE BOXES: 1 for plastic jars	
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER: not encountered	
		16. DATE HOLE: STARTED 10-20-83 / COMPLETED 10-20-83	
7. THICKNESS OF OVERBURDEN: greater than 20 ft.		17. ELEVATION TOP OF HOLE: 173.98 ft..	
8. DEPTH DRILLED INTO ROCK: no rock drilling		18. TOTAL CORE RECOVERY FOR BORING: 63%	
9. TOTAL DEPTH OF HOLE: 20 ft.		19. SIGNATURE OF INSPECTOR: GUILLERMO ABUDO	

ELEVATION (a)	DEPTH (b)	LEGEND (c)	CLASSIFICATION OF MATERIALS (Description) (d)	% CORE RECOVERY (e)	BOX OR SAMPLE NO. (f)	Blows	N	W (g)	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
173.98				8" / 44%	1	4, 5, 12	17	10	
	1		ROCK FRAGMENTS, subangular to subrounded, fine sand, little silt, trace clay, compact, friable, varying from dark brown (samples 1,2) to light yellowish brown and olive brown. (GC)*	9.5" / 53%	2	18, 25, 62	87	6.3	
	2								
	3			10.5" / 58%	3	12, 17, 11	28	4.2	
	4			8.5" / 47%	4	10, 20, 17	37	14	
	5								
	6			10" / 56%	5	14, 9, 18	27	6.6	
	7			7.5" / 42%	6	20, 20, 34	64	5.1	
	8			10.5" / 58%	7	14, 18, 13	31	7.3	
	9			7" / 39%	8	11, 62	62/6"		
	10		*Unified Soils Classification symbol and legend reflect lab test data results.	13" / 72%	9	15, 17, 16	33	9.4	
160.48	13.5								
	14		SAND, weathered rock fragments, some clay, little silt, compact, friable, yellowish brown. (SC)	18" / 100%	10	16, 16, 20	36	13.3	
	15								
	16			18" / 100%	11	7, 17, 21	38	12	
	17			13" / 72%	12	20, 24, 24	48	13.7	
	18					AUGERED 5"			
	19			17" / 94%	13	13, 25, 28	53	12	
153.98	20								

ENG FORM 1836 MAR 71 — PREVIOUS EDITIONS ARE OBSOLETE. (TRANSLUCENT)

PROJECT: ESTATE MON BIJOU ST. CROIX, U. S. V. I. — HOLE NO. CB-VIM-2

PLATE B-6

Hole No. CB-VIM

DRILLING LOG	DIVISION: SOUTH ATLANTIC	INSTALLATION: JACKSONVILLE	SHEET 1 OF 2 SHEETS
1. PROJECT: ESTATE MON BIJOU, ST. CROIX, U.S.V.I.		10. SIZE AND TYPE OF BIT: 4x5½ core barrel	
2. LOCATION (Coordinates or Station): X = 1,072,792 Y= 73,790		11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL	
3. DRILLING AGENCY: GEO CIM, INC.		12. MANUFACTURER'S DESIGNATION OF DRILL: CME 45B	
4. HOLE NO. (As shown on drawing title and file number): CB-VIM-3		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 12	UNDISTURBED
5. NAME OF DRILLER: FLOR RIVERA		14. TOTAL NUMBER CORE BOXES: 1-for plastic jars&c	
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.		15. ELEVATION GROUND WATER: NONE	
7. THICKNESS OF OVERBURDEN: Bed rock not reached.		16. DATE HOLE: STARTED 10-21-83	COMPLETED 10-28-83
8. DEPTH DRILLED INTO ROCK: -0-		17. ELEVATION TOP OF HOLE: 172.72 ft.	
9. TOTAL DEPTH OF HOLE: 30 ft.		18. TOTAL CORE RECOVERY FOR BORING: 62 %	
		19. SIGNATURE OF INSPECTOR: Guillermo Abudo	

ELEVATION ft. a	DEPTH ft. g	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	Blows/6"	N-value	W	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
172.72	1		Silty clay, trace fine sand, hard, little white silty concretions, dark brown. (CL)	9.5" / 53%	1	6, 8, 15	23	20	Blows/6"; N-value; W- natural water content %. 140# hammer, 30 inch drop used on 1-3/8" ID x 2" ODx2 ft. long split spoon sampler.
171.22	1.5								
	2		Silty fine sand, little clay, mixed weathered rock fragments, light yellowish brown.(SC)*	13" / 72"	2	10, 15, 18	33	10	
	3			12.5" / 69%	3	12, 22, 19	41	9	
	4			14" / 78%	4	10, 12, 14	26	11	
	5			10.5" / 58%	5	13, 15, 23	38	11	
	6			12" / 67%	6	15, 20, 18	38	7	
	7			14" / 78%	7	13, 35, 30	65	6	
162.22	10.5								
	11		Silty clay, trace fine sand, hard, yellowish brown, dark brown spots, trace rock fragments. (CL)	11.5" / 64%	8	18, 56, 39	95	17	
	12								
	13		Fine sand, weathered rock fragments, hard clayey silt lumps, yellowish brown mixed white. (SC)* *Unified Soils Classification symbol and legend reflect lab test data results.	4" / 22%	9	102	102/6"	Boulder 13	
	14			17.5" / 97%	10	22, 67, 35	102	10	
	15								
	16			17" / 94%	11	27, 39, 45	84	9	
	17								
154.72	18			13" / 72%	12	28, 34, 43	76	12	Start Core Drilli on 10-27-
154.68				100%	12A	50/1"	50/1"		
	19		Sub angular to subrounded rock fragments in a silty clay matrix varying to clayey silty sand, (GC)	12"	13	1) Used 4x5½ Core Barrel 2) Drilling time 3pm-6pm.			
152.72	20								

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. (TRANSLUCENT)

PROJECT: Mon-Bijou, St. Croix, U.S.V.I. HOLE NO. CB-VIM-3

PLATE B-7

DRILLING LOG (Cont Sheet) ELEVATION TOP OF HOLE 172.72 **Hole No.** CB-VIM-3

PROJECT Estate Mon Bijou, St. Croix,U.S.V.I. | INSTALLATION Jacksonville, | SHEET 2 OF 2 SHEETS

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
152.72	20		Core run from 18-21 ft. (GC)	33%	13	
	21					
			No recovery	0" / 0%	14	10-28-83 9:20 am to 1 pm.
	22		Rock fragments in silty clay matrix, coarse sand (GC)	10" / 83%	15	17/50/6" Split-spoon sample
149.72	23					
			This borehole stopped at 23 ft. depth. Boring 3B drilled next to boring CB-VIM-3 was completed to required 30 ft. depth.			

ENG FORM 1836-A JUN 67 GPO: 1969 OF—329-243

PROJECT Estate Mon Bijou, St. Croix, U.S.V.I. | HOLE NO CB-VIM-3

PLATE B-8

Hole No. CB-VIM-3B

DRILLING LOG | DIVISION: SOUTH ATLANTIC | INSTALLATION: JACKSONVILLE | SHEET 1 OF 1 SHEETS

1. PROJECT: ESTATE MON BIJOU, ST. CROIX, U.S.V.I.
2. LOCATION (Coordinates or Station): X= 1,072,798 Y= 73,794
3. DRILLING AGENCY: GEO CIM, INC.
4. HOLE NO. (As shown on drawing title and file number): CB-VIM-3B
5. NAME OF DRILLER: FLOR RIVERA
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: Greater than 30 ft.
8. DEPTH DRILLED INTO ROCK: Bedrock not reached
9. TOTAL DEPTH OF HOLE: 30 ft.
10. SIZE AND TYPE OF BIT: 4x5½"Core Barrel (see rema
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: CME 45B
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 1 | UNDISTURBED
14. TOTAL NUMBER CORE BOXES: 1
15. ELEVATION GROUND WATER: not encountered.
16. DATE HOLE: STARTED 11-03-83 | COMPLETED 11-08-83
17. ELEVATION TOP OF HOLE: 172.72 ft.
18. TOTAL CORE RECOVERY FOR BORING: %
19. SIGNATURE OF INSPECTOR: GUILLERMO ABUDO

ELEVATION ft. a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
172.72	0		Augered to 18 feet; then set casing to 18 feet and rotated it to advance to 19 feet.			
154.72	18		Rock fragments, silty clay matrix.			Sample from casing shoe. (ZW).
153.72	19		Subangular to subrounded rock fragments, in a greenish brown silty clay matrix; matrix makes up approximately 10% to 30% by volume; clay has high dry strength, plastic, sticky when wet, trace silt; rock fragments up to 8 cm diameter include andesite, tuff, siliceous tuff, chert, quartz-hornblende, phanerite, basalt, moderately strong to very strong rock fragments. Soil matrix varies to sandy gravelly silt. (GC)	12" 100%	1	Water pressure in drilling (psi) 28
	20			24" 100%	1	
	21					
	22			12" 100%	1	Water press. 10-15 psi
	23			11" 46%	1	Water press. 10-35 psi
	24					
	25					N-Blows
	26			45" 37%	1	50 / 50 / 50/3" 140# hammer, 30" drop on 2 ft. long 1-3/8"IDx2"OD split spoon sampler.
	27			8" 67	1	Water press. 8 psi
	28			7" 58	1	Water press. 15-30 psi
	29			22" 92%	1	Water press. 15 psi
142.72	30					

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. (TRANSLUCENT)

PROJECT: Estate Mon Bijou, St. Croix, U. S. V. I. | HOLE NO. CB-VIM-3B

PLATE B-9

Hole No. CB-VIM-4

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION JACKSONVILLE	SHEET 1 OF 2 SHEETS

1. PROJECT: ESTATE MON BIJOU, ST. CROIX, V.I.
2. LOCATION (Coordinates or Station): X = 1,072,830 Y = 73,697
3. DRILLING AGENCY: GEO CIM, INC.
4. HOLE NO. (As shown on drawing title and file number): CB-VIM-14
5. NAME OF DRILLER: FLOR RIVERA
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: approximately 29 ft.
8. DEPTH DRILLED INTO ROCK: no rock drilling
9. TOTAL DEPTH OF HOLE: 29 ft.
10. SIZE AND TYPE OF BIT: 1-3/8"IDx2"OD Split spoon
11. DATUM FOR ELEVATION SHOWN (USGS or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: CME 45B(hollow stem auger drilling)
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 20; UNDISTURBED
14. TOTAL NUMBER CORE BOXES: 1 for plastic jars
15. ELEVATION GROUND WATER: not encountered.
16. DATE HOLE: STARTED 10-19-83; COMPLETED 10-19-83
17. ELEVATION TOP OF HOLE: 167.61 ft.
18. TOTAL CORE RECOVERY FOR BORING: 67.3 %
19. SIGNATURE OF INSPECTOR: GUILLERMO ABUDO

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	Blows N	W g	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
167.61	0		Fine sand, little silt, rock fragments, roots, dark brown. (SM)	14" / 78%	1	6, 18, 25	43	18.4
166.1	1.5							
	2		Rock fragments, fine sand, little silt, compact, but friable, brown. (GC)	16" / 89%	2	14, 24, 42	66	7.1
	3			13" / 72%	3	15, 18, 13	31	8.1
	4							
	5			11" / 61%	4	11, 13, 21	34	5.3
	6			14" / 78%	5	22, 43, 53	96	4.2
	7			16" / 89%	6	29, 33, 36	69	8
158.61	9		Clay, some silt, some fine sand, hard, olive brown, dark brown spots, pockets of white, weathered rock fragments. (CL)	14" / 78%	7	24, 36, 27	63	13
	10							
	11			11" / 61%	8	20, 29, 36	65	15
	12							
	13			14" / 78%	9	13, 22, 24	46	16.3
154.11	13.5							
	14		Rock fragments, subangular, mixed clay, some silt, trace fine sand, very stiff, olive brown and olive. (GC)* *Unified Soils Classification symbol and legend reflect lab test data results.	9" / 50%	10	24, 18, 20	38	19
	15							
	16			10" / 56%	11	20, 25, 28	53	20
	17							
	18			18" / 100%	12	10, 13, 15	28	12.2
	19			8.5" / 47%	13	15, 23, 27	50	19.2
148.61	20					14		

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. (TRANSLUCENT)

PROJECT: ESTATE MON BIJOU ST. CROIX, U.S.V.I. HOLE NO. CB-VIM-4

PLATE B-10

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE 167.61 Ft. | **Hole No.** CB-VIM-4

PROJECT: ESTATE MON BIJOU, ST. CROIX, V.I. | INSTALLATION | SHEET OF 2 SHEETS 2

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY in.e %	BOX OR SAMPLE NO. f	Blows/6" N value		W
	21		Same - From 13.5 ft. to 22.5 ft.	14.5" / 81%	14	18 16	34	12
145.11	22			10.5" / 58%	15	14 17 35	52	15.8
	23		Silty clay, some fine sand, weathered rock fragments, light olive brown, (CL)	17" / 94%	16	16 17 20	37	16.3
	24							
	25			0" / 0%	17	26 32 30	62	-
	26			8" / 44%	18	22 29 41	70	22
140.61	27		Rock fragments, some silty clay, little fine sand, medium olive brown, (GC)	11" / 61%	19	26 48 72	120	7.5
	28							
138.61	29			5" / 85%	20	108/6"	108/6"	

ENG FORM 1836-A JUN 67 | GPO: 1969 OP—329-243

PROJECT: ESTATE MONBIJOU ST. CROIX, U. S. V. I. | HOLE NO. CB-VIM-4

PLATE B-11

Hole No. CB-VIM-5

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION JACKSONVILLE	SHEET 1 OF 1 SHEETS
1. PROJECT: ESTATE MON BIJOU, ST. CROIX, V.I.		10. SIZE AND TYPE OF BIT: see remarks	
2. LOCATION (Coordinates or Station): X= 1,073,150 Y= 73,816		11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL	
3. DRILLING AGENCY: GEO CIM, INC.		12. MANUFACTURER'S DESIGNATION OF DRILL: CME 45-B	
4. HOLE NO. (As shown on drawing title and file number): CB-VIM-5		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 12 / UNDISTURBED	
5. NAME OF DRILLER: FLOR RIVERA		14. TOTAL NUMBER CORE BOXES: 1 for plastic jar sto	
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER: NOT ENCOUNTERED.	
7. THICKNESS OF OVERBURDEN: GREATER THAN 20 ft.		16. DATE HOLE: STARTED 10-19-83 / COMPLETED 10-20-83	
8. DEPTH DRILLED INTO ROCK: -0-		17. ELEVATION TOP OF HOLE: 160.30 ft.	
9. TOTAL DEPTH OF HOLE: 20 ft.		18. TOTAL CORE RECOVERY FOR BORING: 65 %	
		19. SIGNATURE OF INSPECTOR: GUILLERMO ABUDO	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV-ERY e	BOX OR SAMPLE NO. f	Blow	N	W g	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
160.30									N- N-value from standard penetration test:140#hammer,30"drop,on 2ft.long 1-3/8"IDx2"OD,split spoon sampler. W- Natural water content in %
	1		Fine sandy silt, trace clay, rock fragments, trace roots, dark brown. (ML)	14" / 78%	1	12 / 15 / 20	34	30.0	
	2			12.5" / 69%	2	10 / 12 / 14	26	13.4	
157.30	3		Silty clay, little fine sand, rock fragments, hard, dark brown,white silty concretions. (CL)	8" / 44%	3	8 / 15 / 14	29	20	
	4								
	5			10.5" / 58%	4	10 / 15 / 19	34	11.3	
154.30	6		Clay, some silt, trace fine sand, hard, few weathered rock fragments, olive brown to yellowish brown, black and white silty concretions. (CH) *	13" / 72%	5	12 / 16 / 28	44	19	
	7								
	8			14" / 78%	6	9 / 11 / 25	36	17	
	9								
	10			9" / 50%	7	12 / 16 / 27	43	19	
	11								
	12			0" / 0%	8	12 / 14 / 27	41		
	13			18" / 100%	9	14 / 26 / 18	44	15	
146.80	13.5								
	14		Silt, trace fine sand, compact,friable,trace clay, white and pale yellow. (ML)	16" / 89%	10	12 / 16 / 24	40	25.3	
145.30	15		Clayey silt, trace fine sand, hard,olive yellow to light yellowish brown. (MH) *	15" / 83%	11	11 / 20 / 28	48	18.4	
	16								
	17		*Unified Soils Classification symbol and legend reflectlab test data results.	10" / 56%	12	15 / 21 / 26	47	21.1	
	18								AUGER
	19		Fine sand,little silt,brown, at 20 ft.	16" / 89%	13	10 / 15 / 18	33	32	
140.30	20								

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. (TRANSLUCENT)

PROJECT: Estate Mon Bijou,St.Croix. U.S.V.I. | HOLE NO. CB-VIM-5

PLATE B-12

Hole No. CB-VIM-6

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION JACKSONVILLE	SHEET 1 OF 1 SHEETS

1. PROJECT: ESTATE MON BIJOU, ST. CROIX, V.I.
2. LOCATION (Coordinates or Station): X= 1,073,215 Y= 73,958
3. DRILLING AGENCY: GEO CIM, INC.
4. HOLE NO. (As shown on drawing title and file number): CB-VIM-6
5. NAME OF DRILLER: FLOR RIVERA
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: greater than 20 ft.
8. DEPTH DRILLED INTO ROCK: -0-
9. TOTAL DEPTH OF HOLE: 20 ft.
10. SIZE AND TYPE OF BIT: see remarks
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: CME 45B (Hollow Stem Auger Drilling
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 13; UNDISTURBED -
14. TOTAL NUMBER CORE BOXES: 1-for stor.of plastic
15. ELEVATION GROUND WATER: not encountered.
16. DATE HOLE: STARTED 10-21-83; COMPLETED 10-21-83
17. ELEVATION TOP OF HOLE: 166.67 ft.
18. TOTAL CORE RECOVERY FOR BORING: 81 %
19. SIGNATURE OF INSPECTOR: GUILLERMO ABUDO

ELEVATION ft. a	DEPTH ft. b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	Blows	N	% W	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
166.67	1		Silty clay, trace fine sand, hard, yellowish brown, some white silty concretions. (CL)	14" / 78%	1	6, 8, 12	20	23.1	
	1.5								
	2		Silty fine sand, some clay, hard, mixed weathered rock fragments, light yellowish brown. (SC) *	12" / 67%	2	9, 12, 15	27	7.7	
	3			12.5" / 69%	3	8, 11, 11	22	23.2	
	4								
	4.5			12.5" / 69%	4	13, 18, 22	40	8.4	
	5								
	6			13" / 72%	5	25, 20, 18	38	39.4	
	7								
	7.5								
	8		Silt, little fine sand, trace clay, hard, pale yellow, white silt pockets. (ML)	15.5" / 86%	6	10, 17, 23	40	25	
	9								
	10			14" / 78%	7	12, 16, 20	36	30.8	
	10.5								
	11		Fine sand, little silt, some clay, pale brown. (SC)	15.75" / 88%	8	14, 20, 23	43	32.3	
	12								
	13		Silty clay, little fine sand, hard, light yellowish brown to pale yellow. (CH) *	17" / 94%	9	11, 13, 21	34	31.6	
	13.5								
	14		*Unified Soils Classification symbol and legend reflect lab test data results	18" / 100%	10	12, 14, 17	31	25	
	15								
	16			16.5" / 92%	11	8, 14, 15	29	20.3	
	16.5								
	17			16" / 89%	12	14, 17, 20	37	30.7	
	18								
	18.5								
	19			18" / 100%	13	15, 25, 20	45	28.1	
146.67	20								

N-value from standard penetration test: 140#hammer, 30"drop on 2 ft. long 1-3/8"IDx2"OD split spoon sampler.
WL Natural water content in %

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. (TRANSLUCENT)

PROJECT: Estate Mon Bijou, St.Croix | HOLE NO. CB-VIM-6

PLATE B-13

Hole No. CB-VIM-7

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION JACKSONVILLE	SHEET 1 OF 2 SHEETS
1. PROJECT ESTATE MON BIJOU, ST. CROIX, V.I.		10. SIZE AND TYPE OF BIT 1-3/8"IDx2"OD,2ft.splitsp	
2. LOCATION (Coordinates or Station) X = 1,073,450 Y= 73,932		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
3. DRILLING AGENCY GEO CIM, INC.		12. MANUFACTURER'S DESIGNATION OF DRILL CME 45B	
4. HOLE NO. (As shown on drawing title and file number) CB-VIM-7		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 20 / UNDISTURBED -	
5. NAME OF DRILLER FLOR RIVERA		14. TOTAL NUMBER CORE BOXES -0-	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER none	
		16. DATE HOLE: STARTED 10-20-83 / COMPLETED 10-20-83	
7. THICKNESS OF OVERBURDEN GREATER THAN 30 ft.		17. ELEVATION TOP OF HOLE 157.81 ft.	
8. DEPTH DRILLED INTO ROCK none		18. TOTAL CORE RECOVERY FOR BORING 89 %	
9. TOTAL DEPTH OF HOLE 30 ft.		19. SIGNATURE OF INSPECTOR GUILLERMO ABUDO	

ELEVATION ft. a	DEPTH ft. b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	BLOWS/ 6	N g	W
157.81	1		Silt, some clay, trace fine sand, very stiff, weathered rock fragments, dark brown. (ML)	12" / 67%	1	7 13 15	28	26.1
	2			12.5" / 69%	2	15 15 12	27	12.5
154.81	3		Silt, little clay, little fine sand, compact, friable white and pale yellow (MH) *	11" / 61%	3	9 12 15	27	32.3
	4							
	5			16" / 89%	4	8 11 13	24	23.4
	6							
	7			16" / 89%	5	13 17 20	37	20.5
150.31	8		Fine sand, trace silt, compact, but friable, white to light gray. (SM)	17" / 94%	6	11 13 11	24	16.6
148.81	9		Clayey silt, trace fine sand, compact, friable, very pale brown, to brownish yellow (samples 10,11,12,13,14,15) to light yellowish brown (samples 16, 17,18,19,20) (CH)*	15.5" / 86%	7	9 19 28	47	36.3
	10							
	11			15.5" / 86%	8	12 16 20	36	29.7
	12							
	13			18" / 100%	9	10 13 16	29	32.6
	14			13.5" / 75%	10	10 15 18	33	35
	15							
	16			17" / 94%	11	13 13 17	30	36.4
	17							
	18			18" / 100%	12	15 19 22	41	32.9
	19			17.5" / 97%	13	11 13 17	30	44.3
	20				14	12		

*Unified Soils Classification symbol and legend reflect lab test data results

N-value from standard penetration test
140 lb hammer, 30" drop on 2 ft. long
1-3/8"IDx2"OD, split spoon sampler

W-natural water content in %

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. (TRANSLUCENT)

PROJECT ESTATE MON BIJOU ST. CROIX, U. S. V. I. HOLE NO. CB-VIM-7

PLATE B-14

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE 157.81 | **Hole No.** CB-VIM-7

PROJECT: ESTATE MON BIJOU, ST. CROIX, V.I. | INSTALLATION: JACKSONVILLE | SHEET 2 OF 2 SHEETS

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	BLOWS	N	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g W
	21		Clayey silt, trace fine sand, compact, friable, light yellowish brown. (CH) *	18" / 100%	14	15 19	34	
	22			16" / 89%	15	14 23 25	48	
	23			18" / 100%	16	9 12 15	27	
	24			17.5" / 97%	17	10 10 13	23	29
	25		*Unified Soils Classification Symbol and Legend Reflect Lab Test Data Results	16.5" / 92%	18	11 16 18	34	
	26			18" / 100%	19	11 13 16	29	
	27			16" / 89%	20	13 17 20	37	24
127.81	30							

ENG FORM 1836-A JUN 67 GPO: 1969 OF—328-243

PROJECT ESTATE MON BIJOU ST. CROIX, U. S. V. I. | HOLE NO. CB-VIM-7

PLATE B-15

Hole No. CB-VIM-8

DRILLING LOG	DIVISION: SOUTH ATLANTIC	INSTALLATION: JACKSONVILLE	SHEET 1 OF 1 SHEETS
1. PROJECT: ESTATE MON BIJOU, ST. CROIX, V.I.		10. SIZE AND TYPE OF BIT: SEE REMARKS	
2. LOCATION (Coordinates or Station): X = 1,073,630 Y = 74,309		11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL	
3. DRILLING AGENCY: GEO CIM INC.		12. MANUFACTURER'S DESIGNATION OF DRILL: CME 45B (HOLLOW STEM AUGER DRILLING)	
4. HOLE NO. (As shown on drawing title and file number): CB-VIM-8		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 13 / UNDISTURBED	
5. NAME OF DRILLER: FLOR RIVERA		14. TOTAL NUMBER CORE BOXES: 1 plastic jars storag	
6. DIRECTION OF HOLE: X VERTICAL ☐ INCLINED ____ DEG. FROM VERT.		15. ELEVATION GROUND WATER: no groundwater	
7. THICKNESS OF OVERBURDEN: greater than 20 ft.		16. DATE HOLE: STARTED 10-24-83 / COMPLETED 10-25-83	
8. DEPTH DRILLED INTO ROCK: none		17. ELEVATION TOP OF HOLE: 144.00 ft.	
9. TOTAL DEPTH OF HOLE: 20 ft.		18. TOTAL CORE RECOVERY FOR BORING: 86 %	
		19. SIGNATURE OF INSPECTOR: GUILLERMO ABUDO	

ELEVATION ft a	DEPTH ft b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) BLOWS	N	gW
144.00	1		Silt, some clay, little fine sand, hard, trace roots, dark grayish brown. (ML)	9" / 50%	1	4, 6, 8	14	20.6
	1.5							
	2		Fine sand, some silt, trace clay, rock fragments, pale brown. (SM)	11" / 61%	2	7, 10, 8	18	5.9
	3							
	4		Silty clay, little fine sand, hard, light yellowish brown, to brownish yellow to yellowish brown. (CH) *	12" / 67%	3	6, 6, 7	13	29.3
	4.5							
	5			12.5" / 69%	4	5, 7, 10	17	43.3
	6							
	7			17" / 94%	5	11, 13, 15	28	30.4
	7.5							
	8			18" / 100%	6	11, 14, 19	33	22.7
	9			18" / 100%	7	8, 16, 20	36	28.0
	10							
	10.5							
	11			18" / 100%	8	14, 30, 25	55	32.4
	12			18" / 100%	9	14, 17, 20	37	35.2
	13							
	13.5							
	14			18" / 100%	10	11, 16, 20	36	31.6
	15		*Unified Soils Classification symbol and legend reflect lab test data results	18" / 100%	11	12, 18, 20	38	34.4
	16							
	16.5							
	17			18" / 100%	12	18, 23, 29	52	31.3
	18							
	19			18" / 100%	13	14, 18, 22, 30	40	34.0
124.00	20							

N-value from standard penetration test, 140#hammer, 30"drop on 2 ft. long 1-3/8"IDx2"OD split spoon sampler.
W-natural moisture content in %

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. (TRANSLUCENT)

PROJECT: ESTATE MON BIJOU ST. CROIX, U.S.VI. HOLE NO. CB-VIM-8

PLATE B-16

Hole No. CB-VIM-9

DRILLING LOG | DIVISION: SOUTH ATLANTIC | INSTALLATION: JACKSONVILLE | SHEET 1 OF 1 SHEETS

1. PROJECT: ESTATE MON BIJOU, ST. CROIX, V.I.
2. LOCATION (Coordinates or Station): X = 1,074,050 Y= 74,665
3. DRILLING AGENCY: GEO CIM, INC.
4. HOLE NO. (As shown on drawing title and file number): CB-VIM-9
5. NAME OF DRILLER: FLOR RIVERA
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: GREATER THAN 20 ft.
8. DEPTH DRILLED INTO ROCK: none
9. TOTAL DEPTH OF HOLE: 20 ft.
10. SIZE AND TYPE OF BIT: SEE REMARKS
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: CME 45B
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 13 | UNDISTURBED -
14. TOTAL NUMBER CORE BOXES: 1-plastic jar storage
15. ELEVATION GROUND WATER: 131.21 ft.
16. DATE HOLE: STARTED 10-25-83 | COMPLETED 10-25-83
17. ELEVATION TOP OF HOLE: 134.21 ft.
18. TOTAL CORE RECOVERY FOR BORING: 79 %
19. SIGNATURE OF INSPECTOR: GUILLERMO ABUDO

ELEVATION ft. a	DEPTH ft. b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	BLOWS	N	W	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
134.21	0			8" / 44%	1	4, 5, 9	14	44	
	1		Silt, some clay, rock fragments, little fine sand, compact dark grayish brown. (GC)*	11" / 61%	2	8, 10, 12	22		
	2			6" / 33.33%	3	7, 5, 6	11		
	3								
	4								
	4.5								
	5		Silty clay, stiff, little very fine sand, few rock fragments. (CL)	12" / 67%	4	5, 7, 8	15	34.1	
	6			11" / 61%	5	9, 11, 13	24		
	7								
	7.5								
	8		Silt, some clay, little fine sand, very stiff, light olive gray and brownish yellow to pale yellow. (CH)*	17" / 94%	6	6, 7, 9	16		
	9			18" / 100%	7	6, 8, 12	20	34.8	
	10			17" / 94%	8	9, 11, 13	24		
	11								
	12			16" / 89%	9	5, 8, 10	18		
	13		*Unified Soils Classification symbol and legend reflect lab test data results.						
	14			18" / 100%	10	7, 9, 8	17		
	15			14" / 78%	11	7, 9, 9	18		
	16								
	17			18" / 100%	12	9, 13, 16	29		
	18								
	19			24" / 100%	13	10, 12, 17, 22	29	50.6	
114.21	20								

N- value from standard penetration test.
140#hammer, 30" drop on 2 ft. long
1-3/8"IDx2"OD split spoon sampler.
W- natural moisture content in %

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. (TRANSLUCENT)

PROJECT: ESTATE MON BIJOU ST. CROIX, U. S. V.I. | HOLE NO. CB-VIM-9

PLATE B-17

Hole No. CB-VIM-10

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION JACKSONVILLE	SHEET 1 OF 2 SHEETS
1. PROJECT ESTATE MON BIJOU, ST. CROIX, U.S.V.I.		10. SIZE AND TYPE OF BIT SEE REMARKS	
2. LOCATION (Coordinates or Station) X= 1,074,590 Y= 74,965		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
3. DRILLING AGENCY GEO CIM, INC.		12. MANUFACTURER'S DESIGNATION OF DRILL CME 45B(Hollow Stem Auger Drilling)	
4. HOLE NO. (As shown on drawing title and file number) CB-VIM-10		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 23	UNDISTURBED
5. NAME OF DRILLER FLOR RIVERA		14. TOTAL NUMBER CORE BOXES 1-plastic jar storage	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER remarks sheet 2/2	
7. THICKNESS OF OVERBURDEN greater than 35 ft.		16. DATE HOLE STARTED 10-25-83	COMPLETED 10-25-83
8. DEPTH DRILLED INTO ROCK none		17. ELEVATION TOP OF HOLE 133.32 ft.	
9. TOTAL DEPTH OF HOLE 35 ft.		18. TOTAL CORE RECOVERY FOR BORING 82 %	
		19. SIGNATURE OF INSPECTOR GUILLERMO ABUDO	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	BLOWS	N	W% g	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
133.32	0								
	1		Silt, some clay, little fine sand, hard, trace rock fragments, dark grayish brown, white silty concretions. (ML)	7.5" / 42%	1	6, 8, 10	18	13.1	N-value from standard penetration test 140#hammer, 30"drop on 2 ft. long 1-3/8"ID x 2"OD, split spoon sampler. W-natural water content in %
	2			11" / 61%	2	7, 8, 9	17		
130.32	3								
	4		Silty clay, trace fine sand, hard, rock fragments, dark brown to olive brown to yellowish brown. (CH) *	10" / 56%	3	5, 7, 12	19		
	5			9" / 50%	4	8, 12, 16	28	14.3	
	6			12.5 / 69%	5	10, 12, 14	26		
	7		*Unified Soils Classification symbol and legend reflect lab test data results.	18" / 100%	6	7, 11, 14	25		
	8			0" / 0%	7	35, 13, 15	28		
	9								
	10			10" / 56%	8	11, 12, 15	27	20.4	
	11								
121.32	12								
	13		Silt, little clay, little very fine sand, hard, white and brownish yellow stains. (ML)	18" / 100%	9	11, 20, 25	45		
119.82	13.5								
	14			18" / 100%	10	19, 24, 27	51		
	15		Silty clay, trace fine sand, hard, mixed white silty concretions, light yellowish brown, few rock fragments. (CH)	18" / 100%	11	13, 20, 27	47	23.5	
	16								
	16.5			15" / 83%	12	20, 23, 28	51		
	17								
	18			18" / 100%	13	14, 18, 20	38		
	19								
	19.5								
113.32	20				14	14			

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. (TRANSLUCENT)

PROJECT ESTATE MON BIJOU ST. CROIX, U.S.V.I. HOLE NO. CB-VIM-10

PLATE B-18

DRILLING LOG (Cont Sheet) ELEVATION TOP OF HOLE 133.32 ft. **Hole No.** CB-VIM-10

PROJECT ESTATE MON BIJOU, ST. CROIX,V.I. INSTALLATION JACKSONVILLE SHEET 2 OF 2 SHEETS

ELEVATION ft. a	DEPTH ftb	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV-ERY e	BOX OR SAMPLE NO. f	Blows	N	W g	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
113.32	21		Rock fragments,some silty fine sand,pale brown,little white silty concretions.(GM)	18" 100%	14	24 29	53	29.4	
	22		Silty clay,trace fine sand, hard, light yellowish brown to pale yellow. (CH) *	15" 83%	15	22 26 30	56		
	22.5 23			18" 100%	16	23 27 35	62		
	24 25		*Unified Soils Classification symbol and legend reflect lab test data results.	18" 100%	17	12 18 18	36	21.5	
	25.5 26			16" 89%	18	18 22 30	52		
106.32	27 28		Clayey silt,some fine sand, rock fragments, stiff, yellowish brown (ML)	18" 100%	19	14 23 65	88		
	28.5 29		Silty clay,some fine sand, hard, light yellowish brown. (CL)	18" 100%	20	23 33 69	102		
103.32	30 31		Silty clay, some rock fragments,little fine sand,stiff to medium,yellowish brown. (CL)	16" 89%	21	17 24 43	67	16.5	Ground water first noticed.
	31.5 32 33		Silt,some clay,little fine sand,rock fragments,compact friable,light yellowish brown. (ML)	18" 100%	22	28 35 47	82		
	34		Silty clay, trace fine sand, hard, light yellowish brown. (CL)	24" 100%	23	10 12 19 23	31	40	
98.32	35		NOTE: Groundwater noticed initially at 30 feet depth. The hole collapsed, however, and a final water level could not be taken after 24 hours.						

ENG FORM 1836-A JUN 67 GPO: 1969 OF—329-243

PROJECT ESTATE MON BIJOU ST. CROIX,U.S.V.I. HOLE NO CB-VIM-10

PLATE B-19

Hole No. CB-VIM-11

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION JACKSONVILLE	SHEET 1 OF 2 SHEETS

1. PROJECT: ESTATE MON BIJOU, ST. CROIX, V.I.
2. LOCATION (Coordinates or Station): X = 1,074,640 Y = 74,780
3. DRILLING AGENCY: GEO CIM, INC.
4. HOLE NO. (As shown on drawing title and file number): CB-VIM-11
5. NAME OF DRILLER: FLOR RIVERA
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: greater than 35 ft.
8. DEPTH DRILLED INTO ROCK: NONE
9. TOTAL DEPTH OF HOLE: 35 ft.
10. SIZE AND TYPE OF BIT: See remarks.
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: CME 45B
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 23; UNDISTURBED -
14. TOTAL NUMBER CORE BOXES: 1-plastic jar storage
15. ELEVATION GROUND WATER: 117.85
16. DATE HOLE: STARTED 10-26-83; COMPLETED 10-26-83
17. ELEVATION TOP OF HOLE: 136.22 ft.
18. TOTAL CORE RECOVERY FOR BORING: 65%
19. SIGNATURE OF INSPECTOR: GUILLERMO ABUDO

ELEVATION ft. a	DEPTH ft. b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)	N	W %
136.22	1		Silt and clay, some fine sand very stiff, dark grayish brown. (MH)	5" / 28%	1	4 5 5	10	13.8
134.72	1.5							
	2		Silty clay, trace fine sand, hard, few rock fragments, yellowish brown, white silty concretions. (MH)*	7.5" / 42%	2	5 5 7	12	
	3			10" / 56%	3	5 5 7	12	
	4			12" / 67%	4	6 6 7	13	16.4
	5			10" / 56%	5	7 9 11	20	
	6			9" / 50%	6	5 9 8	17	
	7			9" / 50%	7	5 8 11	19	16.1
	8			15.5" / 86%	8	12 11 11	22	
	9			13" / 72%	9	7 8 15	23	
	10			5" / 33%	10	12 18 11	29	14.9
	11			1" / 6%	11	6 9 11	20	
	12			0" / 0%	12	9 11 13	24	
	13			15" / 83%	13	5 8 13	21	
	14				14	5		
118.22	18		Silty clay, little fine sand some rock fragments, little roots, olive gray. (CL)					
116.22	20							

*Unified Soils Classification symbol and legend reflect lab test data results.

N-value from standard penetration test
140# hammer, 30" drop on 2 ft. long
1-3/8" ID x 2" OD, split spoon sampler
W-natural water content in %

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. (TRANSLUCENT)

PROJECT ESTATE MON BIJOU ST. CROIX, U. S. V.I. HOLE NO. CB-VIM-11

PLATE B-20

DRILLING LOG (Cont Sheet) | ELEVATION TOP OF HOLE | **Hole No.** CB-VIM-11

PROJECT: ESTATE MON BIJOU, ST. CROIX,U.S.V.I. | INSTALLATION: JACKSONVILLE | SHEET 2 OF 2 SHEETS

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	Blows	N	WR	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
116.22				0	14	8	17	24	
				0		9			
115.22	21								
	22		Silty clay, rock fragments, very stiff, white silty concretions, dark gray to olive brown, pieces of wood on sample 17. (CL) *	9" / 50%	15	8 10 10	20		
	23			18" / 100%	16	3 6 9	15		
	24		*Unified Soils Classification symbol and legend reflect lab test data results.	18" / 100%	17	5 7 9		23.4	
	25								
	25.5								
	26		Silty clay,little fine sand, very stiff,little rock fragments,white silty concretions, dark gray. (CL)	18" / 100%	18	7 9 9	18	26.4	
109.22	27								
	28		Silt, some clay,little fine sand, medium,yellowish brown, and gray,little white silty pockets. (ML)	17" / 94%	19	2 5 6	11	24.1	
	29			18" / 100%	20	3 6 8	14	33.8	
	30								
	31			18" / 100%	21	6 7 9	16		
	32			18" / 100%	22	6 8 8	16		
103.72	32.5								
	33		Silty fine sand,trace clay brownish yellow. (SC)						
102.72	33.5			24" / 100%	23	10 11 12 12	23	39.4	
	34		Clayey silt,little fine sand, stiff, pale yellow. (ML)						
101.22	35								
			End of boring 35'-0"						

ENG FORM 1836-A JUN 67 | GPO: 1969 O—329-245

PROJECT: ESTATE MON BIJOU ST. CROIX,U.S.V.I. | HOLE NO. CB-VIM-11

PLATE B-21

Hole No. CB-VIM-12

DRILLING LOG | DIVISION: SOUTH ATLANTIC | INSTALLATION: JACKSONVILLE | SHEET 1 OF 2 SHEETS

1. PROJECT: ESTATE MON BIJOU, ST. CROIX, V.I.
2. LOCATION (Coordinates or Station): X = 1,074,670 Y = 74,678
3. DRILLING AGENCY: GEO CIM, INC.
4. HOLE NO. (As shown on drawing title and file number): CB VIM-12
5. NAME OF DRILLER: FLOR RIVERA
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: greater than 35 ft.
8. DEPTH DRILLED INTO ROCK: no rock drilled
9. TOTAL DEPTH OF HOLE: 35 ft.
10. SIZE AND TYPE OF BIT: split spoon sampler (2ft.)
11. DATUM FOR ELEVATION SHOWN (USGS or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: CME 45B
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 23 | UNDISTURBED -
14. TOTAL NUMBER CORE BOXES: 1-for plastic jars
15. ELEVATION GROUND WATER: not encountered
16. DATE HOLE: STARTED 10-26-83 | COMPLETED 11-09-83
17. ELEVATION TOP OF HOLE: 137.99
18. TOTAL CORE RECOVERY FOR BORING: 78%
19. SIGNATURE OF INSPECTOR: GUILLERMO ABUDO

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	Blows	N	W g
137.99								
	1		Clayey silt, little sand, stiff, weathered rock fragments, white to olive brown. (ML)	7" / 39%	1	3 3 5	8	18.8
	2			11.5" / 64%	2	4 6 8	14	18.2
	3			12" / 67%	3	7 9 9	18	10.9
	4							
	4.5							
	5		Silty clay, some sand, soft to very stiff, weathered rock fragments, white. (CL)	16" / 89%	4	8 10 10	20	17.9
	6							
	7			12" / 67%	5	10 13 17	30	19.2
	8			14" / 78%	6	8 12 16	28	21.3
128.99	9							
	10		Silty clay, some sand, hard, weathered rock fragments, brown to olive brown. (SC)*	11" / 61%	7	9 13 18	31	13.6
	11			13" / 72%	8	20 35 48	83	10.2
	12			16" / 89%	9	33 48 64	112	9.8
	13							
	14		*Unified Soils Classification symbol and legend reflect lab test data results.	13" / 72%	10	22 40 45	85	10.3
	15							
	16			16" / 89%	11	15 35 40	75	20.6
	17							
	18			12" / 67%	12	38 45 90	135	16.7
	19			17" / 94%	13	17 23 37	60	19.4
	19.5							
117.99	20				14	27		

N-value from standard penetration test
140# hammer dropping 30 inches on 2 ft. long
1-3/8" ID x 2" OD split spoon sampler
W-natural water content in %.

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. (TRANSLUCENT)

PROJECT: ESTATE MON BIJOU ST. CROIX, U.S.V.I. | HOLE NO. CB-VIM-12

PLATE B-22

DRILLING LOG (Cont Sheet) ELEVATION TOP OF HOLE 137.99 **Hole No.** CB-VIM-12

PROJECT ESTATE MON BIJOU | INSTALLATION JACKSONVILLE | SHEET 2 OF 2 SHEETS

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	Blows	N	gW	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
117.99									
	21		Silty clay, some sand, hard, weathered rock fragments, brown to olive brown. (SC)*	16" / 89%	14	70 / 42	112	11.7	
	22			16" / 89%	15	65 / 80 / 166	246	20	*
	23			18" / 100%	16	30 / 46 / 46	92	13	
	24			12" / 67%	17	18 / 37 / 64/3"	64/3"	17	
	25								
	26			18" / 100%	18	20 / 20 / 66	86	13	
	27			14" / 78%	19	17 / 17 / 17	34	25	
	28								
	29		*Unified Soils Classification symbol and legend reflect lab test data results.	18" / 100%	20	7 / 28 / 47	75	30	
	30								
	31			10" / 56%	21	50 / 50/6"	50/6"	10	
	32			12" / 67%	22	Auger / 48 / 42 / 45	87	11	
	33			24" / 100%	23	44 / 43 / 50 / 69	93	18	
102.99	34								
	35								

Second borehole 5 feet away towards CB-VIM-11 Between 11-08-83 and 11-09-83

This boring was drilled originally to 22.5 feet depth between 10-26-83 to 10-28-83, and stopped due to hard clay encountered. Because it was definitely not rock, the boring was relocated 5 feet along axis toward boring CB-VIM-11 and redrilled with augers to 21 feet depth. Sampling was then resumed to the required 35 feet depth. This second boring was drilled between 11-08-83 and 11-09-83.

ENG FORM 1836-A JUN 67 GPO: 1969 OF—329-243

PROJECT ESTATE MON BIJOU ST. CROIX, U.S.V.I. HOLE NO CB-VIM-12

PLATE B-23

Hole No. CB-VIM-13

DRILLING LOG | DIVISION: SOUTH ATLANTIC | INSTALLATION: JACKSONVILLE | SHEET 1 of 2 SHEETS

1. PROJECT: ESTATE MON BIJOU, ST. CROIX, V.I.
2. LOCATION (Coordinates or Station): X = 1,075,115 Y= 74,680
3. DRILLING AGENCY: GEO CIM, INC.
4. HOLE NO. (As shown on drawing title and file number): CB-VIM-13
5. NAME OF DRILLER: FLOR RIVERA
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: greater than 25 ft.
8. DEPTH DRILLED INTO ROCK: NONE
9. TOTAL DEPTH OF HOLE: 25 ft.
10. SIZE AND TYPE OF BIT: SEE REMARKS
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: CME 45B
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 17 | UNDISTURBED
14. TOTAL NUMBER CORE BOXES: 1-storage plastic jar
15. ELEVATION GROUND WATER: 99.12 ft.
16. DATE HOLE: STARTED 10-26-83 | COMPLETED 10-27-83
17. ELEVATION TOP OF HOLE: 106.50 ft.
18. TOTAL CORE RECOVERY FOR BORING: 83%
19. SIGNATURE OF INSPECTOR: GUILLERMO ABUDO

ELEVATION ft. a	DEPTH ft. b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	Blows	N	W g
106.50	1		Silt, some clay, little fine sand, hard, few rock fragments, dark brown. (ML)	10"	1	5 10 12	22	9.4
	1.5							
	2		Silty clay, trace fine sand, hard, yellowish brown, trace rock fragments. (CL)	7"	2	4 4 6	10	18.6
	3			10"	3	5 8 19	27	9.6
102.00	4.5							
	5		Silt, little clay, little fine sand, very stiff, mixed rock fragments, light olive brown. (CL)*	15"	4	17 16 18	34	8.3
	6			15",	5	14 14 15	29	10.6
	7			11"	6	12 13 16	29	9.0
	7.5							
97.50	8							
	9		Silty clay, little fine sand, hard light olive brown, mixed olive gray, and pale yellow, trace rock fragments. (CL)	15"	7	7 9 11	20	19.8
	10			14"	8	13 25 24	49	
	10.5							
	11							
	12			18" 100%	9	3 7 7	14	
	13							
93.00	13.5							
	14		Silty clay, trace fine sand, very stiff, light olive brown, trace rock fragments. (CH)*	18" 100%	10	11 11 10	21	
	15							
	16		*Unified Soils Classification symbol and legend reflect lab test data results.	18" 100%	11	10 12 13	25	39.1
	16.5							
	17			18" 100%	12	12 15 14	29	
	18							
	19			18" 100%	13	7 12 11	23	
	19.5							
86.50	20					6		

REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)

N-value from standard penetration test
140# hammer, 30" drop on 2 ft. long
1-3/8" ID x 2" OD, split spoon sampler.
W-natural water content in %

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. (TRANSLUCENT)

PROJECT: ESTATE MON BIJOU ST. CROIX, U. S. V.I. | HOLE NO. CB-VIM-13

PLATE B-24

DRILLING LOG (Cont Sheet) ELEVATION TOP OF HOLE 106.00 **Hole No.** CB-VIM-13

PROJECT ESTATE MON BIJOU | INSTALLATION JACKSONVILLE | SHEET 2 OF 2 SHEETS

ELEVATION ft. a	DEPTH ft. b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV-ERY e	BOX OR SAMPLE NO. f	Blows	N	g W	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
86.50			Silty clay, trace fine sand, very stiff, trace rock fragments, olive brown to yellowish brown. (CH)	18" / 100%	14	9, 10	19	37.1	
	21			18" / 100%	15	18, 14, 25	39		
	22								
	23			18" / 100%	16	15, 13, 17	30		
	24			9"	17	16, 13	29	42.9	
81.50	25								

ENG FORM 1836-A JUN 67 GPO. 1969 O-328-343 PROJECT HOLE NO. CB-VIM-13

PLATE B-25

Hole No. CB-VIM-14

DRILLING LOG | DIVISION: SOUTH ATLANTIC | INSTALLATION: JACKSONVILLE | SHEET 1 OF 1 SHEETS

1. PROJECT: ESTATE MON BIJOU
2. LOCATION (Coordinates or Stations): X= 1,075,774 Y = 74,514
3. DRILLING AGENCY: GEO CIM, INC.
4. HOLE NO. (As shown on drawing title and file number): CB-VIM-14
5. NAME OF DRILLER: FLOR RIVERA
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: greater than 20 ft.
8. DEPTH DRILLED INTO ROCK: none
9. TOTAL DEPTH OF HOLE: 20 ft.
10. SIZE AND TYPE OF BIT: SEE REMARKS
11. DATUM FOR ELEVATION SHOWN (MSL or MLW): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: CME 45B (Hollow stem auger drilling)
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: DISTURBED 13 | UNDISTURBED
14. TOTAL NUMBER CORE BOXES: 1-plastic jars storag
15. ELEVATION GROUND WATER: 83.27 ft.
16. DATE HOLE: STARTED 10-31-83 | COMPLETED 11-9-83
17. ELEVATION TOP OF HOLE: 91.96 ft.
18. TOTAL CORE RECOVERY FOR BORING: 55%
19. SIGNATURE OF INSPECTOR: Guillermo Abudo

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	Blows	N	W g	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
91.96 ft.	1		Silt, little clay, trace fine sand, hard, dark brown, white silty concretions. (ML)	9" / 50%	1	4, 5, 5	10	17.8	
	2			9.5" / 53%	2	6, 6, 6	12	21.0	
88.96	3								
	4		Silty clay lumps, very stiff fine sand, weathered rock fragments, olive gray. (Boulders noted in difficult drilling). (SC)*	10" / 55%	3	4, 10, 21	31	22.9	
	4.5								
	5			4" / 22%	4	25, 52, 23	75	14.2	
	6								
	7			15" /	5	42, 21, 22	43	15.3	
	7.5								
	8			2" / 11%	6	17, 30, 21	51	9.7	
	9								
	10			16" / 89%	7	31, 34, 19	53	14.6	
81.46	10.5								
	11		Clayey sand, some silt, mixed weathered rock fragments very stiff, light olive brown and yellowish brown. (SC) *	14" / 78%	8	20, 22, 25	47	24.9	
	12								
	13			18" / 100%	9	9, 26, 30	56	17.4	
	13.5								
	14			6" / 33%	10	83, 83/6"		16.3	
	15		*Unified Soils Classification symbol and legend reflect lab test data results						
	16			3" / 16.7%	11	50/3", 50/3"		21	
	17			12" / 67%	12	45, 50, 32	82	31	
	18								
	19			14" / 58%	13	21, 31, 20, 28	51	16	
71.96	20								

N-value from standard penetration test;
140# hammer falling 30" on 2 ft. long, 1-3/8"IDx 2"OD split spoon sampler.
W= natural water content in %

Boring CB-VIM-14 drilled initially to this depth on 10-31-83.

On 11-9-83 new boring drilled next to this to complete sampling to 20 feet depth. Approx. X=1075774 Y=74514

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. (TRANSLUCENT)

PROJECT: ESTATE MON BIJOU ST. CROIX, U.S.V.I. | HOLE NO.: CB-VIM-14

PLATE B-26

Hole No. CB-VIM-15

DRILLING LOG	DIVISION: SOUTH ATLANTIC	INSTALLATION: JACKSONVILLE	SHEET 1 OF 1 SHEETS

1. PROJECT: ESTATE MON BIJOU
2. LOCATION (Coordinates or Station): X = 1,076,142 Y = 74,354
3. DRILLING AGENCY: GEO CIM, INC.
4. HOLE NO. (As shown on drawing title and file number): CB-VIM 15
5. NAME OF DRILLER: FLOR RIVERA
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: GREATER THAN 20 FT.
8. DEPTH DRILLED INTO ROCK: none
9. TOTAL DEPTH OF HOLE: 20 ft.
10. SIZE AND TYPE OF BIT: see remarks
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: CME 45B (Hollow stem auger drilling)
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 13; UNDISTURBED
14. TOTAL NUMBER CORE BOXES: 1-plastic jar storage
15. ELEVATION GROUND WATER: no water
16. DATE HOLE: STARTED 11-02-83; COMPLETED 11-02-83
17. ELEVATION TOP OF HOLE: 84.14 ft.
18. TOTAL CORE RECOVERY FOR BORING: 69%
19. SIGNATURE OF INSPECTOR: GUILLERMO ABUDO

ELEVATION ft. a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	Blows	N	W g	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
84.14	0		Sandy clayey silt, compact, some rock fragments, dark grayish brown. (ML)	12" / 67%	1	3, 4, 6	10	11.4	N-value from standard penetration test: 140#hammer, 30" drop on 2 ft. long. 1-3/8"IDx2"Od, split spoon sampler. W- Natural water content in %
	1								
	2			0" / 0%	2	12, 18, 10	28	10.2	
	3			9" / 50%	3	5, 6, 9	15	12.1	
79.64	4.5								
	5		Silty clay, trace fine sand, hard, rock fragments, olive small white silty concretions. (CL) to (GC)	9" / 50%	4	10, 10, 15	25	13.9	
	6			7.5% / 42%	5	21, 13, 16	29	7.7	
77.14	7								
	8		Clayey silt, some fine sand, hard, compact, little rock fragments, olive brown, varies to yellowish brown silty clay. (CL) *	15" / 83%	6	6, 12, 18	30	15.0	
	9			16" / 89%	7	9, 13, 14	27	14.2	
	10								
	10.5			16.5" / 92%	8	17, 20, 19	39	21.9	
	11								
	12			18" / 100%	9	14, 27, 23	50	13.9	
	13								
	14			18" / 100%	10	21, 33, 47	80	16.0	
69.64	14.5								
	15		Weathered rock fragments, hard silty clay lumps, light olive brown. (GC) *	12" / 67%	11	49, 64, 69	133	12.5	
	16								
	17		*Unified Soils Classification symbol and legend reflect lab test data results	9" / 50%	12	60, 32, 10	60	12.5	
66.14	18								
	19		Clayey silt, little fine sand, very stiff, trace rock fragments, pale yellow to white. (CL)	24" / 100%	13	6, 11, 22, 33	33	10.5	
64.14	20								

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. (TRANSLUCENT)

PROJECT: ESTATE MON BIJOU ST. CROIX, U. S. V. I. | HOLE NO. CB-VIM-15

PLATE B-27

Hole No. CB-VIM-16

DRILLING LOG | DIVISION: SOUTH ATLANTIC | INSTALLATION: JACKSONVILLE | SHEET 1 OF 1 SHEETS

1. PROJECT: ESTATE MON BIJOU, ST. CROIX, V.I.
2. LOCATION (Coordinates or Station): X = 1,076,627 Y = 74,081
3. DRILLING AGENCY: GEO CIM, INC.
4. HOLE NO. (As shown on drawing title and file number): CB-VIM-16
5. NAME OF DRILLER: FLOR RIVERA
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: greater than 20 feet.
8. DEPTH DRILLED INTO ROCK: none
9. TOTAL DEPTH OF HOLE: 20 ft.
10. SIZE AND TYPE OF BIT: SEE REMARKS
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: CME 45B
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 13 | UNDISTURBED
14. TOTAL NUMBER CORE BOXES: 1-plastic jar storage
15. ELEVATION GROUND WATER: no water
16. DATE HOLE: STARTED 11-01-83 | COMPLETED 11-01-83
17. ELEVATION TOP OF HOLE: 79.67 ft.
18. TOTAL CORE RECOVERY FOR BORING: 85%
19. SIGNATURE OF INSPECTOR: GUILLERMO ABUDO

ELEVATION FT. a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) Blows	N	% W
79.67	1		Silty fine sand, trace clay, weathered rock fragments, grayish brown. (SM)	12" / 67%	1	10, 25, 10	35	9.2
78.17	2		Fine sandy clayey silt, compact, few rock fragments, yellowish brown. (SC) *	15" / 83%	2	10, 12, 18	30	13.3
	3			14" / 78%	3	12, 10, 9	19	4.5
	4			15" / 83%	4	7, 9, 7	16	8.3
	5			13" / 72%	5	8, 9, 10	19	17.3
	6			14" / 78%	6	14, 29, 16	45	7.6
70.17	9.5			15" / 83%	7	7, 23, 32	55	15.7
	10		Silt, some clay, to silty clay, little fine sand, hard, trace weathered rock fragments, strong brown to dark brown. (CL) *	16" / 89%	8	26, 14, 14	28	21.1
	11			18" / 100%	9	9, 16, 20	36	16.7
	12			17" / 94%	10	10, 17, 18	35	17.6
	13			16" / 89%	11	11, 27, 24	51	23.9
	14			14" / 78%	12	19, 23, 25	48	18.6
	15			24" / 100%	13	13, 17, 23, 28	40	20.7
	16							
	17							
	18							
59.67	19							
	20							

*Unified Soils Classification symbol and legend reflect lab test data results.

N-N-value from standard penetration test: 140#hammer, 30"drop, on 2 ft. long 1-3/8" ID x 2" OD, split spoon sampler
W- Natural water content in %

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. (TRANSLUCENT)

PROJECT: ESTATE MON BIJOU ST. CROIX, U.S.V.I. | HOLE NO. CB-VIM-16

PLATE B-28

Hole No. CB-VIM-17

DRILLING LOG | DIVISION: SOUTH ATLANTIC | INSTALLATION: JACKSONVILLE | SHEET 1 OF 1 SHEETS

1. PROJECT: ESTATE MON BIJOU, ST. CROIX, V.I.
2. LOCATION (Coordinates or Bearing): X= 1,076,855 Y = 73,760
3. DRILLING AGENCY: GEO CIM, INC.
4. HOLE NO. (As shown on drawing title and file number): CB-VIM-17
5. NAME OF DRILLER: FLOR RIVERA
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: greater than 20 ft.
8. DEPTH DRILLED INTO ROCK: not drilled
9. TOTAL DEPTH OF HOLE: 20 ft.
10. SIZE AND TYPE OF BIT: SEE REMARKS
11. DATUM FOR ELEVATION SHOWN (MSL or MLL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: CME 45-B (Hollow stem auger drilling)
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 13; UNDISTURBED
14. TOTAL NUMBER CORE BOXES: 1-plastic jar storage
15. ELEVATION GROUND WATER: 57.22(11-2-83):dry11-9
16. DATE HOLE: STARTED 11-01-83; COMPLETED 11-01-83
17. ELEVATION TOP OF HOLE: 70.47 ft.
18. TOTAL CORE RECOVERY FOR BORING: 74 %
19. SIGNATURE OF INSPECTOR: GUILLERMO ABUDO

ELEVATION ft. a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	Blows	N	W g	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
70.47	1		Silt, some clay, rock fragments, trace fine sand, dark grayish brown. (ML)	7" / 39%	1	4, 6, 8	14	21.8	N- N-value from standard penetration test: 140# hammer, 30" drop, on 2 ft. long 1-3/8" ID x 2" OD, split spoon sampler. W- Natural water content in %
	2			0 / 0%	2	8, 10, 14	24	16.7	
67.47	3		Silty sandy clay, very stiff, rock fragments, olive brown. (SC) *	14" / 78%	3	5, 7, 11	18	14.7	
	4								
	5			13" / 72%	4	7, 12, 13	25	17.0	
64.47	6		Silty fine sand, little clay, rock fragments, olive brown, very stiff. (SM)	14" / 78%	5	27, 19, 16	35	12.9	
62.47	8		Fine sand, trace silt, yellowish brown. (SM)	18" / 100%	6	6, 11, 12	23	9.9	
61.47	9		Weathered rock fragments, some silty fine sand, yellowish brown. (GM) * *Unified Soils Classification symbol and legend reflect lab test data results.	18" / 100%	7	15, 29, 50	79	10.7	
	10								
	11			12" / 67%	8	43, 34, 29	63	9.0	
	12			9" / 50%	9	24, 60/3"	60/3"	11.6	
56.97	13.5		Silty clay, trace fine sand, very stiff, light olive brown & light gray. (CH)	18" / 100%	10	25, 36, 32	68	20.8	
55.47	15		Weathered rock fragments, in wet silty clay matrix, little fine sand, light olive gray. (GC)	13" / 72%	11	30, 28, 26	54	21.7	
53.97	16.5		Silt, some clay, trace fine sand, stiff, olive yellow & pale brown. (MH)	18" / 100%	12	14, 15, 15	30	29.3	
	18								
	19			24" / 100%	13	11, 13, 17, 21	30	19.0	
50.47	20								

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. (TRANSLUCENT)

PROJECT: ESTATE MON BIJOU, ST. CROIX, U. S. V. I. | HOLE NO. CB-VIM-17

PLATE B-29

Hole No. CB-VIM -18

DRILLING LOG	DIVISION SOUTH ATLANTIC	INSTALLATION JACKSONVILLE	SHEET 1 OF 1 SHEETS
1. PROJECT ESTATE MON BIJOU, ST. CROIX, V.I.		10. SIZE AND TYPE OF BIT SEE REMARKS	
2. LOCATION (Coordinates or Station)		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
3. DRILLING AGENCY GEO CIM, INC.		12. MANUFACTURER'S DESIGNATION OF DRILL CME-45B	
4. HOLE NO. (As shown on drawing title and file number) CB-VIM-18		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 13	UNDISTURBED
5. NAME OF DRILLER FLOR RIVERA		14. TOTAL NUMBER CORE BOXES 1-plastic jar storage	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER 56.73 ft.	
7. THICKNESS OF OVERBURDEN greater than 20 ft.		16. DATE HOLE STARTED 11-01-83	COMPLETED 11-01-83
8. DEPTH DRILLED INTO ROCK none		17. ELEVATION TOP OF HOLE 64.60 ft.	
9. TOTAL DEPTH OF HOLE 20 ft.		18. TOTAL CORE RECOVERY FOR BORING 65 %	
		19. SIGNATURE OF INSPECTOR GUILLERMO ABUDO	

ELEVATION ft. a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) Blows	N g	W
64.60	1		Fine sandy silt, trace clay, few rock fragments, very stiff, dark brown. (SM)	8" / 44%	1	6, 12, 12	24	14.3
	2			13" / 72%	2	10, 20, 24	44	15.8
61.60	3		Silty fine sand, little clay, varying mixed weathered rock fragments, light olive brown to olive brown. (SC)*	15" / 83%	3	12, 15, 16	31	11.9
	4			14" / 78%	4	13, 10, 8	18	13.8
	5			8" / 44%	5	14, 16, 26	42	11.7
	6			11" / 61%	6	17, 22, 25	47	9.0
	7			6" / 33%	7	13, 28, 19	47	9.7
	8			0 / 0%	8	29, 28, 33	61	4.8
	9			6" / 33%	9	20, 43, 19	62	11.5
51.1	13.5							
	14		Silty clay, trace fine sand, very stiff, light olive gray and yellowish brown to olive brown, white silt pockets. (CH) * *Unified Soils Classification symbol and legend reflect lab test data results.	16" / 89%	10	10, 12, 15	27	35.5
	15							
	16			18" / 100%	11	8, 11, 12	23	33.1
	17							
	18			18" / 100%	12	13, 16, 16	32	31.3
	19							
40.60	20			24" / 100%	13	9, 12, 16, 16	28	39.6

N- N-value from standard penetration test: 140# hammer, 30" drop, on 2 ft. long 1-3/8" ID x 2"OD, split spoon sampler.
W- Natural water content in %

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. (TRANSLUCENT)

PROJECT ESTATE MON BIJOU ST. CROIX, U. S. V.I. HOLE NO. CB-VIM-18

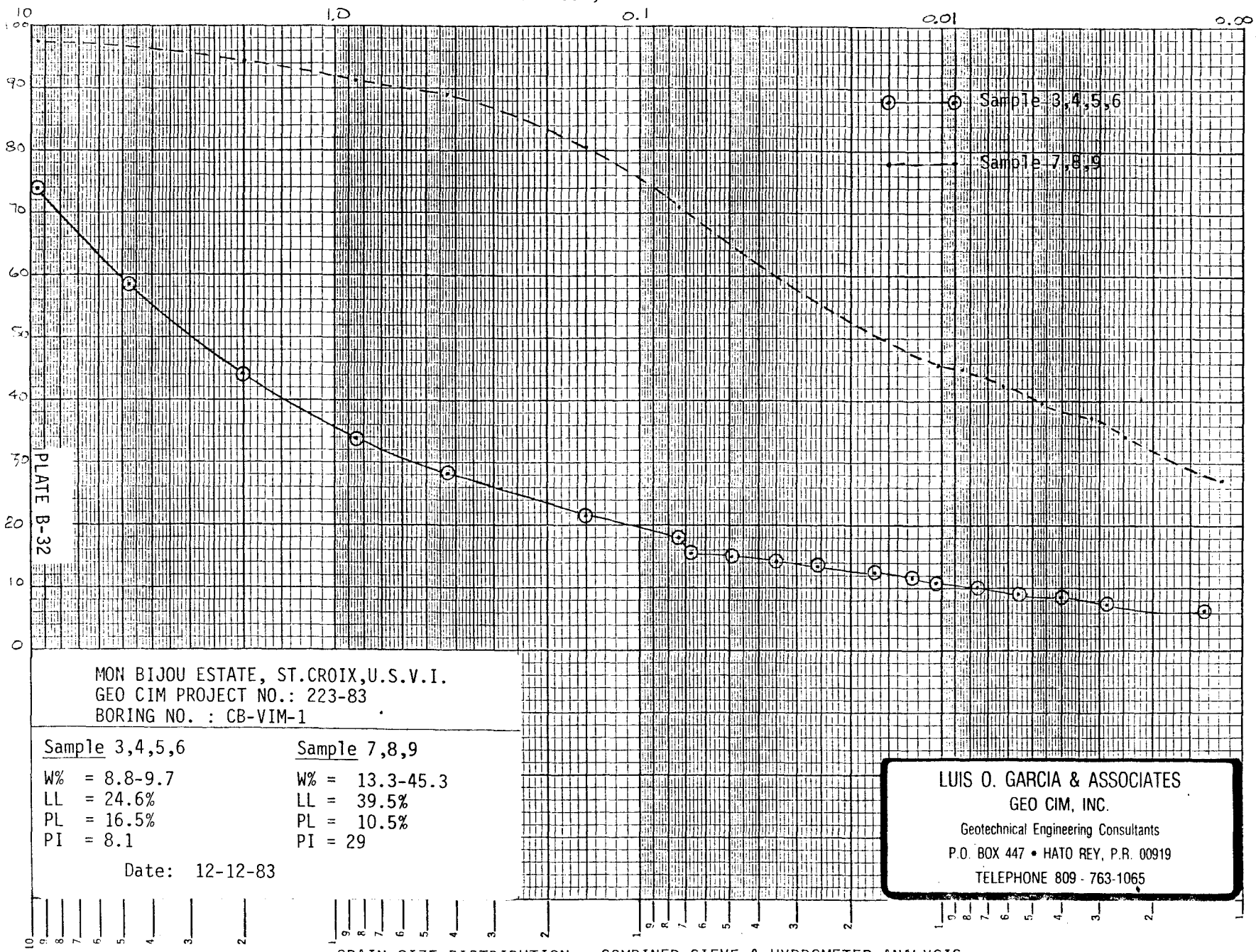
PLATE B-30

Description		Sieve & Hydrometer Analysis			Water Contents for each sample in %				Att Limits %		Plasticity Index	USC
		Tot. sample % of mat. ret. on No. 200										
Boring	Samples	Gravel % >No. 4	Sand No. 4 ≥ % > No. 200	Fine % ≤ No. 200	I	II	III	IV	W_P	W_L	PI	
3	2-3-4-5	38	62	33.9	9.5	9.1	10.7	10.8	10.8	25.5	14.7	SC
3	10-11-12	44.2	55.8	23.9	10.5	9.4	11.6	—	35.6	93.0	57.4	SC
4	11-12-13-14	54.8	45.2	36.7	20	12.2	19.2	12	6.9	38 ?	31.1	GC
5	5-6-7-9	14.7	85.3	64.6	19	17	19	15	13.5	56	42.5	CH
5	11-12-13	0	100	72.2	18.4	21.1	32	—	32.5	63	30.5	MH
6	2-3-4-5	29.5	70.5	38	7.7	23.2	8.4	39.4	13	36	23	SC
6	9-10-11	0	100	88	31.6	25	20.3	—	31.5	79	47.5	CH
7	3-4-5	0	100	81	32.3	23.4	20.5	—	40.5	90	49.5	MH
7	9-10-11-12	0	100	88.3	32.6	35	36.4	32.9	20.1	115	94.9	CH
8	6-7-8-9	0	100	97.2	22.7	28	32.4	35.2	30.3	122	91.7	CH
9	1-2-3	62.1	37.9	40.4	44	—	—	—	27.2	55	27.8	GC
9	8-9-10-11	0	100	90.1	—	—	4.6	—	32.5	111	78.5	CH
10	4-5-6	15.1	84.9	81.4	14.3	—	—	—	19.5	92	72.5	CH
10	15-16-17-18	0	100	81.7	—	—	21.5	—	25	143	118	CH
11	7-8	16.9	83.1	58	16.1	—	—	—	34.5	59.5	25	MH
11	15-16	5.8	94.2	56.7	—	—	—	—	23.15	44.5	21.3	CL
12	4-5	4.1	95.9	65.7	17.9	19.2	—	—	25	39.8	14.8	CL
12	10-11	5.6	94.4	42.5	10.3	20.6	—	—	23.35	69	467	SC
13	4-5	37.7	62.3	18.2	8.3	10.0	—	—	12.3	34.4	22.1	CL
13	12-13	8	92	82.5	—	—	—	—	24.8	87	62.2	CH
14	4-5-6	48.4	51.6	25.2	14.2	15.3	9.7	—	21	46.6	25.6	SC
14	9-10	41.4	58.6	33.6	17.4	16.3	—	—	21.75	40	18.3	SC
15	6-7-8	33	67	50.8	15	14.2	21.9	—	23.8	41.9	18.1	CL
15	11-12	63.4	36.6	21.9	12.5	12.5	—	—	25	52	27	GC
16	3-4-5	10.2	89.8	37	4.5	8.3	17.3	—	17	34.7	17.7	SC
16	10-11	2	98	65.5	17.6	23.9	—	—	21.1	38.8	17.7	CL
17	3-4	20	80	41.9	14.7	17	—	—	26.9	76	49.1	SC
17	8-9	58.9	41.1	14.2	9	11.6	—	—	27.5	45	17.5	GM
18	4-5-6	40.1	59.9	21.9	13.8	11.7	9	—	14.85	31	16.15	SC
18	11-12	6.1	93.9	57.6	33.1	31.3	—	—	23.5	54	30.5	CH
1	3-4-5-6	50.7	49.3	18.0	9.7	9.2	9.6	8.8	16.5	24.6	8.1	GC
2	2-3-4-5	59.8	40.2	18.4	6.3	4.2	14	6.6	12.3	26.6	14.3	GC
4	2-3-4-5	53.8	46.2	19.5	7.1	8.1	5.3	4.2	18	26.1	8.1	GC
4	10	Repeat of test with samples 11,12,13,14			19.1	—	—	—	23.1	55.5	32.4	GC

Proyecto Estate Mon Bijou (223-83)
Hoja Núm. 1 de
Calculado por L.E.L. Fecha 1-23-84
Laboratory Test Results

LUIS O. GARCIA & ASSOCIATES
GEO CIM. INC.
GEOTECHNICAL ENGINEERING CONSULTANTS
P. O. BOX 447 • HATO REY, P.R. 00919

PLATE B-31



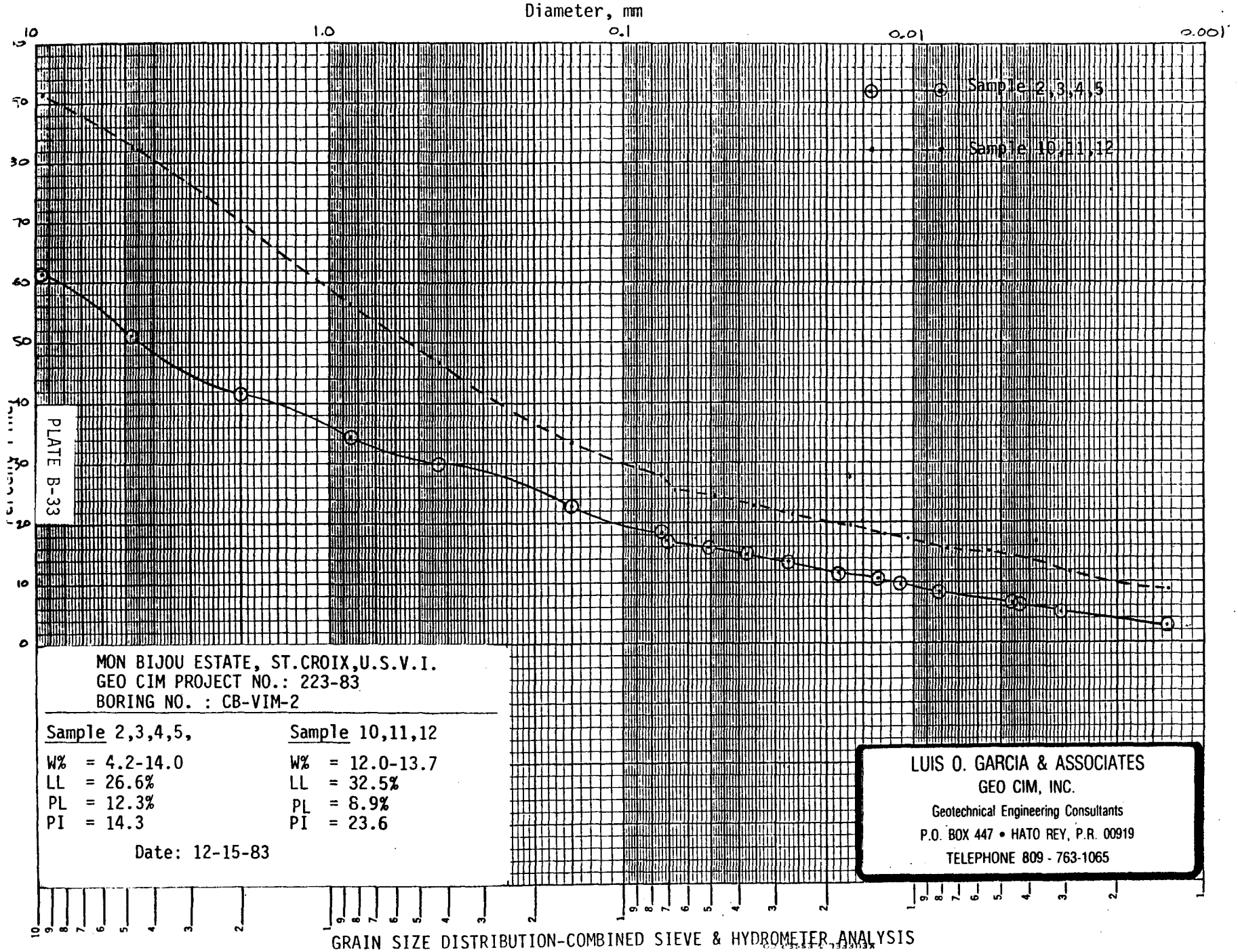
MON BIJOU ESTATE, ST.CROIX,U.S.V.I.
GEO CIM PROJECT NO.: 223-83
BORING NO. : CB-VIM-1

Sample 3,4,5,6	Sample 7,8,9
W% = 8.8-9.7	W% = 13.3-45.3
LL = 24.6%	LL = 39.5%
PL = 16.5%	PL = 10.5%
PI = 8.1	PI = 29

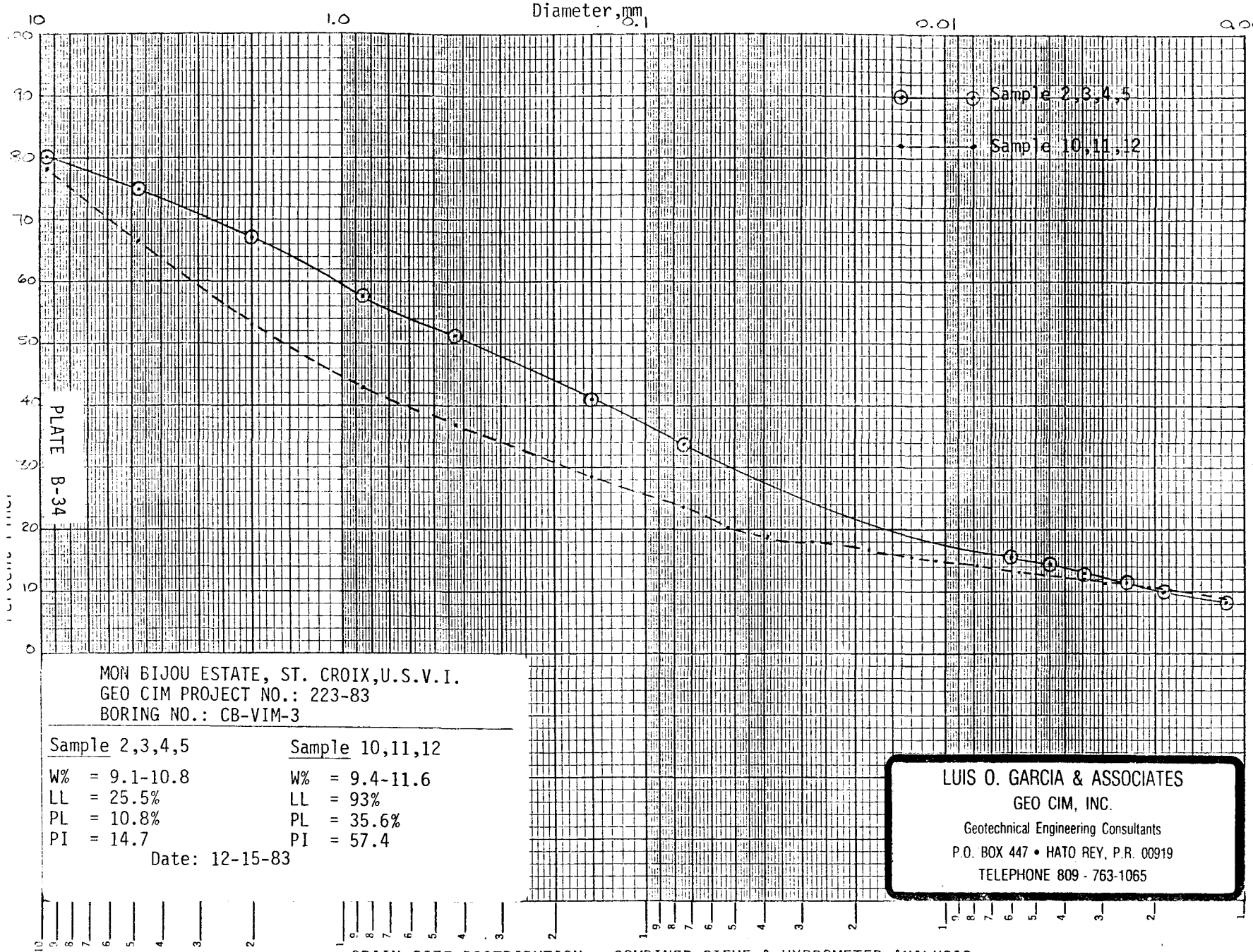
Date: 12-12-83

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GRAIN SIZE DISTRIBUTION - COMBINED SIEVE & HYDROMETER ANALYSIS



GRAIN SIZE DISTRIBUTION-COMBINED SIEVE & HYDROMETER ANALYSIS



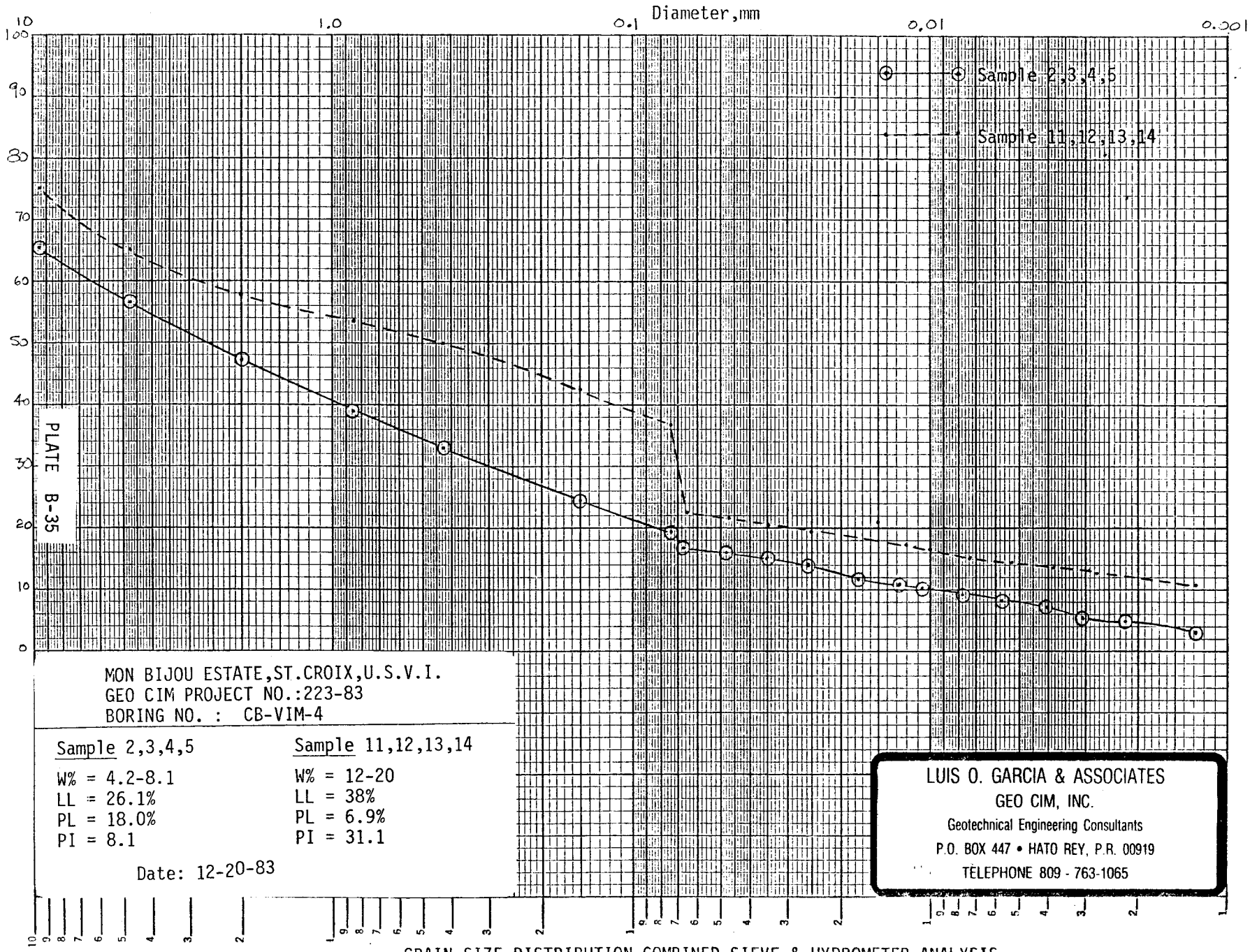
MON BIJOU ESTATE, ST. CROIX, U.S.V.I.
GEO CIM PROJECT NO.: 223-83
BORING NO.: CB-VIM-3

Sample 2,3,4,5	Sample 10,11,12
W% = 9.1-10.8	W% = 9.4-11.6
LL = 25.5%	LL = 93%
PL = 10.8%	PL = 35.6%
PI = 14.7	PI = 57.4

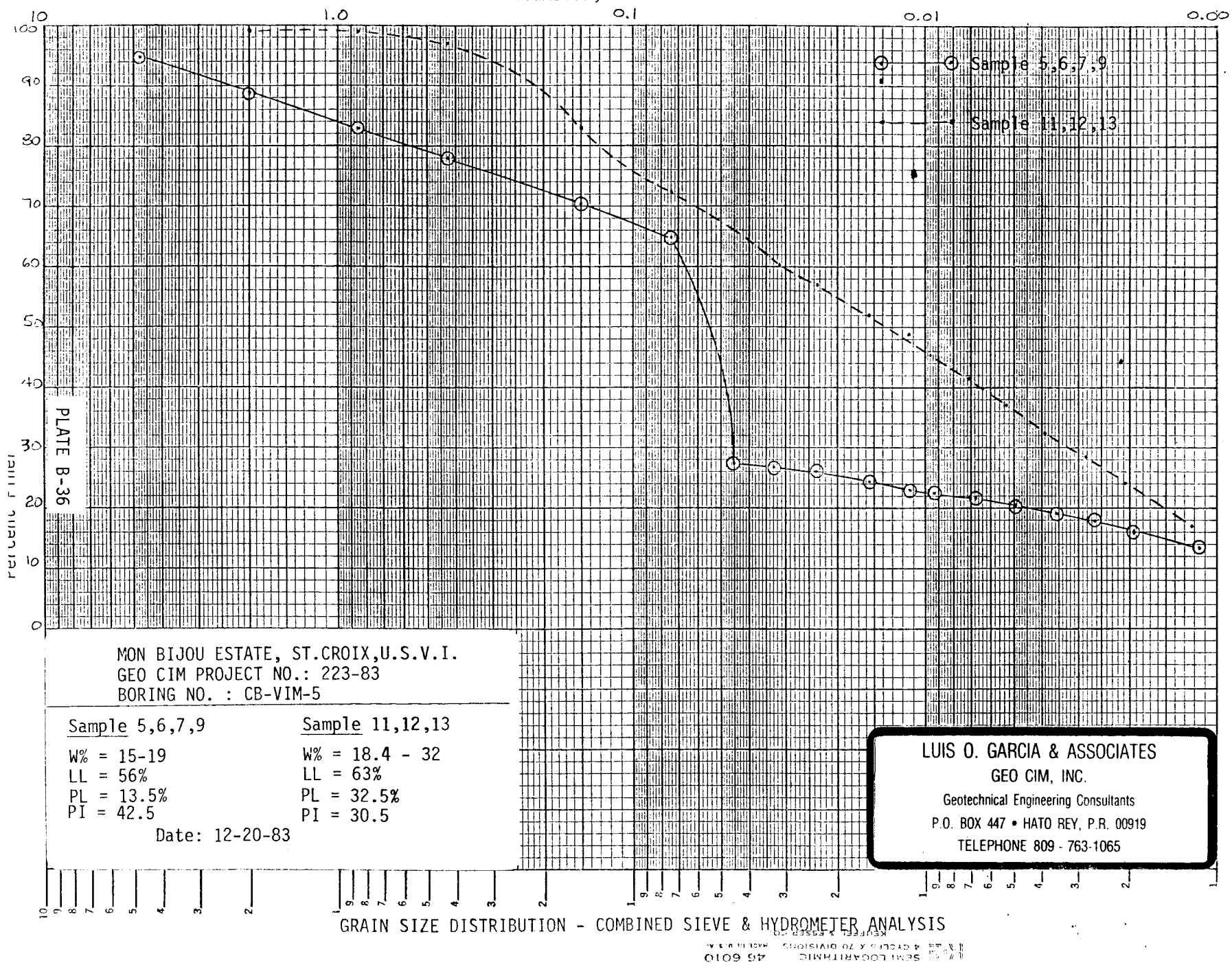
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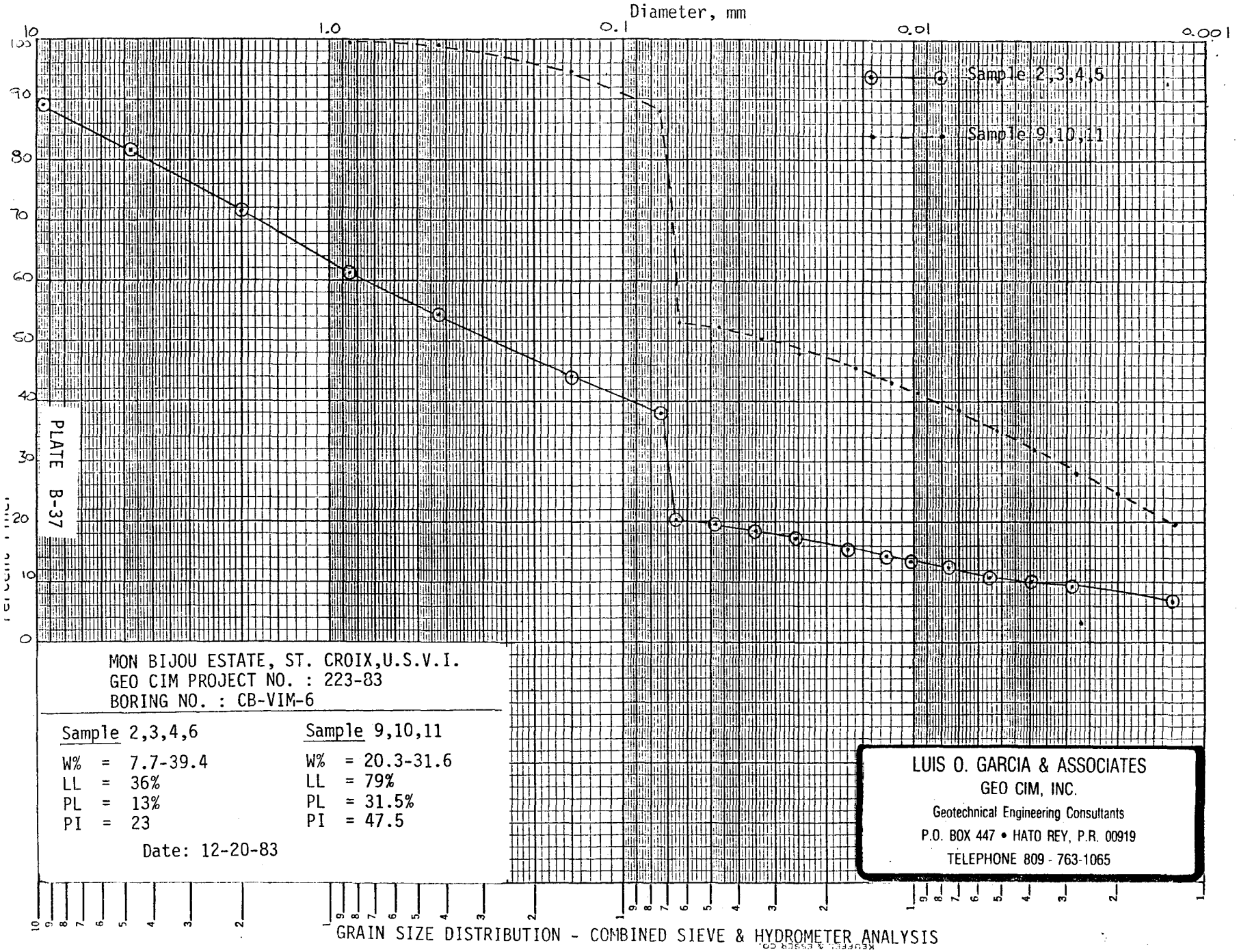
GRAIN SIZE DISTRIBUTION - COMBINED SIEVE & HYDROMETER ANALYSIS



GRAIN SIZE DISTRIBUTION-COMBINED SIEVE & HYDROMETER ANALYSIS



GRAIN SIZE DISTRIBUTION - COMBINED SIEVE & HYDROMETER ANALYSIS



GRAIN SIZE DISTRIBUTION - COMBINED SIEVE & HYDROMETER ANALYSIS

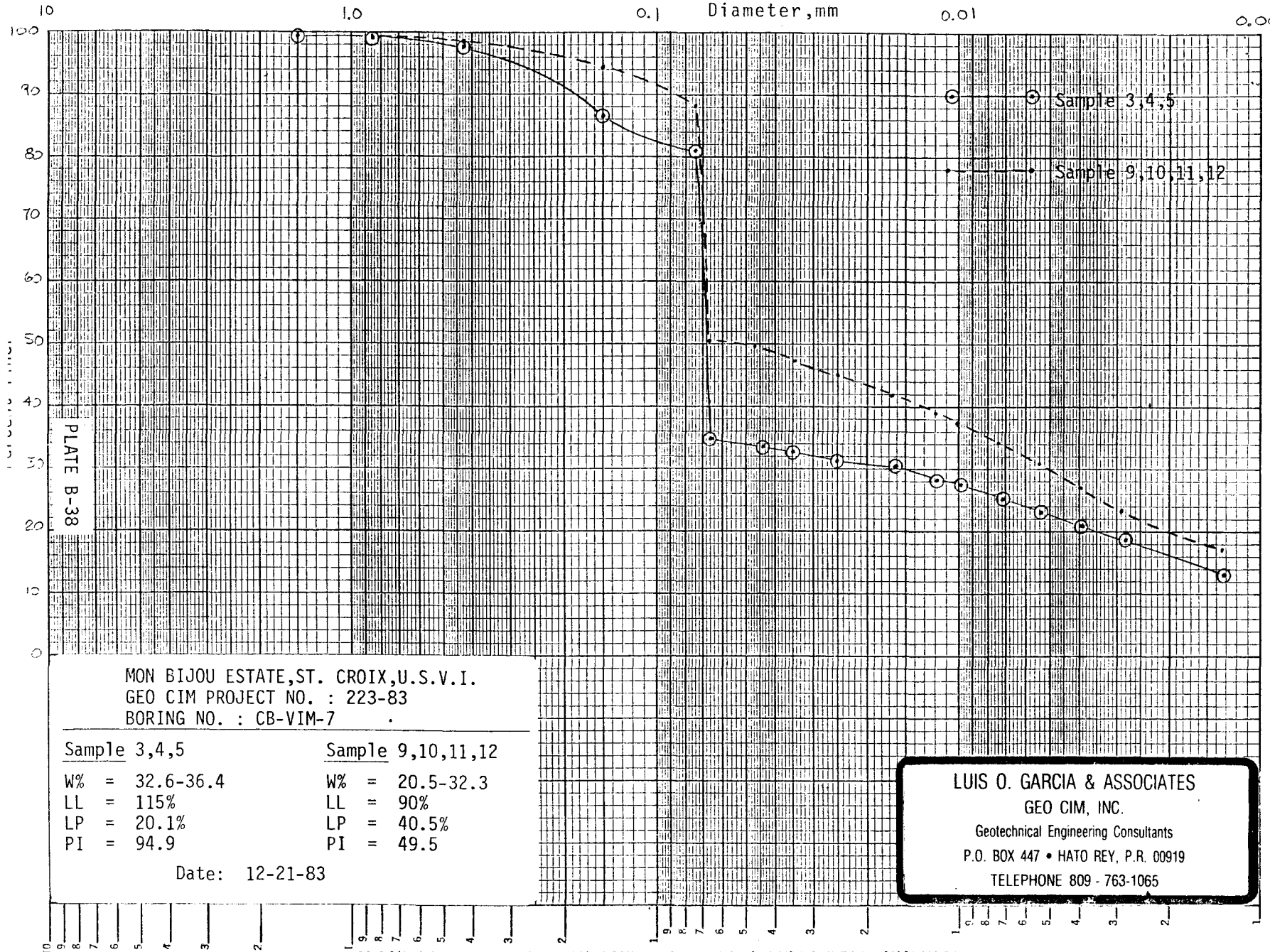


PLATE B-38

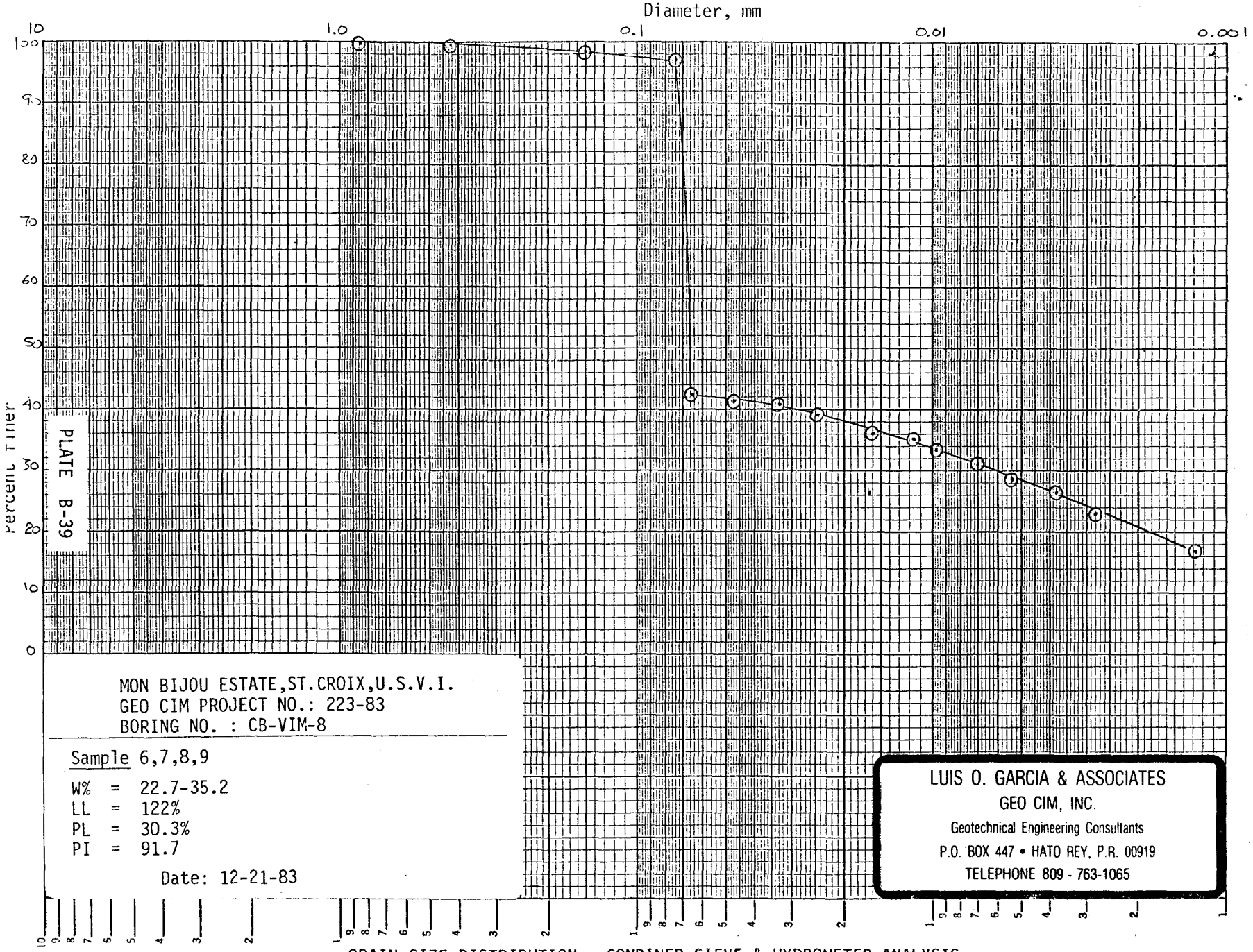
MON BIJOU ESTATE, ST. CROIX, U.S.V.I.
GEO CIM PROJECT NO. : 223-83
BORING NO. : CB-VIM-7

Sample 3,4,5		Sample 9,10,11,12	
W%	= 32.6-36.4	W%	= 20.5-32.3
LL	= 115%	LL	= 90%
LP	= 20.1%	LP	= 40.5%
PI	= 94.9	PI	= 49.5

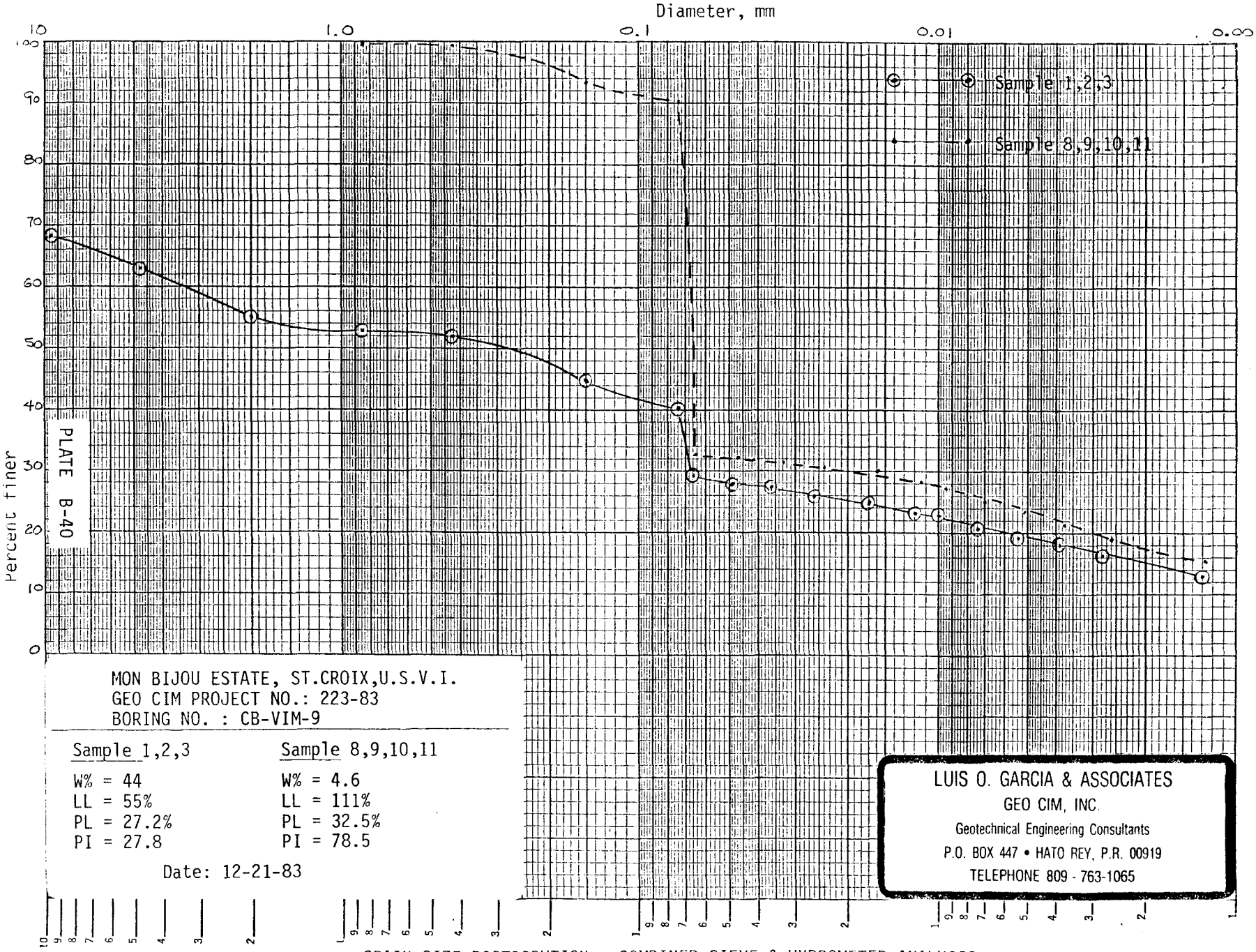
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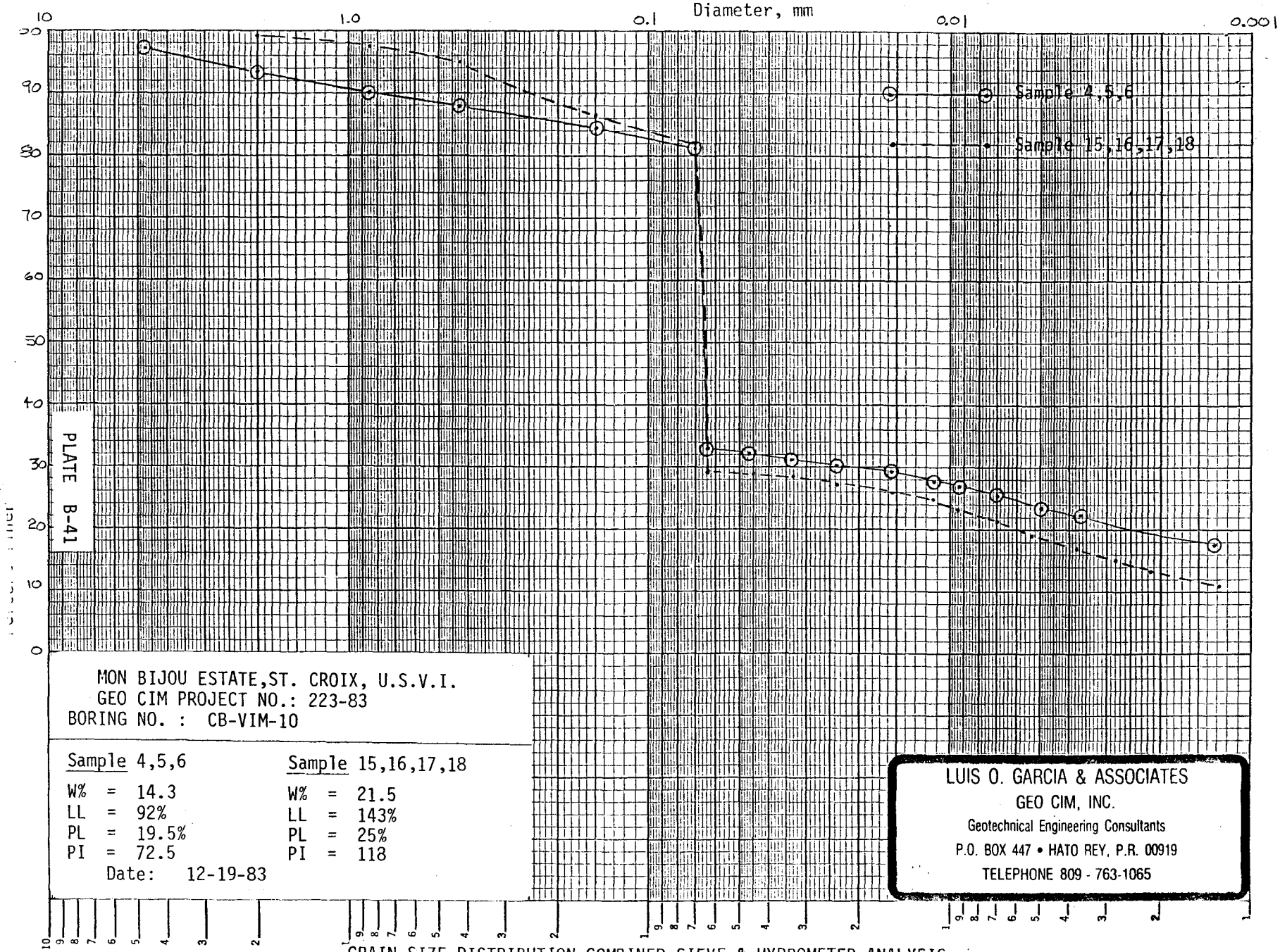
GRAIN SIZE DISTRIBUTION-COMBINED SIEVE & HYDROMETER ANALYSIS



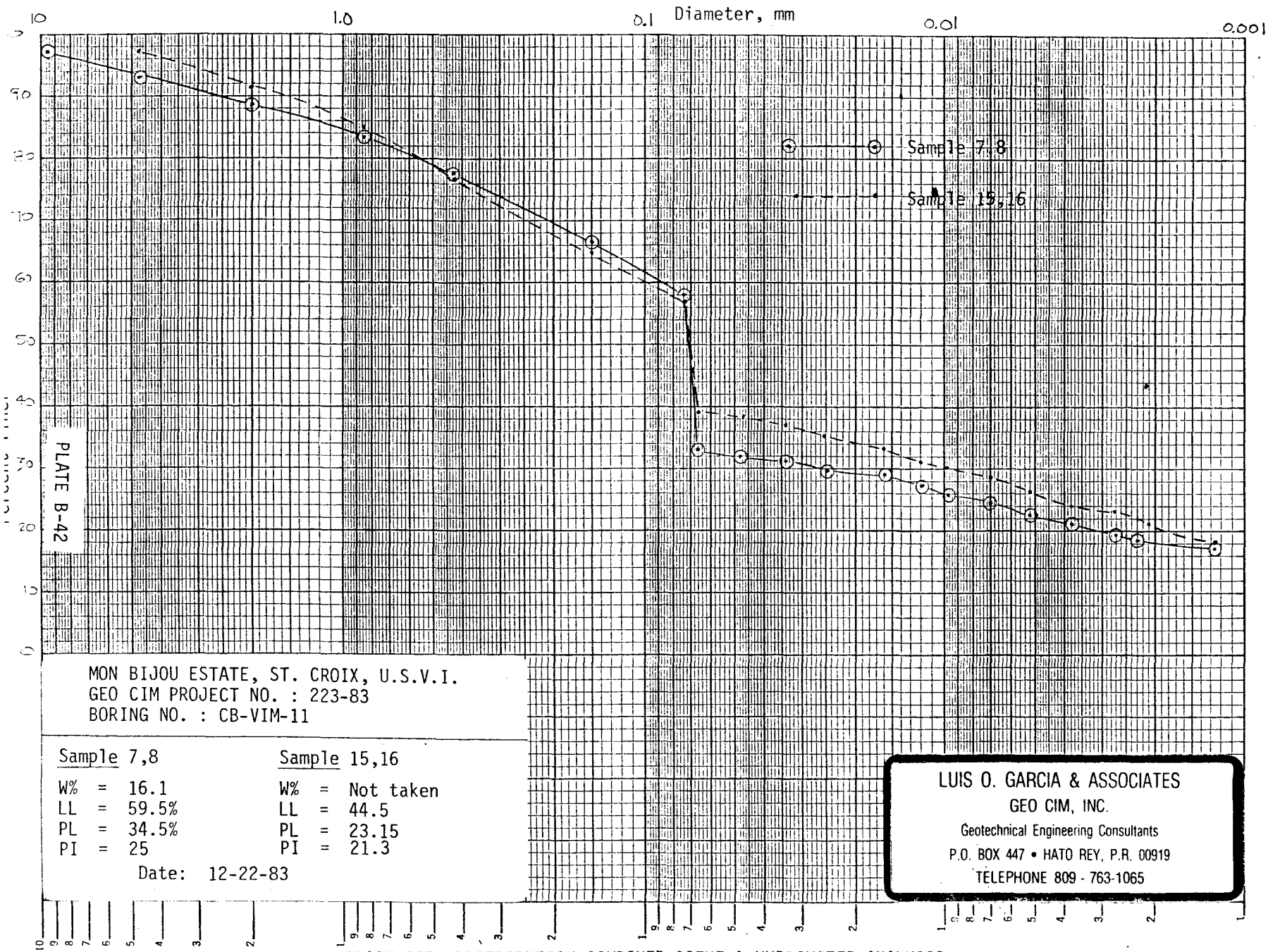
GRAIN SIZE DISTRIBUTION - COMBINED SIEVE & HYDROMETER ANALYSIS



GRAIN SIZE DISTRIBUTION - COMBINED SIEVE & HYDROMETER ANALYSIS



GRAIN SIZE DISTRIBUTION-COMBINED SIEVE & HYDROMETER ANALYSIS



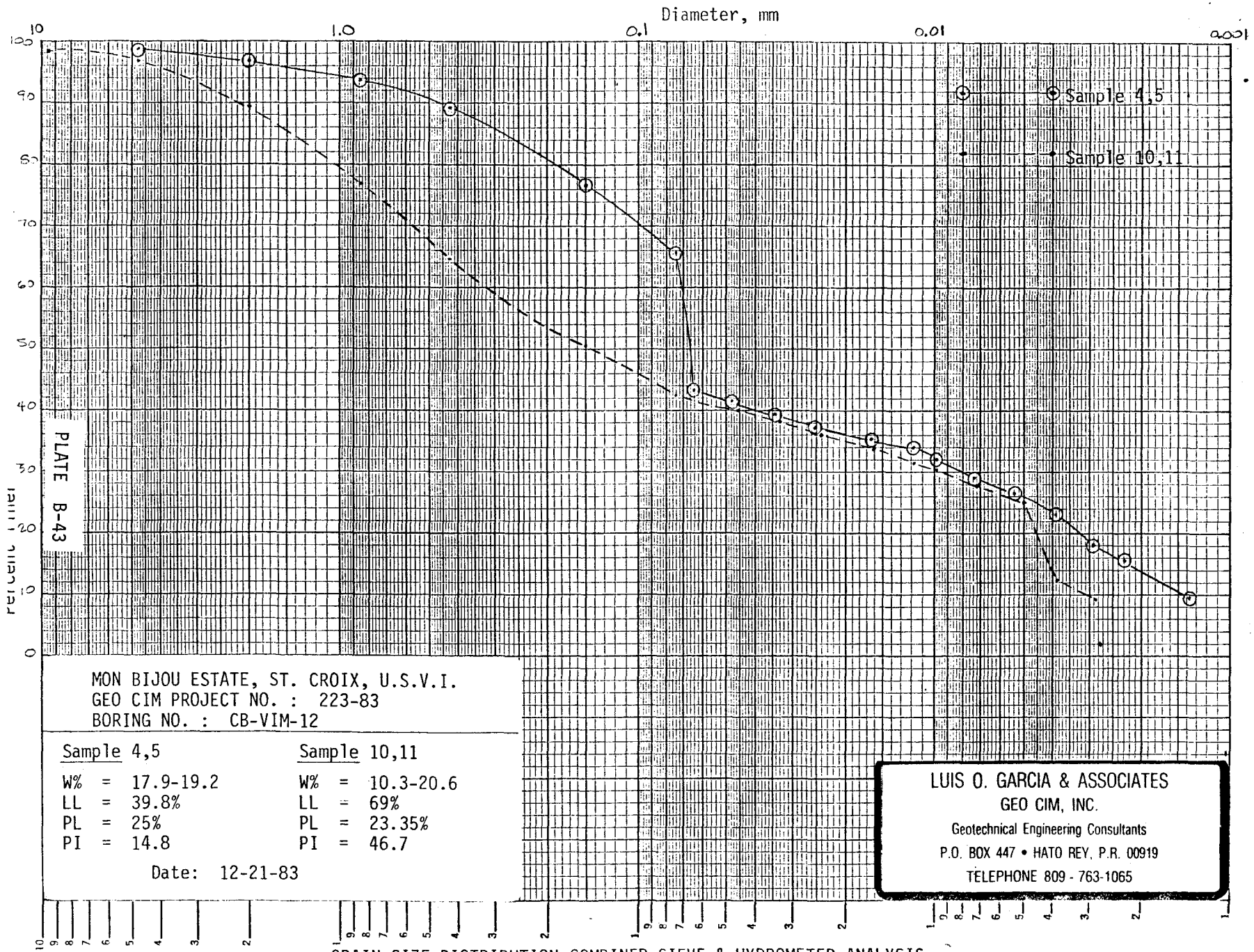
MON BIJOU ESTATE, ST. CROIX, U.S.V.I.
GEO CIM PROJECT NO. : 223-83
BORING NO. : CB-VIM-11

Sample 7,8		Sample 15,16	
W%	= 16.1	W%	= Not taken
LL	= 59.5%	LL	= 44.5
PL	= 34.5%	PL	= 23.15
PI	= 25	PI	= 21.3

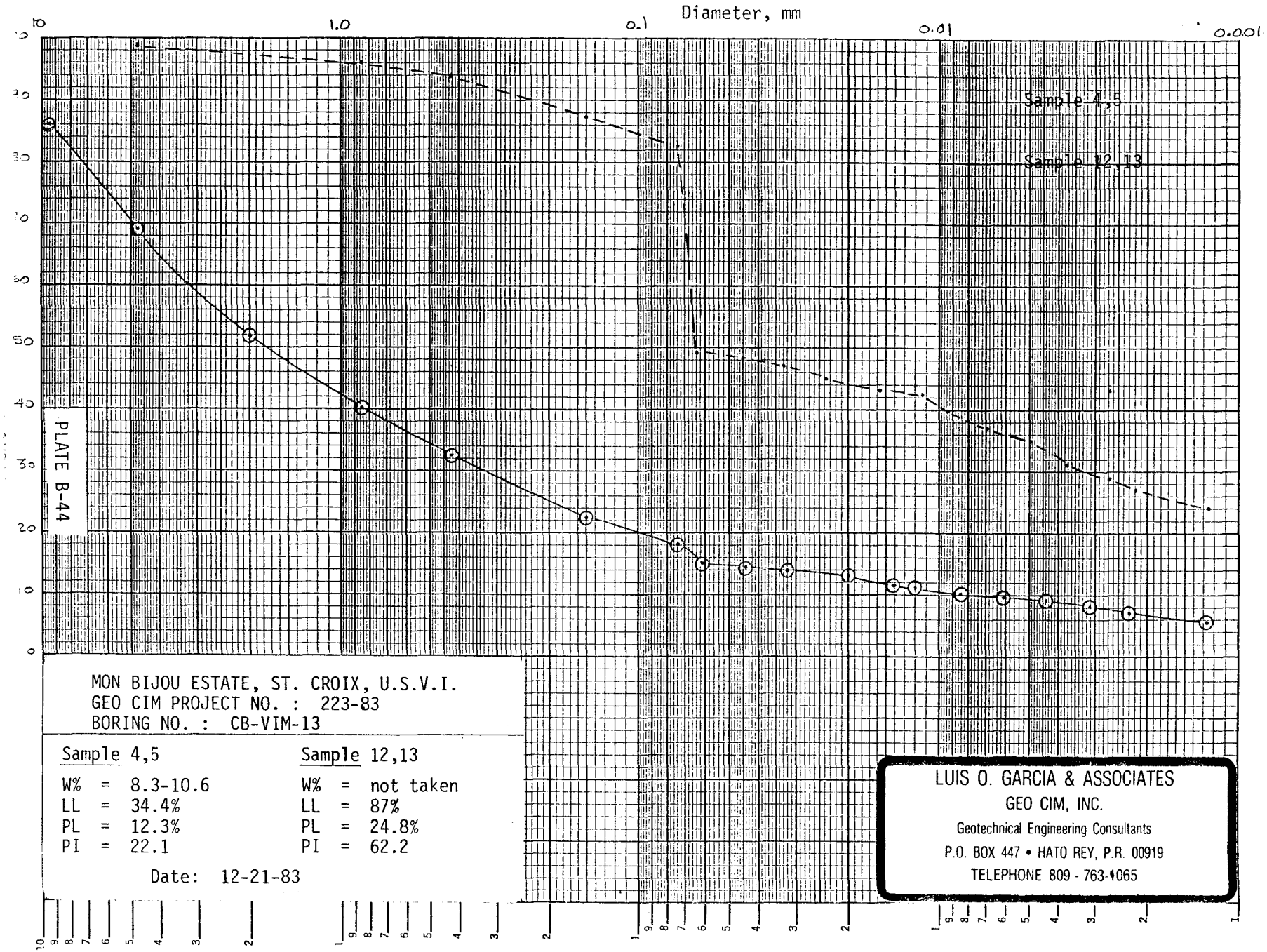
Date: 12-22-83

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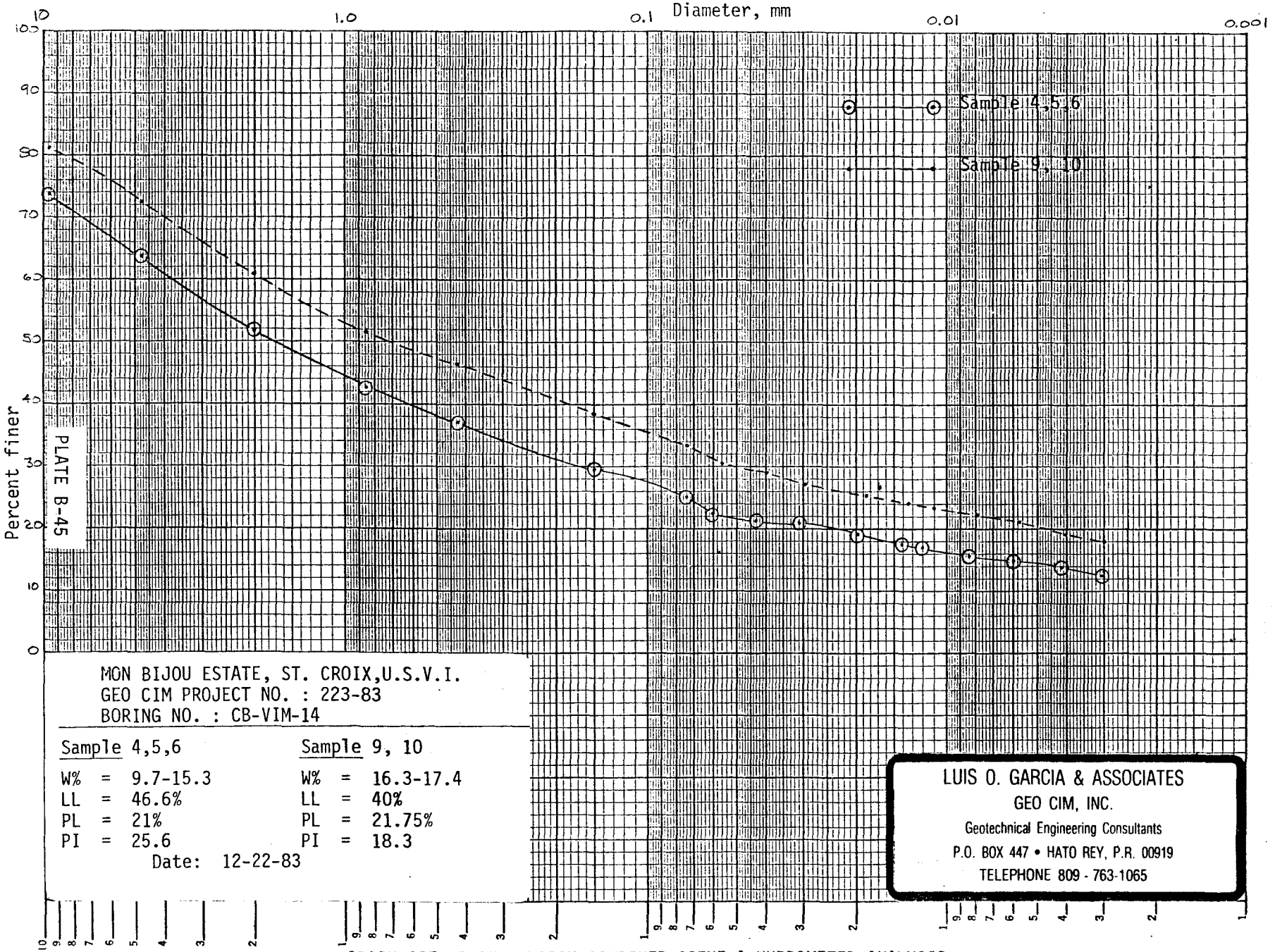
GRAIN SIZE DISTRIBUTION-COMBINED SIEVE & HYDROMETER ANALYSIS



GRAIN SIZE DISTRIBUTION-COMBINED SIEVE & HYDROMETER ANALYSIS



GRAIN SIZE DISTRIBUTION-COMBINED SIEVE & HYDROMETER ANALYSIS



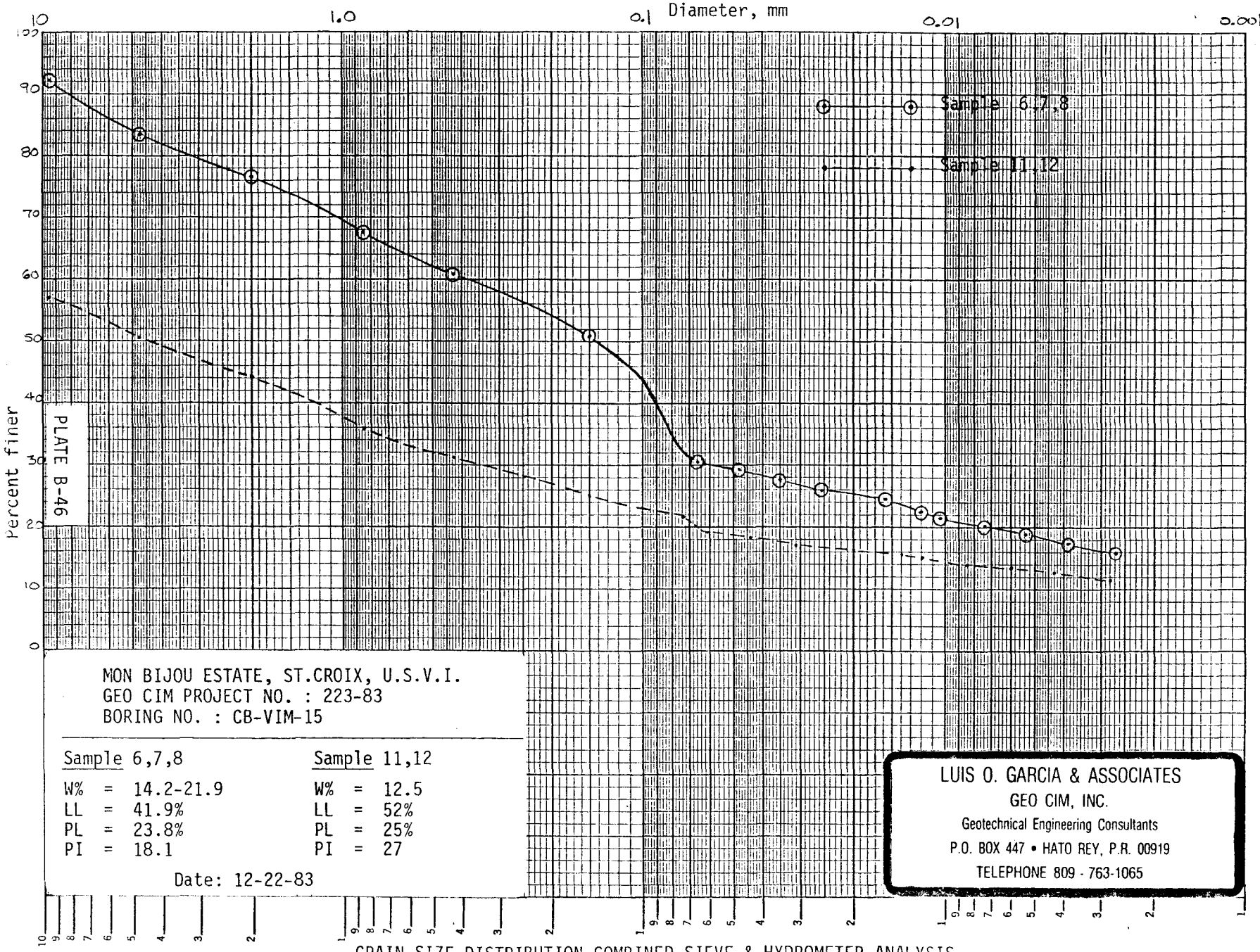
MON BIJOU ESTATE, ST. CROIX,U.S.V.I.
GEO CIM PROJECT NO. : 223-83
BORING NO. : CB-VIM-14

Sample 4,5,6		Sample 9, 10	
W%	= 9.7-15.3	W%	= 16.3-17.4
LL	= 46.6%	LL	= 40%
PL	= 21%	PL	= 21.75%
PI	= 25.6	PI	= 18.3

Date: 12-22-83

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Geotechnical Engineering Consultants
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TELEPHONE 809 - 763-1065

GRAIN SIZE DISTRIBUTION-COMBINED SIEVE & HYDROMETER ANALYSIS



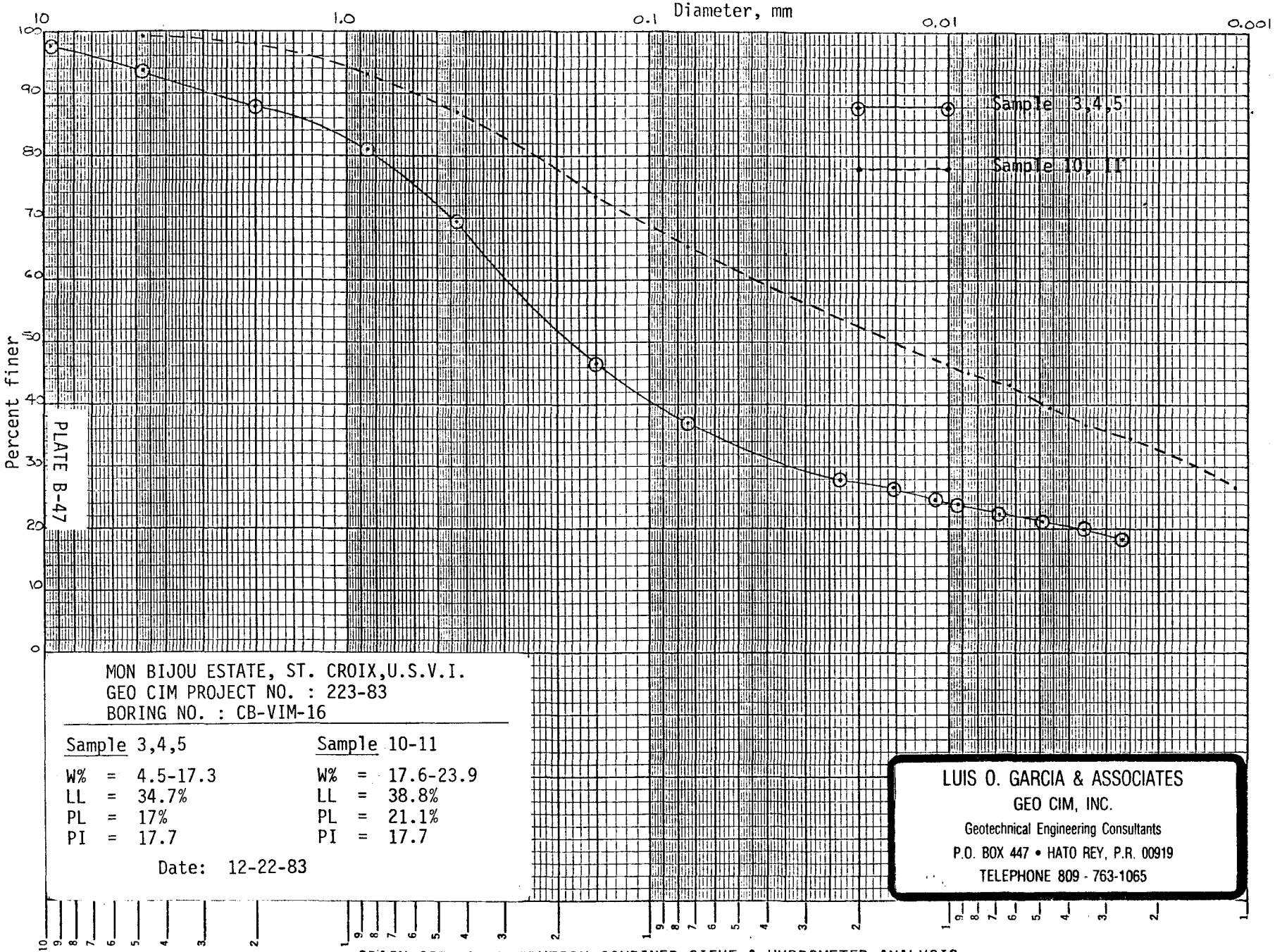
MON BIJOU ESTATE, ST.CROIX, U.S.V.I.
GEO CIM PROJECT NO. : 223-83
BORING NO. : CB-VIM-15

Sample 6,7,8		Sample 11,12	
W%	= 14.2-21.9	W%	= 12.5
LL	= 41.9%	LL	= 52%
PL	= 23.8%	PL	= 25%
PI	= 18.1	PI	= 27

Date: 12-22-83

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GRAIN SIZE DISTRIBUTION-COMBINED SIEVE & HYDROMETER ANALYSIS



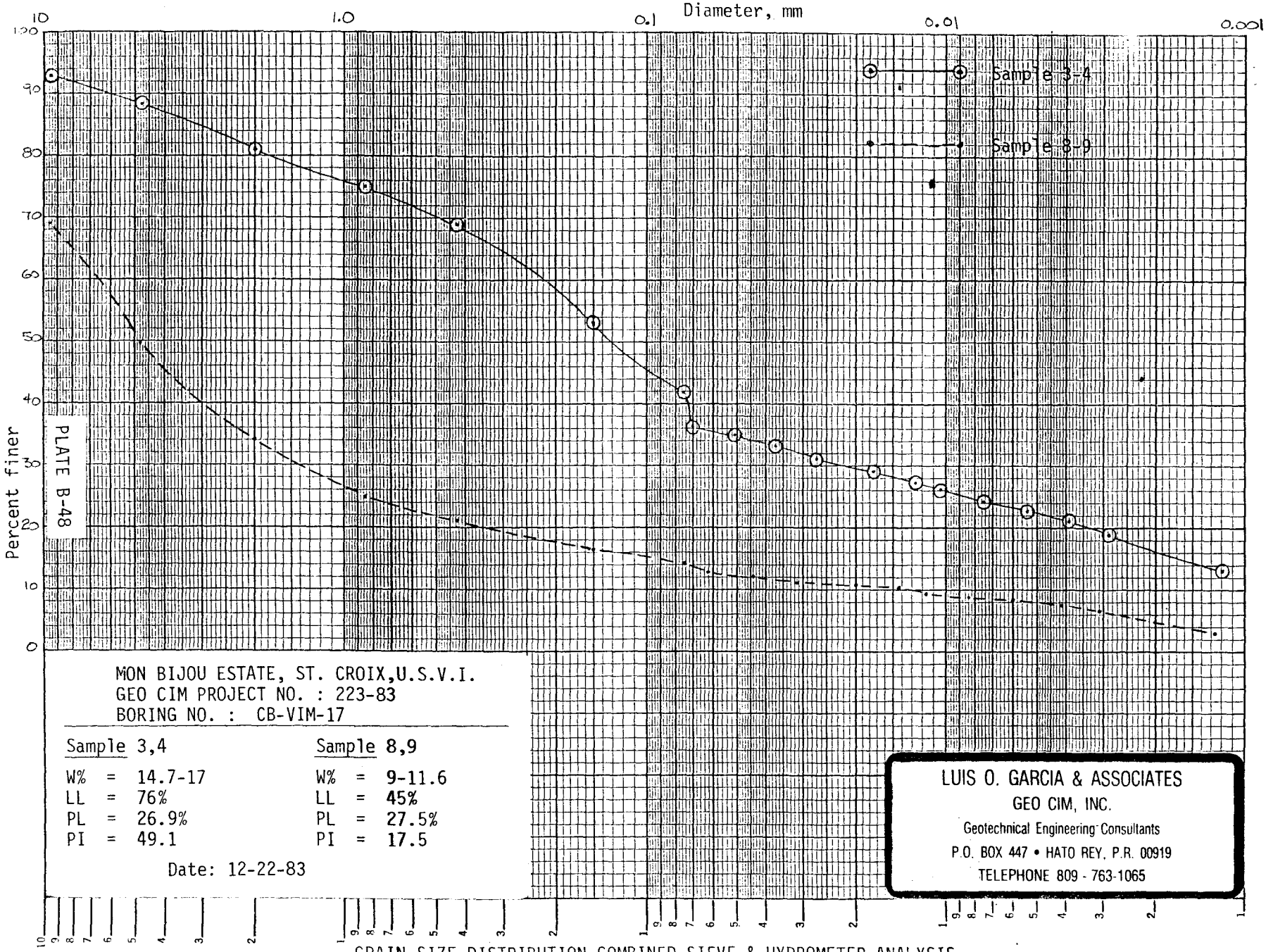
MON BIJOU ESTATE, ST. CROIX,U.S.V.I.
GEO CIM PROJECT NO. : 223-83
BORING NO. : CB-VIM-16

Sample 3,4,5		Sample 10-11	
W%	= 4.5-17.3	W%	= 17.6-23.9
LL	= 34.7%	LL	= 38.8%
PL	= 17%	PL	= 21.1%
PI	= 17.7	PI	= 17.7

Date: 12-22-83

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GRAIN SIZE DISTRIBUTION-COMBINED SIEVE & HYDROMETER ANALYSIS



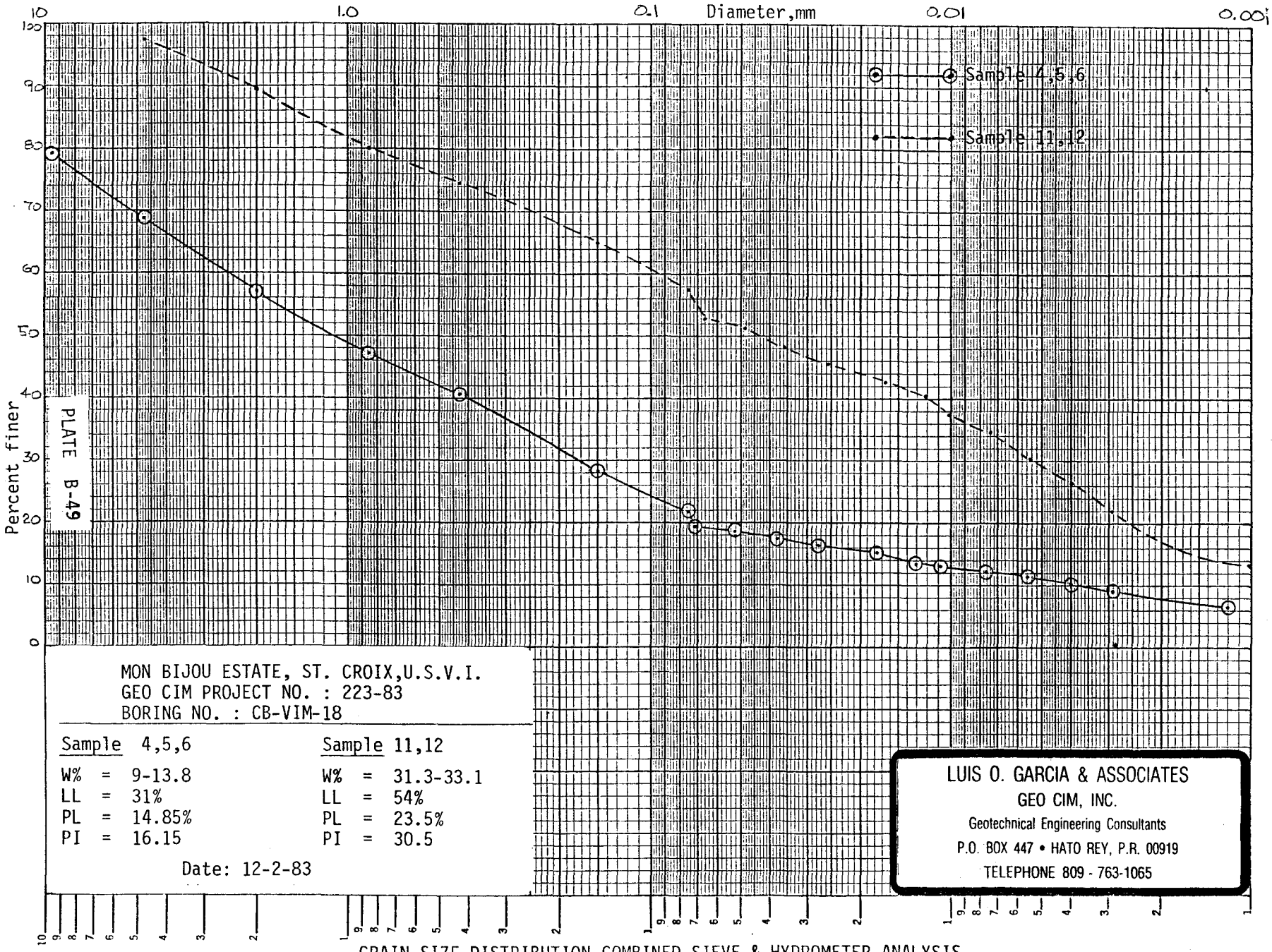
MON BIJOU ESTATE, ST. CROIX, U.S.V.I.
GEO CIM PROJECT NO. : 223-83
BORING NO. : CB-VIM-17

Sample 3,4		Sample 8,9	
W%	= 14.7-17	W%	= 9-11.6
LL	= 76%	LL	= 45%
PL	= 26.9%	PL	= 27.5%
PI	= 49.1	PI	= 17.5

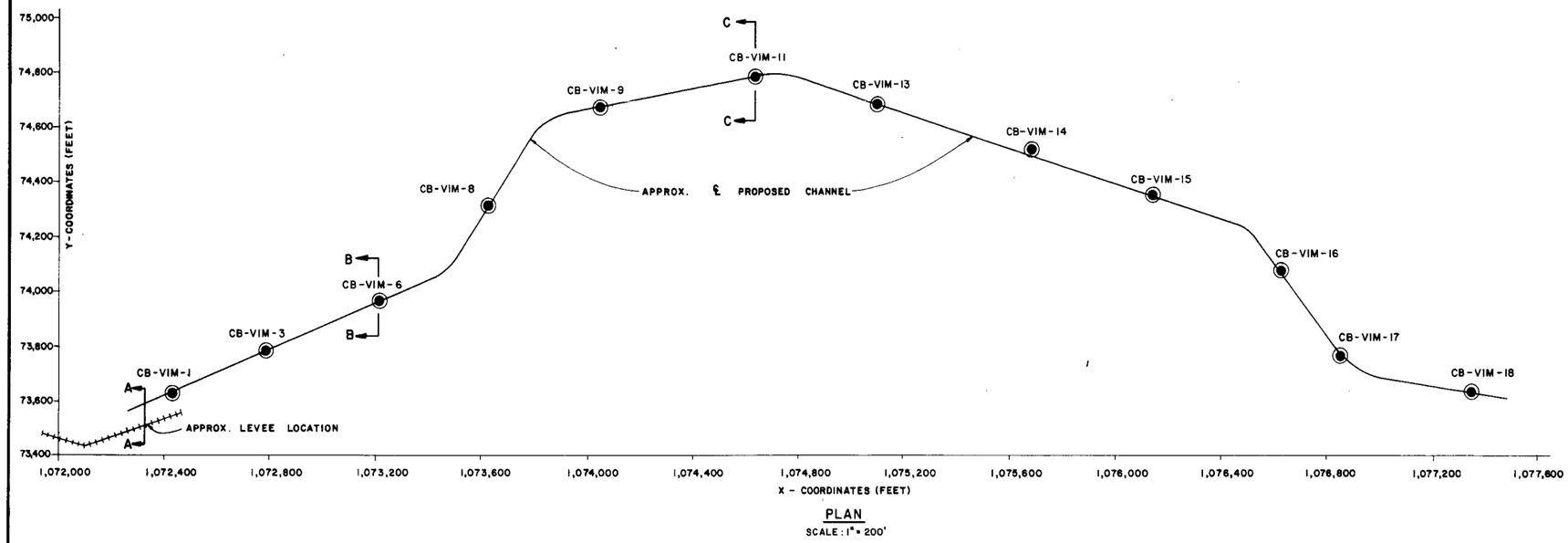
Date: 12-22-83

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GRAIN SIZE DISTRIBUTION-COMBINED SIEVE & HYDROMETER ANALYSIS

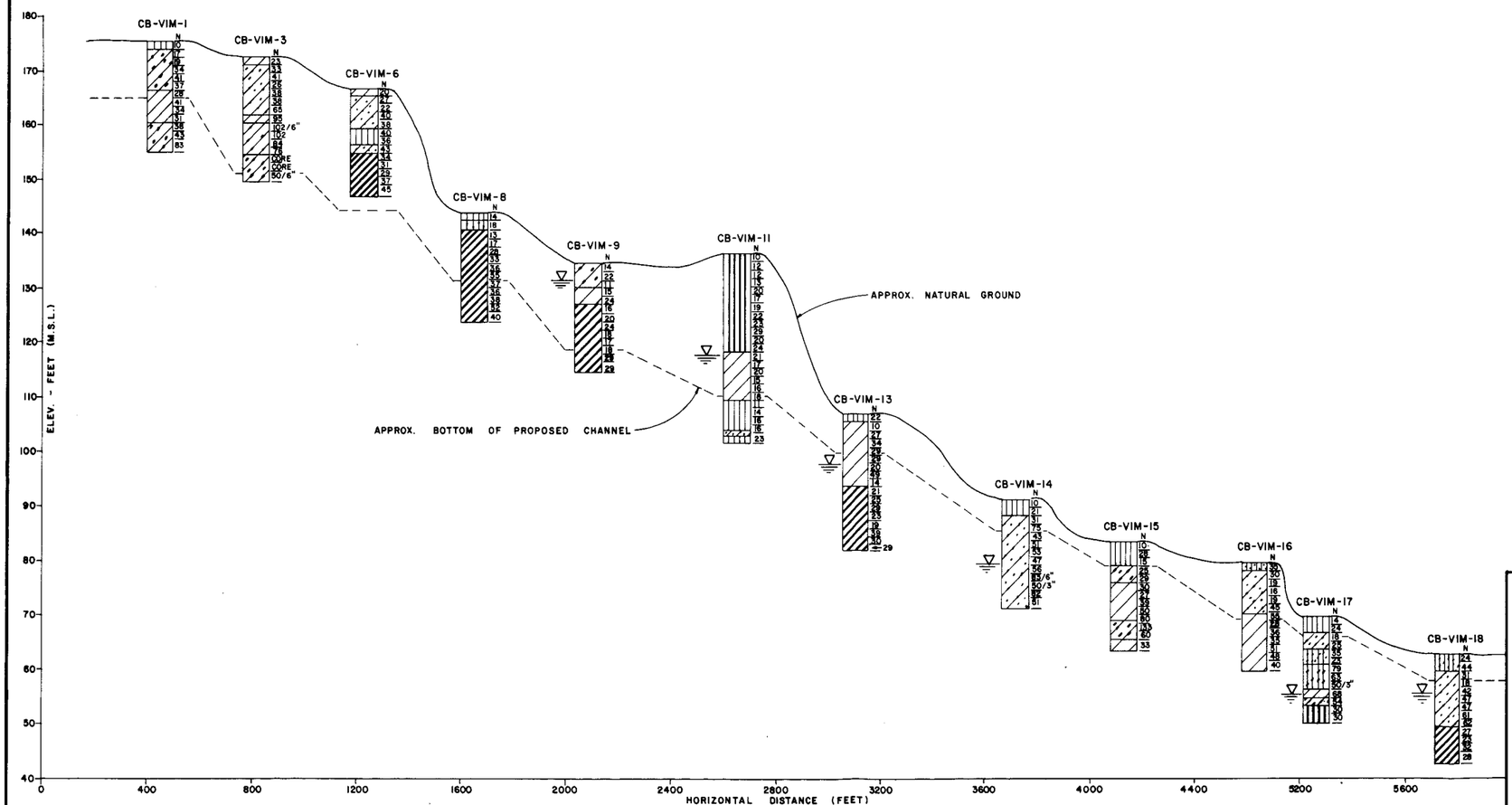


GRAIN SIZE DISTRIBUTION-COMBINED SIEVE & HYDROMETER ANALYSIS



PLAN

SCALE : 1" = 200'

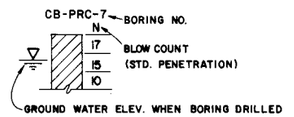


PROFILE

SCALE : VERT. 1" = 10'
HORIZ. 1" = 200'

LEGEND

- POORLY-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES (SP)
- CLAYEY SANDS, SAND-CLAY MIXTURES (SC)
- INORGANIC CLAYS OF HIGH PLASTICITY FAT CLAYS (CH)
- CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURE (GC)
- SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURE (GM)
- SILTY SANDS, SAND - SILT MIXTURES (SM)
- INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS (CL)
- ORGANIC CLAYS OF MEDEUM TO HIGH PLASTICITY ORGANIC SOILS (OH)
- INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS (MH)
- ORGANIC SILTS AND ORGANIC SILTY CLAYS
- INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY (ML)



NOTES:

1. FOR BORING LOCATION PLAN, SEE PLATE B-4.
2. FOR DETAILED SOIL DESCRIPTION, SEE BORING LOGS.
3. FOR SECTIONS A-A, B-B AND C-C, SEE PLATES B-51, B-52 AND B-53.

SECTION 205
DETAILED PROJECT REPORT
ESTATE MON BIJOU
ST. CROIX, U.S. VIRGIN ISLANDS

APPENDIX B

PLAN - SOIL PROFILE

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA

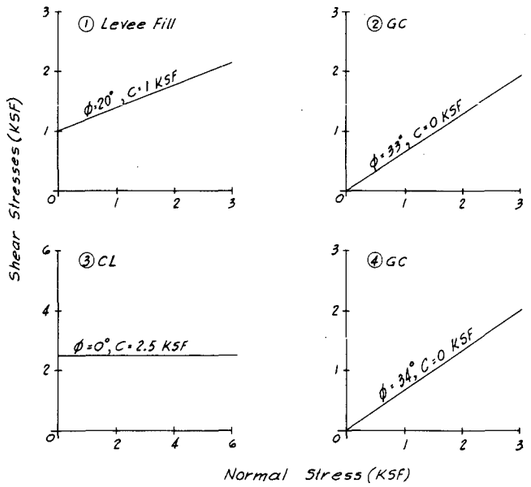
D.O. FILE NO. 109-34,414

PLATE B-50

MTL	Splice	Horz Width (Ft)	Slice HT.(Ft) Lt. Side	Rt. Side	Average	Area of Splice(Ft²)	Weight(kips) Moist	Submerged	Total	Base Length at splice, XL (Ft)	CAL (Kips)	$C_D = \frac{CAL}{F.S.}$ (kips) #	$\phi_D = \frac{\phi}{F.S.}$ (degrees #	Wt. (Eq Factor)** (Kips)
①	1	1.5	0	3	1.5	2.3	.3	—	.3	2.5	2.5	.6	4.4	0
①	2	3.8	3	4.5	3.8	14.3	1.6	—	2.5	6	0	0	7.3	.3
②	2'	3.8	0	3.8	1.9	7.2	.9	—						
①	3	6.4	4.5	4.5	4.5	28.8	3.3	—	8.3	8.8	22	4.9	0	.8
②	3'	6.4	3.8	3.8	3.8	24.3	2.9	—						
③	3"	6.4	0	6	3	19.2	2.1	—						
①	4	3.5	4.5	4.5	4.5	15.8	1.8	—	6.3	4.5	0	0	7.5	.6
②	4'	3.5	3.8	3.8	3.8	13.3	1.6	—						
③	4"	3.5	6	6	6	21	2.3	—						
④	4'''	3.5	0	2.5	1.3	4.6	.6	—						
①	5	11.5	4.5	0	2.3	26.5	3	—	22.8	13	0	0	7.5	2.3
②	5'	11.5	3.8	3.8	3.8	43.7	5.2	—						
③	5"	11.5	6	6	6	69	7.6	—						
④	5'''	11.5	2.5	7.2	4.9	55.8	7	—						
②	6'	14.5	3.8	0	1.9	27.6	3.3	—	26.9	15	0	0	7.5	3
③	6"	14.5	6	6	6	87	9.6	—						
④	6'''	14.5	7.2	8.3	7.6	112.4	14	—						
③	7"	5.4	6	4.4	5.2	28	3.1	—	8.4	5.4	0	0	7.5	.8
④	7'''	5.4	8.3	7.5	7.9	42.7	5.3	—						
③	8"	16.2	4.4	4.4	4.4	71.3	7.8	—	15.5	18.5	0	0	7.5	1.6
④	8'''	16.2	7.3	0	3.8	61.6	7.7	—						
③	9"	5	4.4	0	2.2	11	1.2	—	1.2	7	17.5	3.9	0	0

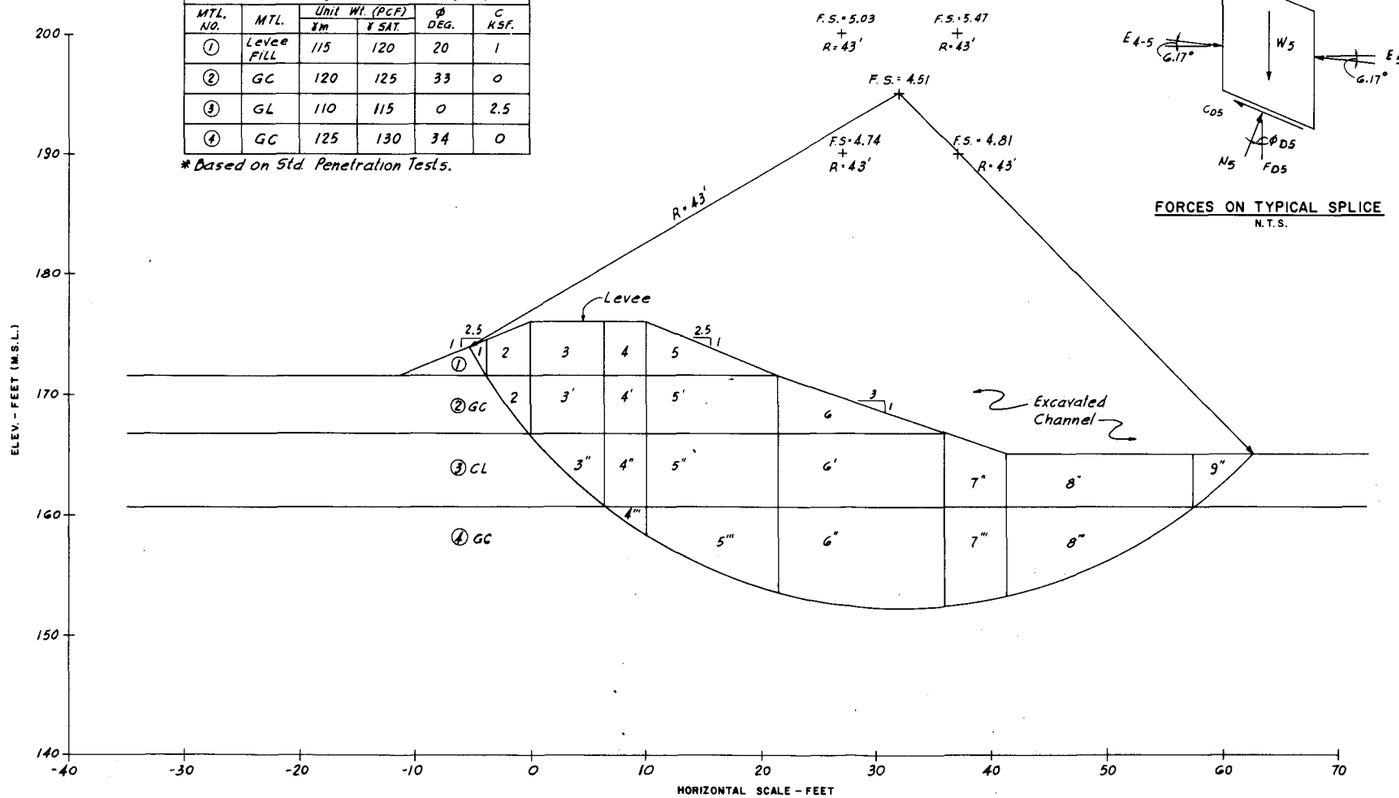
* F.S. = 4.51

** Eq. Coeff. = 0.1

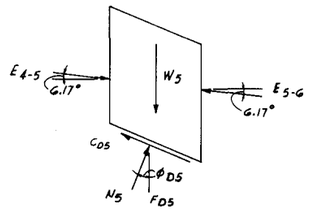


MTL. NO.	MTL.	Unit Wt. (PCF) γm	γ SAT.	φ DEG.	C KSF.
①	Levee FILL	115	120	20	1
②	GC	120	125	33	0
③	GL	110	115	0	2.5
④	GC	125	130	34	0

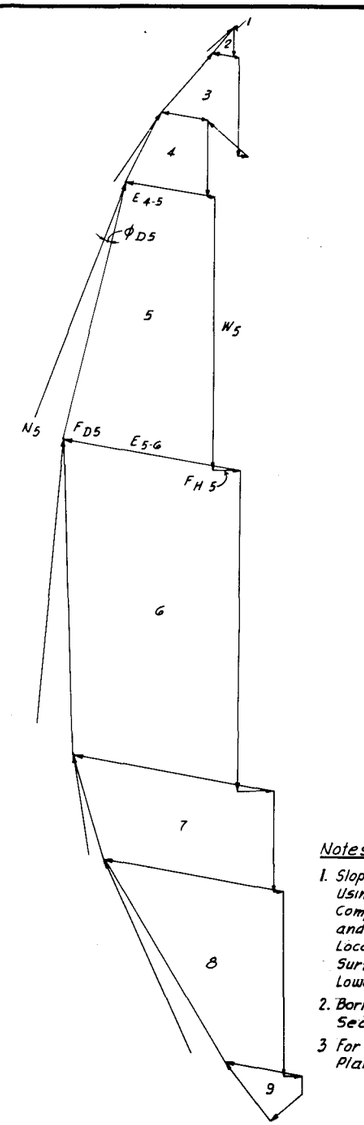
* Based on Std. Penetration Tests.



SECTION A-A



FORCES ON TYPICAL SPLICE
N.T.S.



Notes:

1. Slope Stability Analysis Performed Using Utexas 2 (Spencer Method) Computer Program. Various Arc and Wedge Failure Surface Locations Were Tried With Failure Surface Shown That Produced Lowest F.S.
2. Boring CB-VIM-1 Used For Soil Section Information.
3. For Section Location, See Plate B-50.

COMPOSITE FORCE POLYGON
F.S. = 4.51
SCALE: = 5 KIPS

SECTION 205
DETAILED PROJECT REPORT
ESTATE MON BIJOU
ST. CROIX, U.S. VIRGIN ISLANDS

APPENDIX B

SLOPE STABILITY – LEVEE
END OF CONSTRUCTION

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA

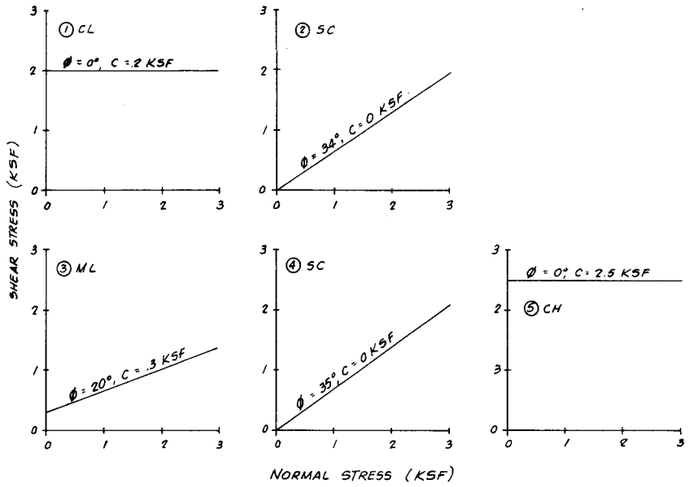
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PLATE B-51

MTL.	SLICE	HORIZ WIDTH (FT.)	SLICE HT. (FT.) LT. SIDE	RT. SIDE	AVERAGE	AREA OF SLICE (FT²)	WEIGHT (KIPS) MOIST	SUBMERGED	TOTAL	BASE LENGTH OF SLICE, AL (FT.)	CAL (KIPS)	$C_D = \frac{CAL}{F.S.}$ (KIPS) *	$\phi_D = \frac{\phi}{F.S.}$ (DEGREES)*	W.T. (EQ. FACTOR)** (KIPS)
②	1	6.5	0	3	1.5	9.8	1.1	–	1.1	8	0	0	11.6	.1
②	2	6.5	3	.8	1.9	12.3	1.4	–						
③	2'	6.5	0	3	1.5	9.8	1.1	–	2.5	7.5	2.9	.8	6.8	.3
①	3	6.5	.8	0	.4	2.6	.3	–						
⑤	3'	6.5	3	1.6	2.3	14.9	1.6	–	2.5					
④	3"	6.5	0	1.5	.8	4.8	.6	–		6.5	0	0	12	.3
⑤	4'	5	1.8	0	.9	4.5	.5	–	1.6					
④	4"	5	1.8	2	1.9	9.5	1.1	–		5	0	0	12	.2
④	5"	5	2	0	1	5	.6	–	.6	5	0	0	12	.1

* F.S. = 2.92

** EQ. COEFF. = 0.1

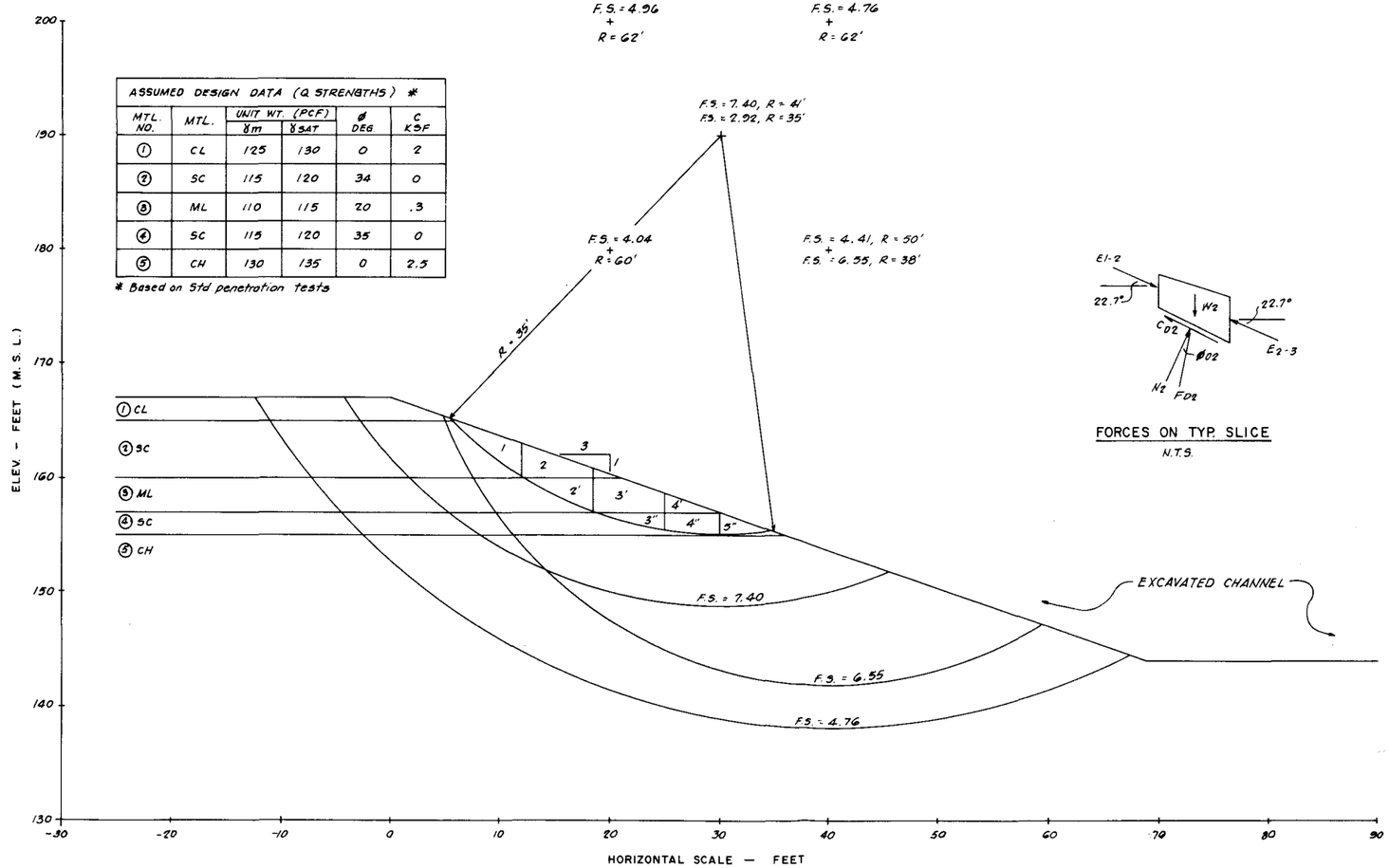


F.S. = 4.96
+
R = 62'

F.S. = 4.76
+
R = 62'

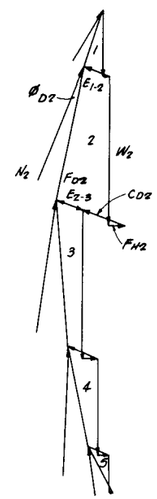
ASSUMED DESIGN DATA (Q STRENGTHS) *					
MTL. NO.	MTL.	UNIT WT. (PCF) γ_m	γ_{SAT}	ϕ DEG.	C KSF
①	CL	125	130	0	2
②	SC	115	120	34	0
③	ML	110	115	20	.3
④	SC	115	120	35	0
⑤	CH	130	135	0	2.5

* Based on Std penetration tests



SECTION B-B

FORCES ON TYP. SLICE
N.T.S.



COMPOSITE FORCE POLYGON
F.S. = 2.92
SCALE: 1" = 1 KIP

NOTES:

1. Slope stability analysis performed using UTEXAS 2 (Spencer Method) Computer Program. Various arc and wedge failure surface locations were tried with failure surface shown that produced lowest F.S.
2. Boring CB-VIM-G used for soil section information.
3. For section location, see Plate B-50.

SECTION 205
DETAILED PROJECT REPORT
ESTATE MON BIJOU
ST. CROIX, U.S. VIRGIN ISLANDS

APPENDIX B

SLOPE STABILITY - CHANNEL
END OF CONSTRUCTION

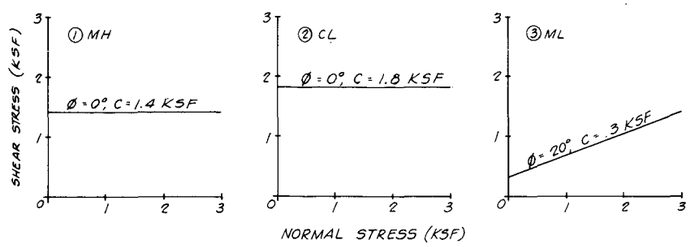
DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA

D.O. FILE NO. 109-34,414

MTL	SL/ICE	HORIZ WIDTH (FT.)	SLICE HT. (FT.) LT. SIDE	RT. SIDE	AVERAGE	AREA OF SLICE (FT²)	WEIGHT (KIPS) MOIST	SUBMERGED	TOTAL	BASE LENGTH OF SLICE, AL (FT.)	CAL (KIPS)	CAL (KIPS) * C_D = C/F.S.	ϕ_D = ϕ/F.S. (DEGREES)*	W.T. (EQ. FACTOR)** (KIPS)
①	1	13.5	0	18	9	121.5	13.4	—	13.4	22	30.8	20.1	0	1.3
①	2	9	18	18	18	162	17.8	—						
②	2'	9	0	9	4.5	40.5	—	2.6	20.4	13	28.4	15.3	0	2
①	3	24	18	18	18	432	47.5	—						
②	3'	24	9	9	9	216	—	13.6						
③	3"	24	0	17	8.5	204	—	11.8	72.9	30	9	6	13.1	7.3
①	4	30	18	8	13	390	42.9	—						
②	4'	30	9	9	9	27		1.7	84.6					
③	4"	30	17	29	23	690	—	40		33	9.9	6.5	13.1	8.5
①	5	24	8	0	4	96	10.6	—						
②	5'	24	9	9	9	216	—	13.6	67.4					
③	5"	24	29	33	31	744	—	43.2		25	7.5	5	13.1	6.7
②	6'	27.5	9	0	4.5	123.8	—	7.8	59.6					
③	6"	27.5	33	32	32.5	893.8	—	51.8		27	8.1	5.3	13.1	5.9
③	7"	19	31	25	28	532	—	30.9	30.9	20	6	4	13.1	3.1
③	8"	20	25	17	21	420	—	24.4	24.4	22	6.6	4.3	13.1	2.4
③	9"	24	17	0	8.5	204	—	11.8	11.8	29	8.7	5.7	13.1	1.2

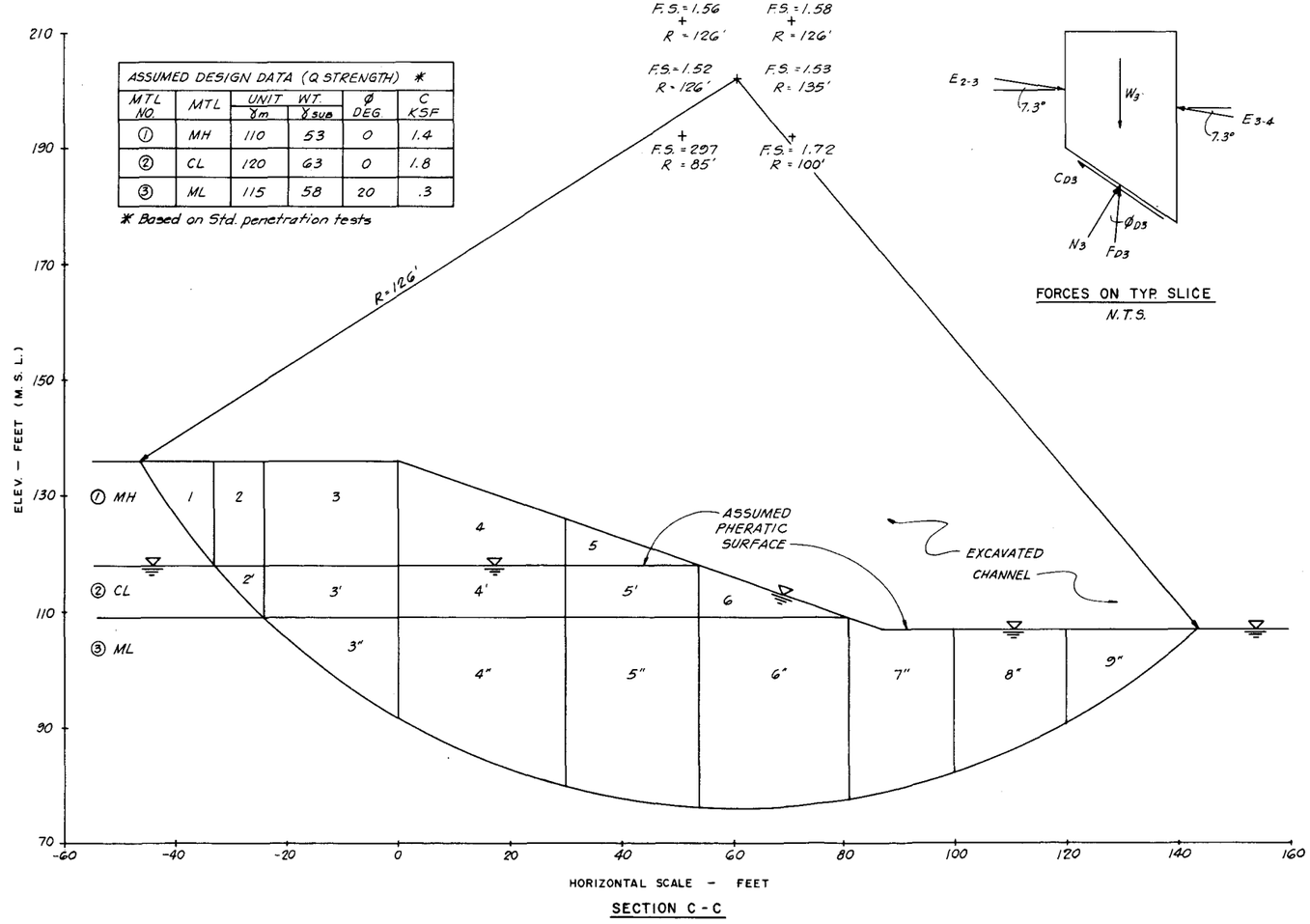
* F.S. = 1.53

** EQ. COEFF. = 0.1



ASSUMED DESIGN DATA (Q STRENGTH) *					
MTL NO.	MTL	UNIT WT. γm	UNIT WT. γsub	ϕ DEG	C KSF
①	MH	110	53	0	1.4
②	CL	120	63	0	1.8
③	ML	115	58	20	.3

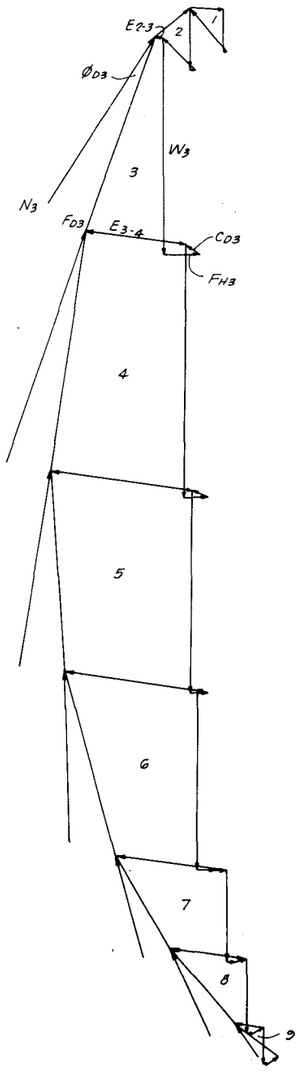
* Based on Std. penetration tests



SECTION C - C

FORCES ON TYP. SLICE

N.T.S.



COMPOSITE FORCE POLYGON

F.S. = 1.53

SCALE : 1" = 20 KIPS

NOTES:

1. Slope stability analysis performed using UTEXAS 2 (Spencer Method) Computer Program. Various arc and wedge surface locations were tried with failure surface shown that produced lowest F.S.
2. Boring CB-VIM-11 used for soil section information.
3. For section location, see Plate B-50.

SECTION 205
DETAILED PROJECT REPORT
ESTATE MON BIJOU
ST. CROIX, U.S. VIRGIN ISLANDS

APPENDIX B

SLOPE STABILITY – CHANNEL
END OF CONSTRUCTION

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA

D.O. FILE NO. 109-34,414

SECTION 205 DETAILED PROJECT REPORT

ESTATE MON BIJOU

ST. CROIX, U.S. VIRGIN ISLANDS

APPENDIX C

RECREATION ASSESSMENT

A. RECREATION ASSESSMENT

1. Recreation Assessment.

a. The structural features to alleviate flooding, as presented in this report, limit recreational opportunity. The possibility exists, however, to upgrade the existing municipal parks within the project boundaries by using suitable material from project construction to re-contour some park areas to alleviate site flooding. Construction of additional facilities such as a restroom, multi-purpose court, playground, etc., with appropriate landscaping could also be considered. Where opportunities for development of recreational facilities do not exist, appropriate treatment of project features would include landscape plantings to minimize visual impacts.

b. The opportunity for including these recreation features in the proposed project was coordinated with a letter dated May 9, 1984, to the Department of Public Works in St. Thomas. No interest in recreation development has been expressed; therefore, recreation planning has been suspended.

SECTION 205 DETAILED PROJECT REPORT

ESTATE MON BIJOU

ST. CROIX, U.S. VIRGIN ISLANDS

APPENDIX D

ENGINEERING, DESIGN, AND COST ESTIMATES

SECTION 205 DETAILED PROJECT REPORT
ESTATE MON BIJOU
ST. CROIX, U.S. VIRGIN ISLANDS

APPENDIX D
ENGINEERING, DESIGN, AND COST ESTIMATES

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APPENDIX D

ENGINEERING, DESIGN, AND COST ESTIMATES

A. INTRODUCTION

1. General. This appendix presents the discussion of applicable design considerations and construction methods utilized to establish a basis for the cost estimates. The proposed plan is presented in the main report and Appendix A - "HYDROLOGY - HYDRAULICS". General requirements for real estate and operation and maintenance are also presented.

B. DESIGN AND CONSTRUCTION

2. Channel. Approximately 6,500 feet of channel would be constructed along the alinement shown on plate 2 in the main report. The channel would be excavated to satisfy the hydraulic design data shown in Table A-5. A portion of the excavated material would be used to construct the proposed levee, and the excess would be hauled to an off-site disposal area or possibly placed alongside the channel.

3. Levee. A levee, approximately 450 feet in length would be constructed along the upstream portion of the proposed project to provide an SPF level of protection. The crown would be 15 feet wide and vary in elevation from 190 feet (msl) at the westerly end to about 175 feet (msl) at the intersection with Highway 73. Side slopes would be 1V on 2.5H. A gabion mattress would be placed along the north face of the levee to provide erosion protection. The levee alinement is shown on plate 2 in the main report, and a profile is shown on plate A-5.

4. Gabion Control Structures. Thirty-three gabion control structures would be constructed at various intervals along channel alinement to maintain subcritical velocities and prevent erosion. A plan and section of the proposed gabion control structure is provided on plate 3 in the main report. The geotechnical requirements for construction of the structures are presented in Appendix B - "GEOTECHNICAL AND MATERIALS".

5. Inflow Modifications. The two major inflow points at Station 23+00 and Station 57+00 along the proposed channel would be modified to provide erosion protection. A description of these modifications is provided in Appendix A. The gabion bank protection would extend to one-foot above the inflow design water surface.

C. REAL ESTATE REQUIREMENTS

6. Real Estate Requirements. The local sponsor would be required to assume the cost of all land, easements, and rights-of-way, including disposal areas, required for construction maintenance of the project.

D. RELOCATIONS

7. General. The local sponsor would be required to assume the costs for relocations and alterations. These would include highway bridges, streets, houses, buildings, electric transmission lines, utilities, fences, and other miscellaneous items.

8. Bridges. The proposed project would require the construction of two bridges as shown on plate 2 in the main report. For cost estimating purposes, the bridge slabs would be poured-in-place beam and slab reinforced concrete construction. The bridge at Station 20+60 would be approximately 140 feet in length and provide for two 10-foot lanes. The bridge at Station 60+60 on Canaan Road would be approximately 150 feet in length and provide for two 12-foot lanes with 3-foot-wide sidewalks. Prior to construction of this bridge, a detour road would have to be constructed to maintain the flow of traffic. Detours to be used during construction of the other bridge would utilize existing roadways.

9. Houses. At least three houses located along the eastern end of the proposed channel alinement would be relocated.

10. Utilities. Topographic surveys would be obtained prior to preparation of contract plans and specifications in order to locate any underground utilities, above ground telephone lines, and/or electric transmission lines which would require relocation or alteration in order to construct the improvements presented in this report. Twenty-five thousand dollars has been included in the estimated relocation costs for unknown utilities.

E. OPERATION AND MAINTENANCE

11. Operation and Maintenance. The local sponsor would be responsible for the maintenance of the improvements proposed in this report upon completion of the construction contract. The Contractor would be responsible for all maintenance during the construction contract.

F. CONSTRUCTION SCHEDULE

12. Construction Schedule. Following approval of this report and appropriation of funds, contract plans and specifications would be prepared for the proposed plan presented herein. It is anticipated that a construction start would be scheduled for Fiscal Year 1988 or 1989. The estimated construction time would be 12 months.

G. QUANTITIES AND COST ESTIMATES

13. Cost Estimates Presented. Quantities and cost estimates for construction of the proposed plan are presented in table D-1.

TABLE D-1

ESTATE MON BIJOU - ST. CROIX, VIRGIN ISLANDS
QUANTITIES AND COST ESTIMATES
(Date of Estimate: July 1987)

Cost Account Number	Item	Unit	Quantity	Unit Price	Total
	CONSTRUCTION COST				
	Mobilization/Demobilization	Job	1	L.S.	$ 20,000
09	Excavation	C.Y.	285,000	2.50	712,500
11	Levee Construction	C.Y.	1,500	1.25	1,875
	Clearing and Grubbing	Acre	25	$1500.00	37,500
	Grassing	Acre	10	$1500.00	15,000
	Gabion Control Structures	C.Y.	8,500	$ 90.00	765,000
	Inlet Modifications	Job	1	L.S.	63,500
	Building Removal	Job	3	$2000.00	6,000
	Subtotal				$1,621,375
	Contingencies (20%±)				324,275
	Contract Price				$1,945,650
30	Engineering and Design				194,550
31	Supervision and Administration				155,600
	CONSTRUCTION COST				$2,295,800
	LANDS AND RELOCATIONS				
01	Lands and Damages				
	Rights-of-Way and Easements				$ 307,500
	Residential Acquisition				150,000
	PL 91-646				31,500
	Administrative Costs (10%±)				47,500
	Subtotal				$ 536,500
	Contingencies (15%±)				80,500
	Lands and Damages				$ 617,000
02	Relocations				
	Bridges				$ 605,000
	Utilities				25,000
	Subtotal				$ 630,000
	Contingencies (20%±)				125,000
	Relocations				755,000
	LANDS AND RELOCATIONS				$1,372,000
	TOTAL FIRST COST				$3,667,800
	Interest During Construction @ 8 5/8% - 12 months				150,000
	TOTAL INVESTMENT COST				$3,817,800
	ANNUAL COST				
	Interest and Amortization @ 8 5/8 - 50 years				$ 334,600
	Maintenance				3,400
	ANNUAL COST				$ 338,000

SECTION 205 DETAILED PROJECT REPORT

ESTATE MON BIJOU

ST. CROIX, U.S. VIRGIN ISLANDS

APPENDIX E

ECONOMIC ANALYSIS

SECTION 205 DETAILED PROJECT REPORT
ESTATE MON BIJOU
ST. CROIX, U.S. VIRGIN ISLANDS

APPENDIX E
ECONOMIC ANALYSIS

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A. ECONOMIC SECTION

1. Introduction. The purpose of this section is to evaluate the effects of the modifications which are proposed to be made to the drainage conditions presently existing in the study area.

a. The economic aspects of the study were to:

(1) specifically determine the extent and location of present land use and resource development in the area,

(2) suggest a pattern for future land utilization in the area,

(3) analyze the effects on the economic activity in the area caused by the proposed modifications to the existing drainage conditions, and,

(4) compare the economic trade-offs between the alternative plans proposed.

b. The general assumptions in this study are limited to the following:

(1) during the study period, there will be no major economic recessions which will seriously affect the long term growth pattern of the national economy, and,

(2) the international political tensions will remain at approximately the present level and there will be no widespread outbreak or hostilities.

2. General Background. The study area is located on the Island of St. Croix which is a part of the U.S. Virgin Islands Territories. This territory is made up of three inhabited islands. Although under one government, each island has it owns distinct characteristics. The territories' history has been guided largely by events controlled by outside forces. Originally discovered by Columbus, its most important early developments were provided by Denmark. The United States gained control of the islands in 1917. Original commercial interest was centered in agricultural production, i.e., sugarcane, and as a transcontinental shipping station. These activities declined in importance in the latter part of the 1800's and the early part of the 1900's with a devastating effect upon the economy of the islands. Between 1835 and 1930 the population decreased by one half. The construction of naval facilities on the islands and a resurgance of sugarcane activity due to the repeal of Prohibition in the United States resulted in a 20 percent increase in the population between 1930 and 1950.

a. Economic activity remained depressed through the 1950's; however, during this period the sugarcane industry was being replaced by a diversification of productive activity through expanding tourism and manufacturing exports. The most dramatic growth in every sector of the economy took place during the 1960 to 1970 period. The population grew from about

32,000 persons in 1960 to about 92,000 in 1975. Historical population and population projections are shown in table 1. Gross territorial product grew at 10 percent per year as the tourist, manufacturing, construction, and government sectors of the economy expanded. Tourism, the most dominant economic activity, increased from about 200,000 visitors per year to well over 1,000,000 visitors per year. The employed labor force tripled during this period and the Virgin Islands Government budget rose from 7.1 million dollars a year to 114.1 million dollors per year. The distribution of employment in the territory is shown in Table 2. Personal income for 1980 reached $622.7 million. By 1982, it had climbed to $705.5 million. Per capita income was $7,078 in 1982. The territorial economy is heavily tourist oriented. Much of the employment and income in the transportation, wholesale and retail trade, hotel, and services sections is derived from the tourist demands. In 1982, the number of visitors by air to the islands was 395,420 and by cruise ship was 464,593. There are other industries. The Hess Oil Company, a petrochemical refinery and The Martin Marietta Bauxite Plant are located on St. Croix. There are 44 industries on St. Thomas - Johns Islands. As stated earlier, this expansion was the result of exogenous forces providing the drive for the insular expansion. Included in these external changes were the discovery of the islands as a tourist attraction, large federal subsidies, United States Territorial trade concessions, and legislative privileges, and an influx of off-island capital. As with all island economies dependent upon main land prosperity, fluctuation in the external econony cause similar results in the insular activity. This was true of the 1970's downturn in the United States economy and the high inflation and interest rates on the main land.

b. This extensive growth in population and economic activity resulted in dramatic changes in the residential development pattern in the territory. Past low-density rural residential patterns have been altered to provide the land area necessary to accommodate this large population growth on islands with limited land resources. The average number of persons per square mile was 250 in 1960. In the late 1970's this had increased to 725 persons per square mile. This expansion pressure and change in residential patterns has been especially true for the island of St. Croix. The intensive demand for resources devoted to the tourist segment of the economy has made local city residential dwelling very expensive. The lack of infrastructural shopping catering to permanent resident needs has also made city dwelling inconvenient. These factors coupled with other social changes has resulted in large expanses of suburban sprawl. The mobility provided by the automobile has made suburban residency and center city employment compatible and vast tracts of agricultural lands and open country have been displaced by urban developments.

c. The Estate Mon Bijou and Glynn are examples of the suburban developments resulting from these very recent and dramatic changes in the demographic, economic, and social changes which have taken place on the island. Residents in these two communities commute to the hotels, marinas, industries, and center city commercial locations of their employment.

TABLE E-1

POPULATION & PROJECTIONS

U.S. VIRGIN ISLANDS

	1970*	1975	1980*	1985	1990	1995	2000	2005	2010	2015	2020	2025	2030	2035
St. Thomas	37,285	40,268	44,375	47,938	51,791	55,954	60,451	65,310	70,559	76,230	82,357	88,976	96,127	103,853
St. Croix	35,945	36,131	49,725	50,977	52,260	53,577	54,926	56,309	57,727	59,180	60,670	62,197	63,763	65,731
St. Johns	1,921	1,950	2,472	2,571	2,609	2,648	2,688	2,728	2,769	2,811	2,853	2,896	2,940	2,984
Totals	75,151	78,349	96,569	101,486	106,660	112,179	118,065	124,247	131,055	138,221	145,880	154,069	162,830	172,568

* U.S. Virgin Islands growth statistics, Office of Policy, Planning & Research, U.S. Virgin Islands Department of Commerce.

TABLE E-2

EMPLOYMENT BY INDUSTRIAL GROUP FOR

VIRGIN ISLANDS TERRITORIES 1982

Industrial Group	Number Persons	Percent Total
Agriculture	3,777	9.4
Manufacturing	2,700	6.7
Construction & Mining	3,270	8.2
Transportation and Public Works	2,180	5.4
Wholesale and Retail Trade	7,210	18.0
Finance, Insurance, and Real Estate	1,530	3.8
Hotel, Etc.	2,700	6.7
Other Services	3,240	8.1
Government	13,500	33.7
Totals	40,107	100.0

Individual home ownership is typical of these areas. Portions of both Estate Mon Bijou and Glynn are subject to periodic flooding and the segment of these developments subject to this flooding is the portion being examined in this study.

3. Existing Without Project Flood Damages. The study area is composed of two residential subdivisions called Estate Mon Bijou and Glynn. They are urban in nature, but are surrounded by a rural environment. The homes are privately owned and lived in by permanent residences of the island of St. Croix. These subdivisions are situated in the North Central portion of the island of St. Croix in the upstream sector of the Salt River watershed approximately 5 miles West of Christiansted. Estate Mon Bigou is located upstream of Glynn at the confluence of the Canaan Gut and the Little

Fountain Gut. The physical characteristics of the area are represented by steep topography, thin clayey soils with nonporous rock bases and numerous short drainage basins. Flooding is of short duration with high velocities.

a. There are over 200 individual residential units in the area which have experienced severe flooding and extensive property losses. Their construction ranges from poor frame to good masonry. Many are built at ground level. They range in size from 500 to 3,000 square feet. All housing units in the Estate Mon Bijou and Glynn are not affected by flooding; however, the majority of units in Estate Mon Bijou would be inundated during an SPF condition.

b. Maps were prepared for the study area showing the type of existing land use, its location, and an estimate of the value of the land use activity at each location. Flooded area maps were also prepared of the area for the 2, 5, 10, 25, 50, 100 and SPF without project storm frequencies. These flooded area maps describe the stages and frequencies of each of these floods. The information used in calculating the flood damages caused by each of these storms is obtained by interfacing the data on the land use maps and the flood frequency maps. The damages occurring to existing land use (1985) for each of these flood frequencies is shown in the following tabulation.

TABLE E-3

SUMMARY OF WITHOUT PROJECT DAMAGES
(Existing Land Use)
1986 Price Levels

FLOOD FREQUENCY	DAMAGES WITHOUT PROJECT CONDITIONS		
	MON BIJOU	GLYNN	TOTAL
2	339,990	4,100	344,090
5	629,790	36,230	666,020
10	823,100	74,340	897,440
25	1,108,060	125,580	1,233,640
50	1,318,280	199,400	1,517,680
100	1,504,230	293,370	1,797,600
SPF	2,357,460	931,880	3,289,340
AVERAGE ANNUAL	413,380	28,770	442,150

4. Future Without Project Flood Damages. That portion of the Estate Mon Bijou Subdivision subject to flooding is very densely developed and there is expected to be no change in the future utilization of the land in this area. The Glynn Subdivision is less thickly settled; however, most of the home sites have been developed in the area and it is concluded that little future change will take place in the area under without project conditions. Therefore, existing and future flood damages will be identical.

5. With Project Damages. Five proposals have been examined as solutions to the flooding problems in this area. They consist of the concrete bypass plan, the gabion bypass plan, the earthen bypass with drop structure plan, the non-structural relocation plan and the selected plan. The first three plans are bypass channels around the residential area and provide exactly the same flood protection. The non-structural relocation plan consists of purchasing all structures within the 5-year, the 10-year and the 25-year flood plains and relocating those residences elsewhere. The selected plan consists of a partial channel improvement of the existing channel. The benefits derived from each of these proposals are discussed below.

a. With Project Damages for the Bypass Plans. Flooded area maps were prepared of the area for the 25, 50, 100 and SPF frequency storms with project hydrologic conditions. These maps were interfaced with existing land use maps to obtain the depth of flooding in the residential structures. The structure and content damage was estimated using depth damage curves developed for the area. Additional damage was calculated for autos, lawns and shrubs, roadways and culverts. The results of the analysis are shown in the following tabulation.

TABLE E-4
SUMMARY OF WITHOUT AND WITH PROJECT (BYPASS PLAN) DAMAGES
(Existing Land Use)
1986 Price Levels

FLOOD FREQUENCY	DAMAGES W/O PROJECT CONDITIONS	DAMAGES WITH PROJECT CONDITIONS	DAMAGES PREVENTED
	$	$	$
2	344,090	0	344,090
5	666,020	0	666,020
10	897,440	0	897,440
25	1,233,640	242,550	991,090
50	1,517,680	431,970	1,085,710
100	1,797,600	568,470	1,229,130
SPF	3,289,340	921,480	2,367,860
AVERAGE ANNUAL	442,150	26,550	415,600

No future change is anticipated in the land use as a result of providing these plans. Both existing and future damages are the same. The average annual equivalent benefits derived from these three bypass plans are $396,000.

b. Non-Structural Relocation Plan. The number of structures required to be purchased in each of the three flood plains is shown in the following tabulation.

TABLE E-5
ESTIMATED NUMBER AND VALUE OF STRUCTURES AND LAND TO BE PURCHASED
(Existing Land Use)
1986 Price Levels

FLOOD FREQUENCY	NO. OF STRUCTURES	ESTIMATED AVERAGE VALUE	ESTIMATED TOTAL COST
		$	$
2	29	58,400	
	2	41,500	2,579,180
5	35	58,400	
	5	41,500	3,270,500
10	41	58,400	
	6	41,500	4,027,890
25	51	58,400	
	13	41,500	5,114,080

Flooded area maps were prepared for the areas outside these flood plains and flooding to the remaining structures and contents determined. The average annual damages which would occur to these remaining residences were then computed.

Benefits of the Nonstructural Plans. The nonstructural plans being examined consists of purchasing those residential properties located within the 5, 10, and 25-year without project flood plains and relocating the residences elsewhere. Because only that portion of flood losses prevented which are externalized may be claimed as benefits, the average annual damage was computed separately for those structures within the without project flood lines. Those properties falling outside the without project flood line remain subject to inundation damages from flood frequencies greater than the 2, 5, 10, and 25-year frequency floods and those average annual damages have been computed and are noted as residual damages.

The benefits claimed are computed as the damages to those properties proposed to be removed. Only externalized flood damages are eligible to be claimed as benefits. The externalized flood damages are equal to the total flood damages less the cost of the flood insurance premiums paid by the owner of the insured structure located in the flood plain. ER 1105-2-353 stipulates that flood insurance premiums are a cost borne by the flood plain activity under without project conditions and must be deducted from the without project damages. The flood insurance premium for each activity was computed using the rates and methods specified in the Flood Insurance Manual (NFIP-10/83). The total premium for structure and contents was assumed to be an average annual equivalent since it would be an annual payment.

The deductible portion of flood damages is also assumed to be a cost borne by the flood plain activity, and is therefore subtracted from the damages prevented. The $200 deductible for structure and for content damages ($400 total) from each occurrence was converted to an average annual equivalent by application of expected frequency of flooding based upon the elevation of the structure.

The overhead associated with administration of the Flood Insurance Program for structures to be removed is $85.00 per policy as prescribed in EC 1104-2-167 for 1987. Because this overhead represents a cost borne by the nation, the reduction of the overhead associated with the relocation of flood plain activities is an NED benefit of the project. The estimated overhead and administration cost associated with the subject properties was added to the damages prevented (less flood insurance premiums and deductibles) in order to arrive at the benefit to relocation of the subject flood plain activities.

The average annual equivalent benefits available from each of these three nonstructural plans is shown in the following tabulation (Table E-6).

TABLE E-6

BENEFITS FROM NONSTRUCTURAL PLANS
($1,000)

Plan	Ave Ann Eqvn Damages w/o Project	Flood Insurance Premiums	Deductibles	Overhead and Admin	Benefits
2 Year	262.6	8.9	6.2	2.6	250.1
5 Year	358.0	11.3	7.3	3.4	342.8
10 Year	372.3	13.2	9.4	3.9	353.6
25 Year	384.4	17.6	12.8	5.4	359.4

c. Selected Plan. Flooded area maps were prepared for the 2-year, 5-year, 10-year, 25-year, 50-year, 100-year, and SPF flood with project storm events. These maps were interfaced with the existing land use maps to obtain the depth of flooding in the residential structures. The structure and content damage was estimated using depth-damage curves developed for the area. Additional damage was calculated for autos, lawns and shrubs, roadways and culverts. The results of these calculations are shown in the tabulation on table E-4. These reflect the elimination of most of the flooding in the Mon Bijou and Glynn areas due to the diversion of water around the developed portions.

SECTION 205 DETAILED PROJECT REPORT

ESTATE MON BIJOU

ST. CROIX, U.S. VIRGIN ISLANDS

APPENDIX F

CULTURAL RESOURCES

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APPENDIX F
CULTURAL RESOURCES

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APPENDIX F

CULTURAL RESOURCES

1. A cultural resources survey was conducted of the Mon Bijou Flood Control Project area for the U.S. Army Corps of Engineers, Jacksonville District (Cultural Resources Survey: Mon Bijou Flood Control Project, St. Croix, V.I., 1984). This survey was designed to (1) identify/describe any sites in the project area, (2) evaluate the significance of any located sites and assess their eligibility for nomination to the National Register of Historic Places (NRHP), and (3) prepare mitigation plans for any NRHP sites. Work was accomplished in compliance with the National Historic Preservation Act of 1966, as amended (PL 89-665); the Archeological and Historic Preservation Act, as amended (PL 93-291); and Executive Order 11593. The report was coordinated with the State Historic Preservation Officer (SHPO) and the National Park Service.

Background.

2. The proposed Mon Bijou Flood Control Project crosscuts a portion of the Upper Salt River Archaeological District, which is included on the National Register of Historic Places (NRHP). Four prehistoric (Saladoid) sites are located within this district (Glynn 1 and Glynn 2, and Windsor 1 and Windsor 2). Three other sites have been identified in the area (Concordia 2, Concordia 3, and Windsor 4), and another - the Lebanon Dam Site - was discovered during the survey conducted for this project (see figure 1).

Survey.

3. Fieldwork was conducted from 24 September through 16 October 1983, and focused on a corridor defined as approximately 61 meters wide by 2,016 meters long. This corridor was identified by establishing a centerline for the proposed bypass channel and extending approximately 30.5 meters on either side (see figure 2).

4. Field investigations entailed both surface examination and subsurface testing. Transects divided the area into approximately 30m x 30m sections. These transects were marked, and a 1-meter wide path on each side was visually inspected. This surface study was subsequently supplemented by test units, again placed at 30-meter intervals. Sixty-eight (68) such units were dug. The depth of each was determined by the presence of hard clay or rock, and the majority reached 50-60 cms (see figures 3a-3g).

5. In addition to this systematic pattern of coverage, a reconnaissance was made of significant sites bordering the proposed channel. The purpose of this additional investigation was to establish the boundaries of Glynn 1 and the Lebanon Dam Site to see if they extended into the project corridor.

Results.

6. No significant cultural resources were identified in the proposed project area. Testing of Glynn 1 and the Lebanon Dam Site suggested that materials found inside the project area were secondary or tertiary deposits resulting from slopewash.

7. One potential site was identified. A depression located west of the Estate Lebanon stock pond may be a prehistoric or historic well. Stones filling the area precluded investigations to determine its origin.

Conclusions.

8. The survey concluded that no known significant sites will be adversely affected by construction of the Mon Bijou Flood Control Project. None were identified within the corridor itself, and, since neither the water level nor the velocity will be increased by the proposed project, no adverse effects to downstream sites is anticipated.

9. However, given the proximity of Glynn 1 and the Lebanon Dam Site to the project area (see figure 4), and because the channel passes through a National Register District, an archeological monitor will be present during construction to ensure that no significant sites are adversely affected. In addition, the construction contractor will remove the stones blocking the depression area, and an archeologist will determine if it represents a significant cultural resource. If any sites are identified that will be impacted by the project and that are eligible for nomination to the NRHP, mitigation will be accomplished.

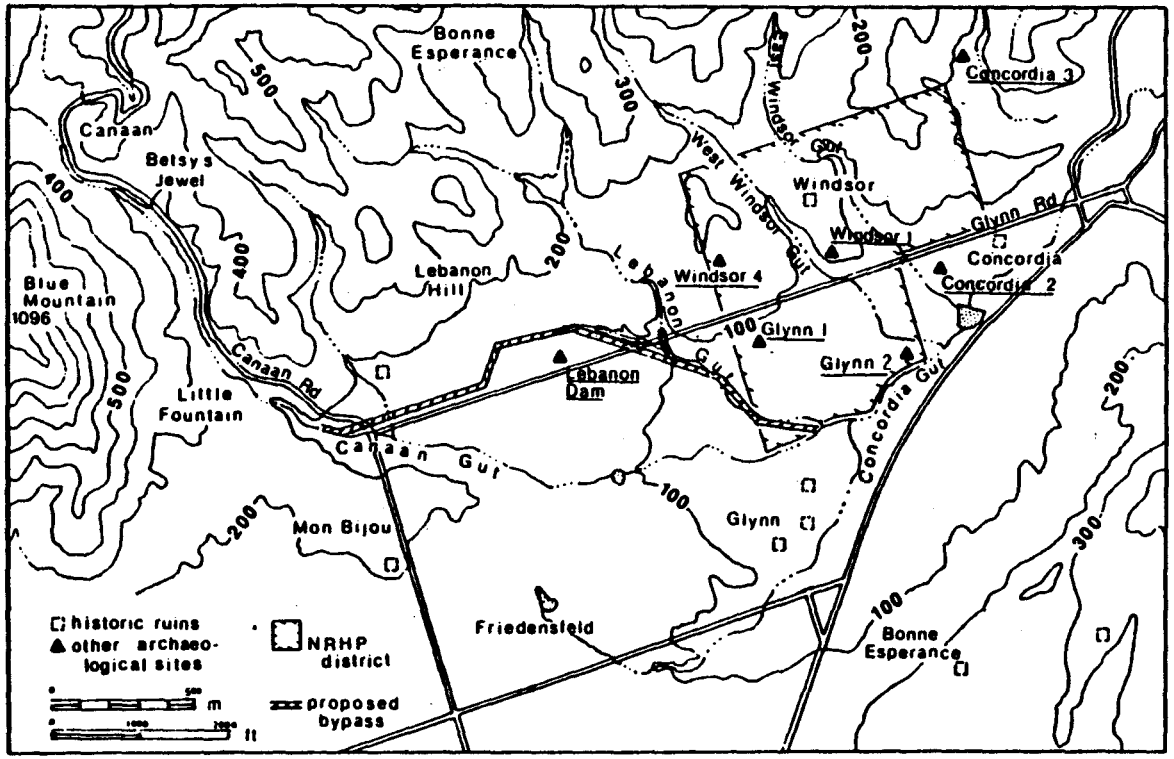
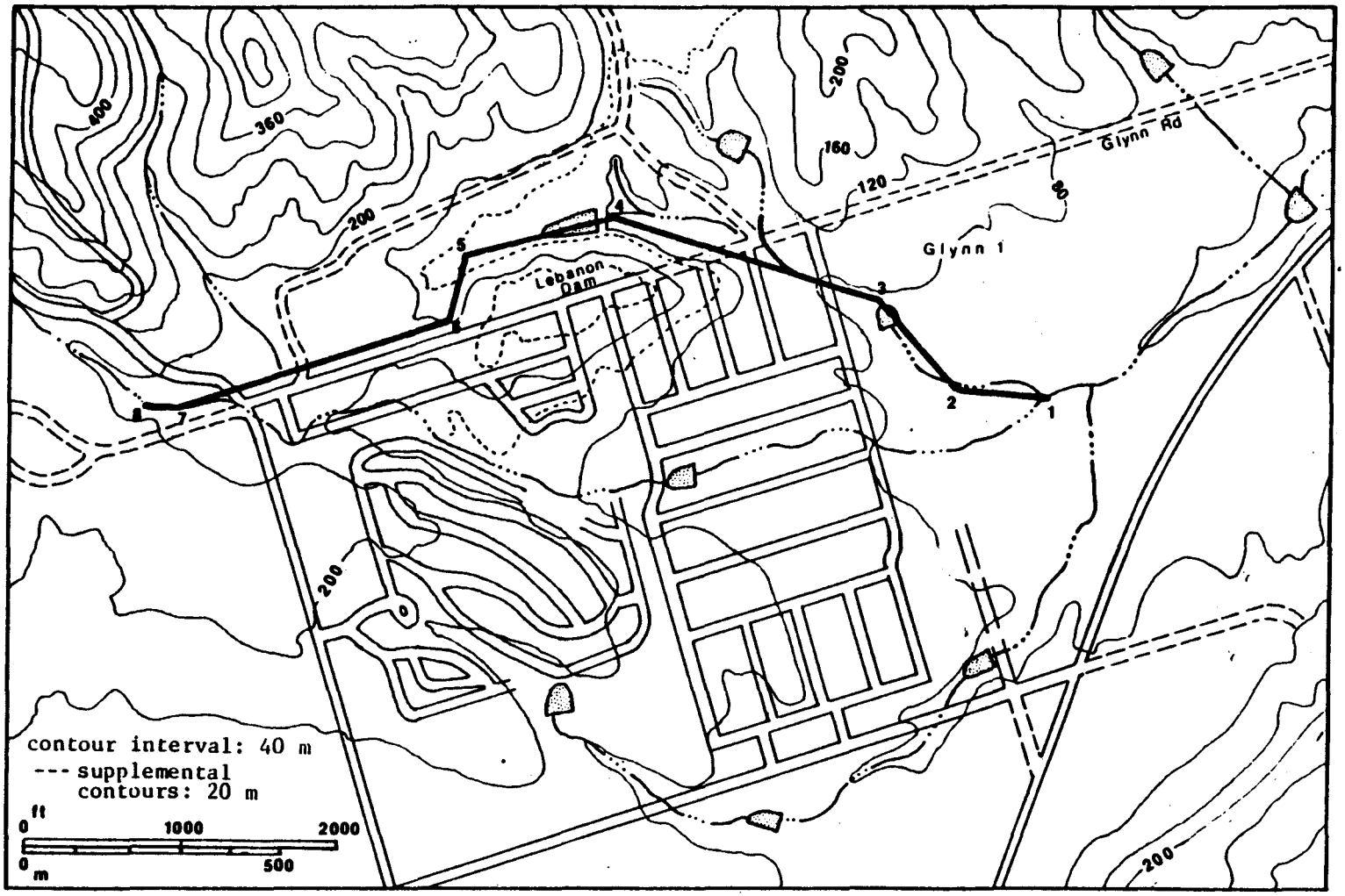


Figure 1 Known cultural resources in the region of the proposed project.



(Base: DCCA 1976)

Figure 2 Approximate location of the proposed project centerline, with numbered turning points.

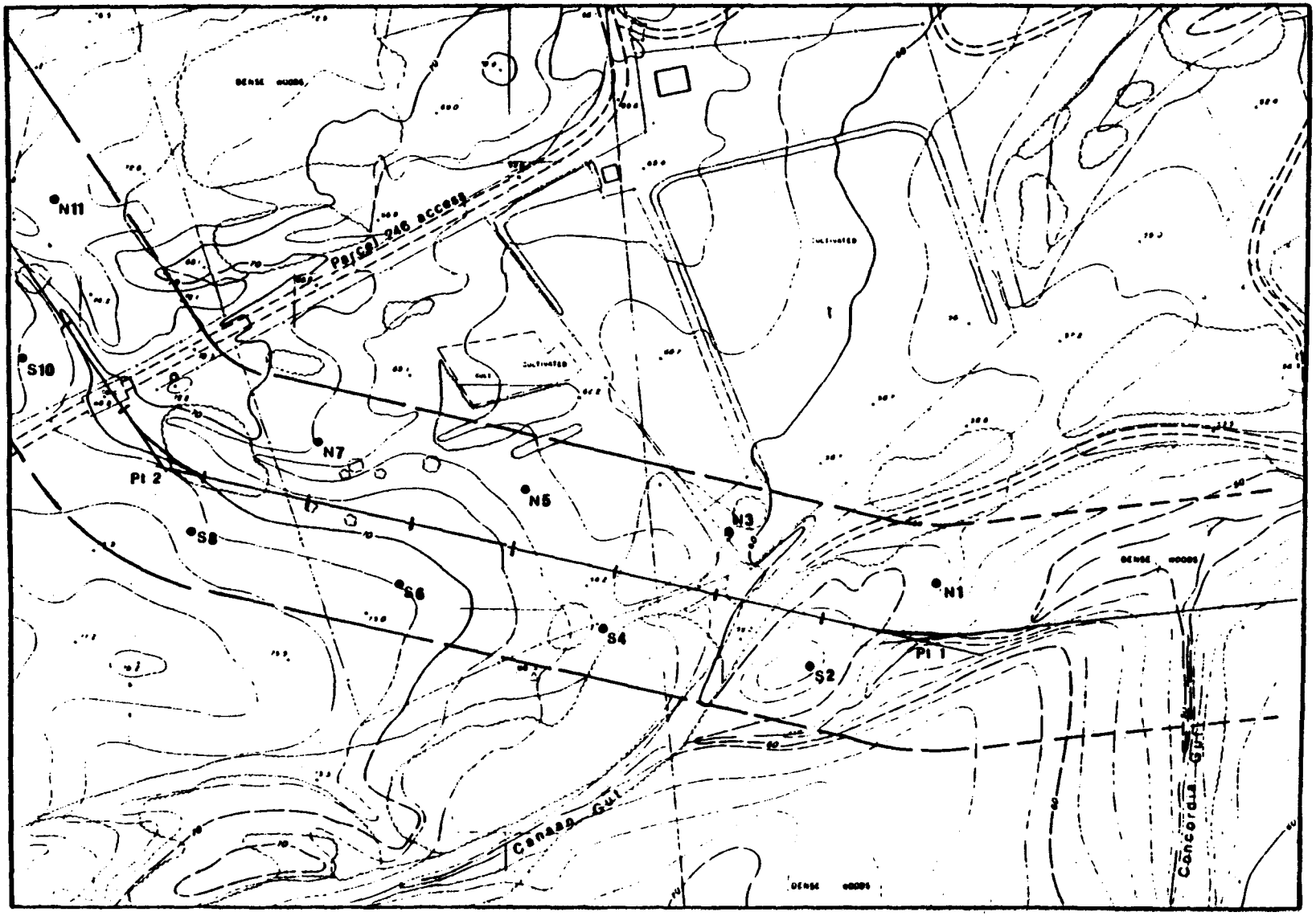


Figure 3a Survey sections and test locations in the project corridor: Canaan Gut to parcel 246 access road.

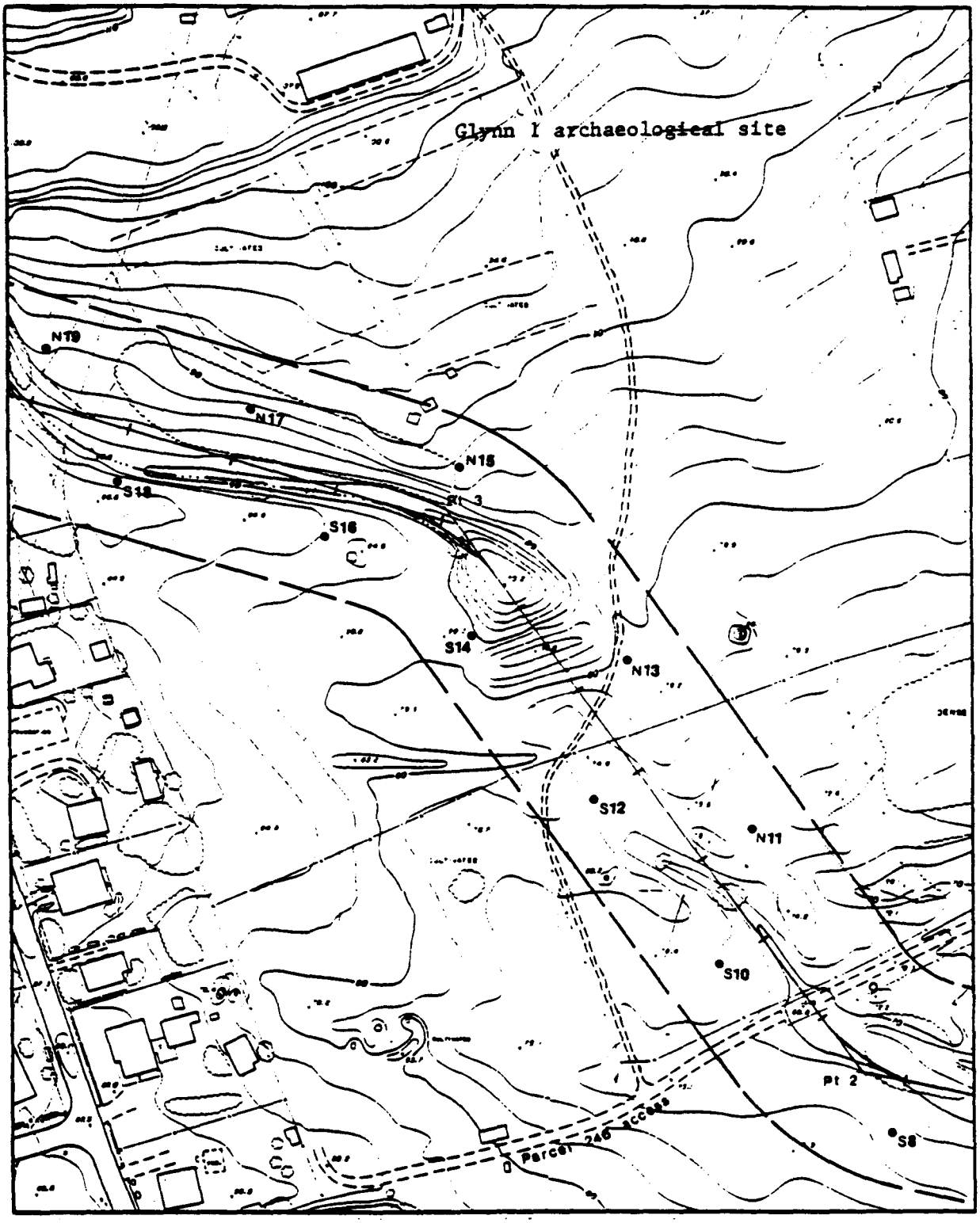


Figure 3b Survey sections and test locations in the project corridor: parcel 246 access road to Glynn subdivision.

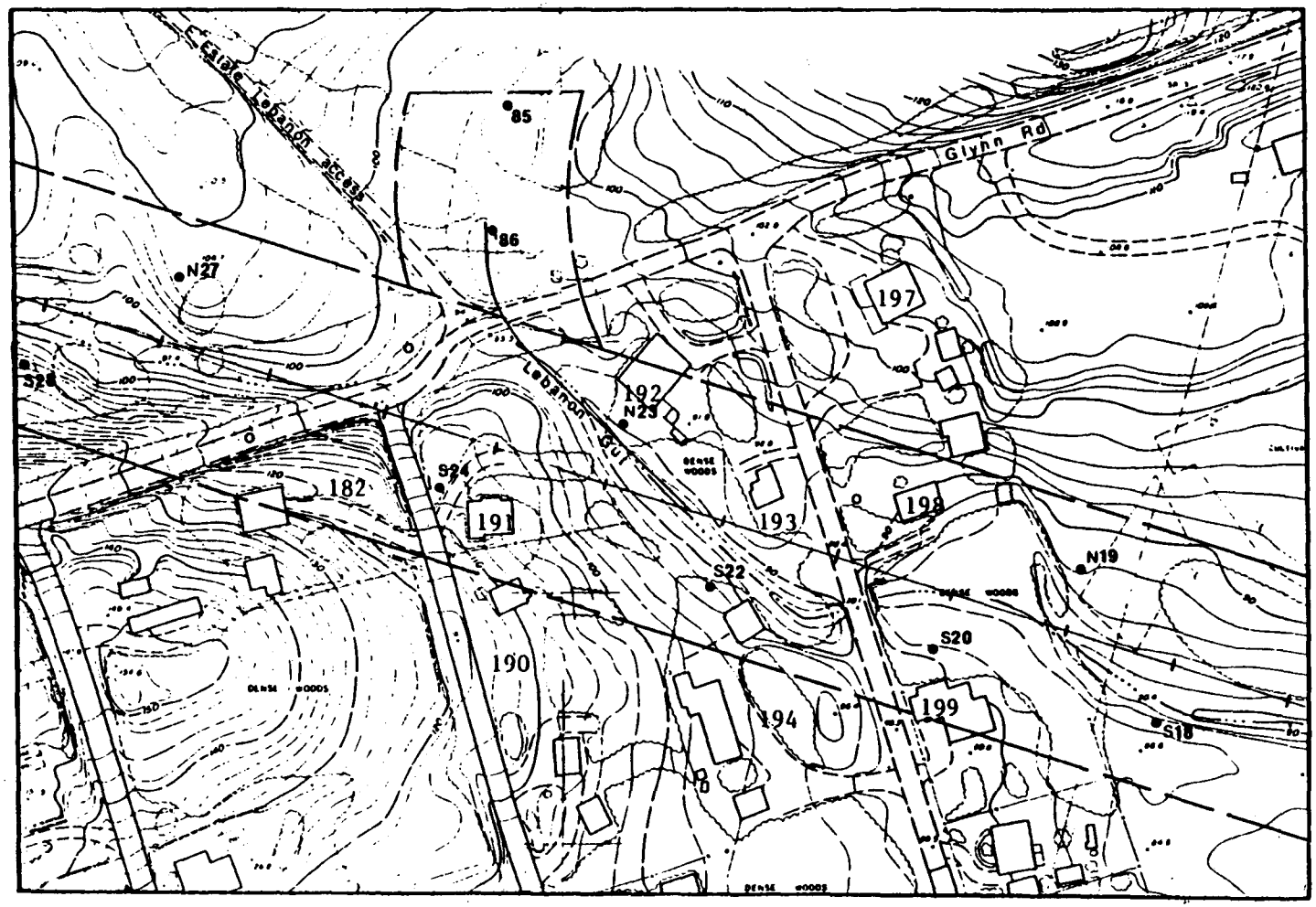


Figure 3c Survey sections and test locations in the project corridor: Glynn subdivision, and additional diversion channel.

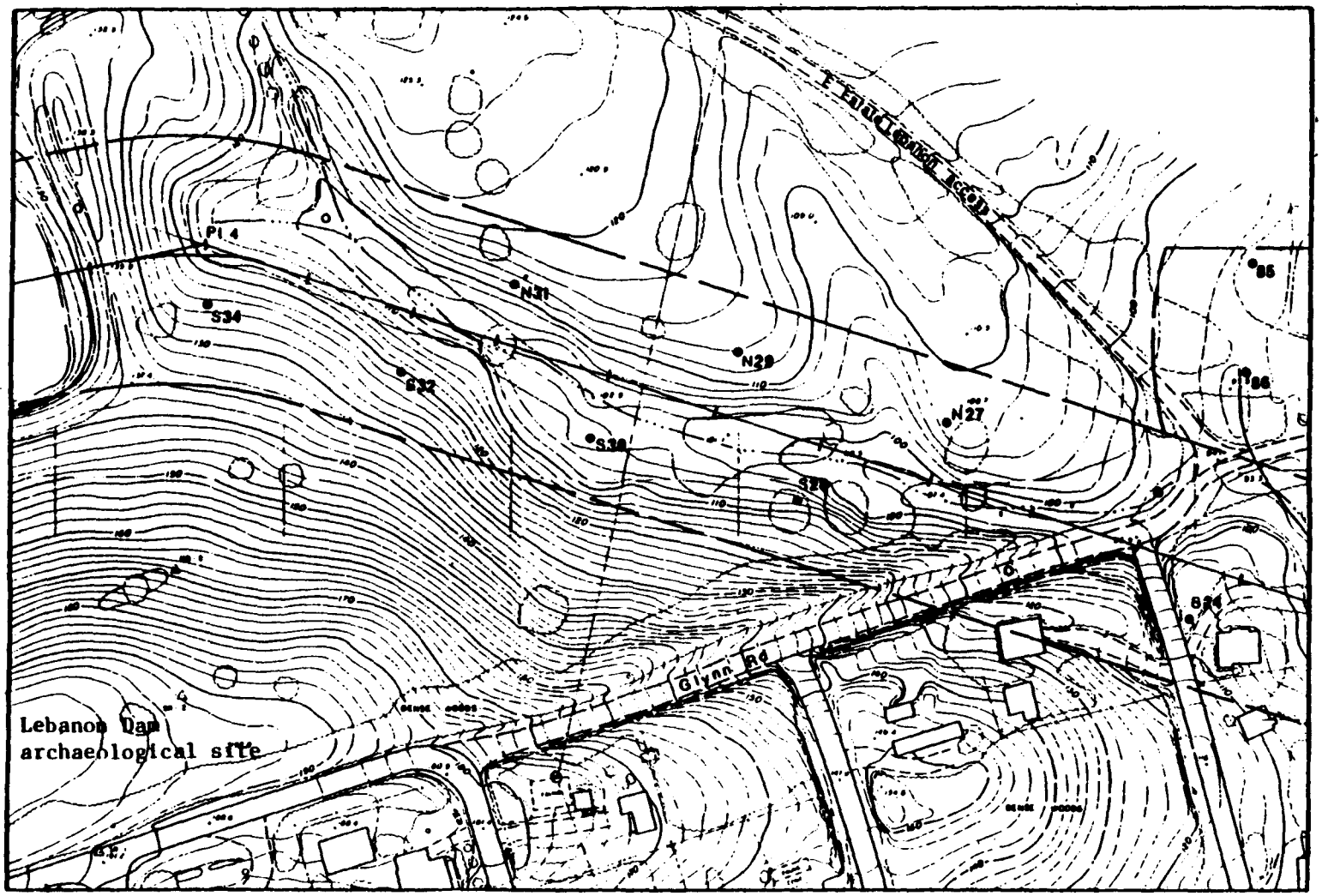


Figure 3d Survey sections and test locations in the project corridor: Glynn Road to Point 4.

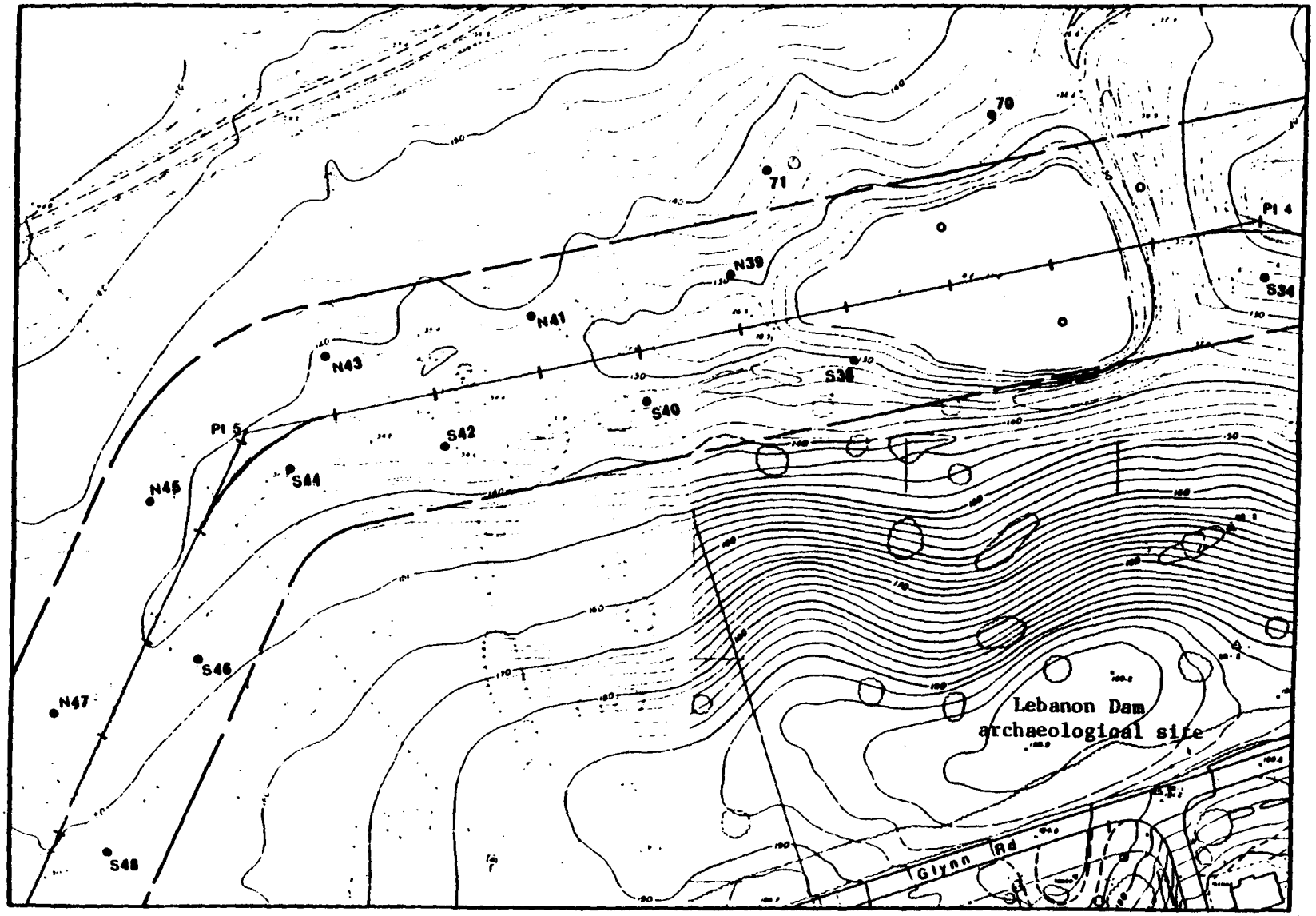


Figure 3e Survey sections and test locations in the project corridor: Point 4 to stake 48.

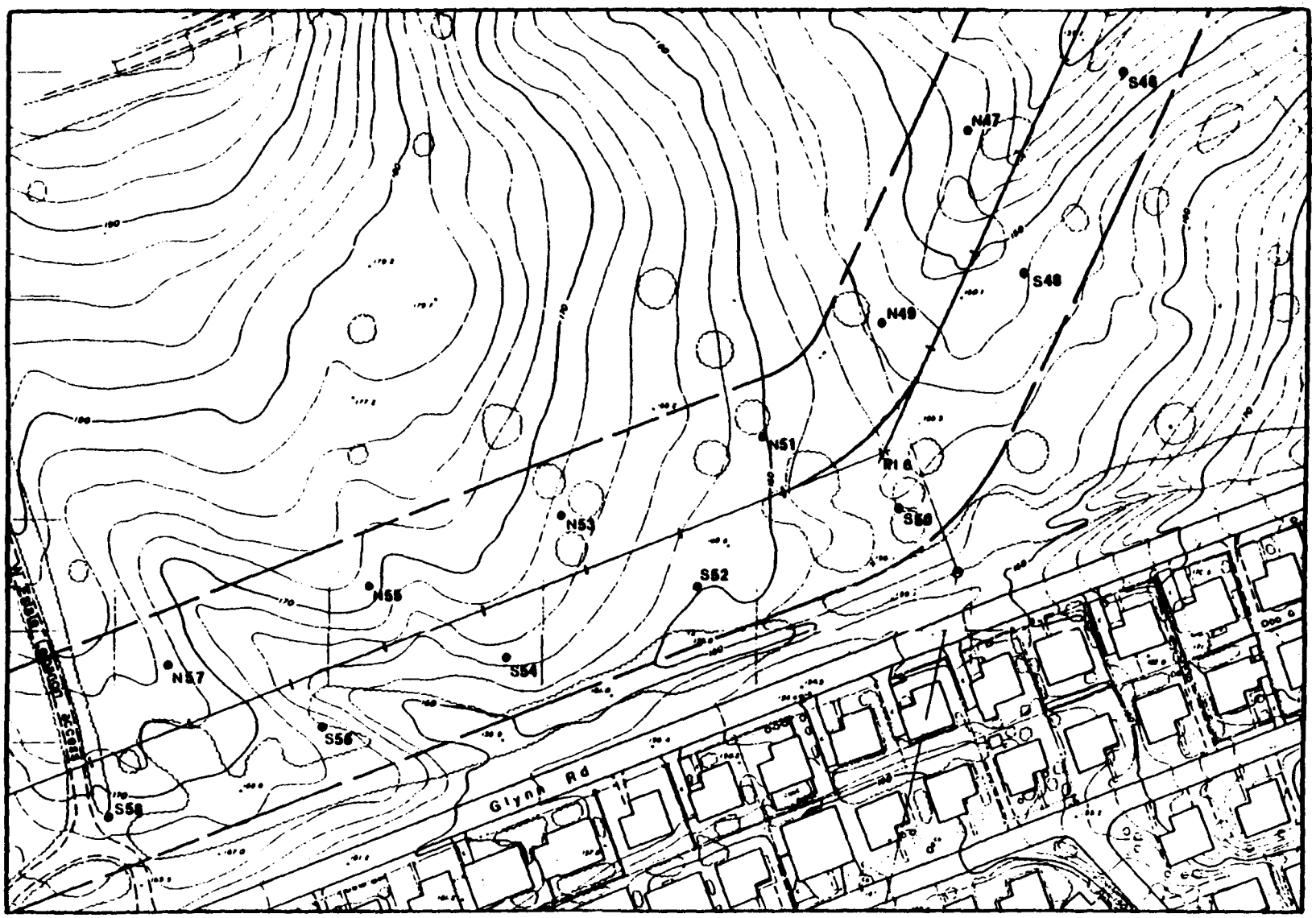


Figure 3f Survey sections and test locations in the project corridor: stake 46 to western Estate Lebanon Hill access road.

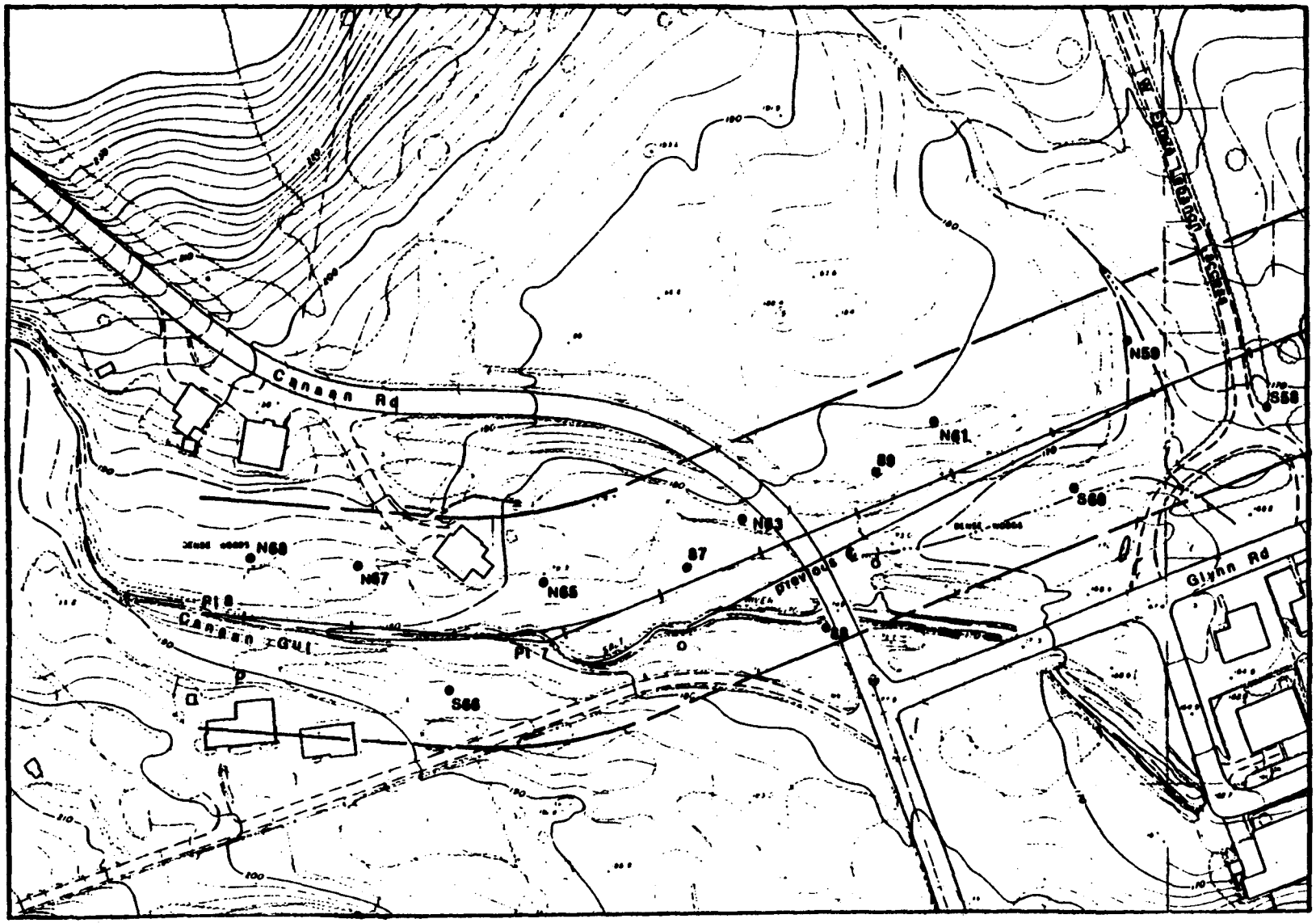
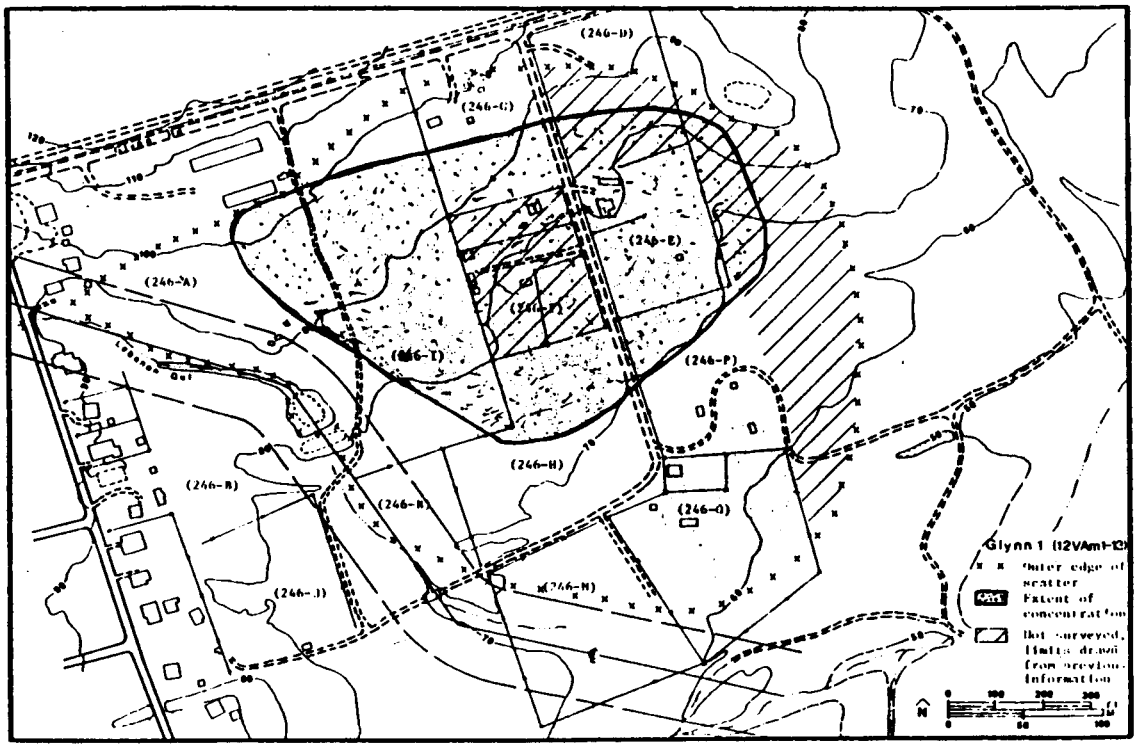
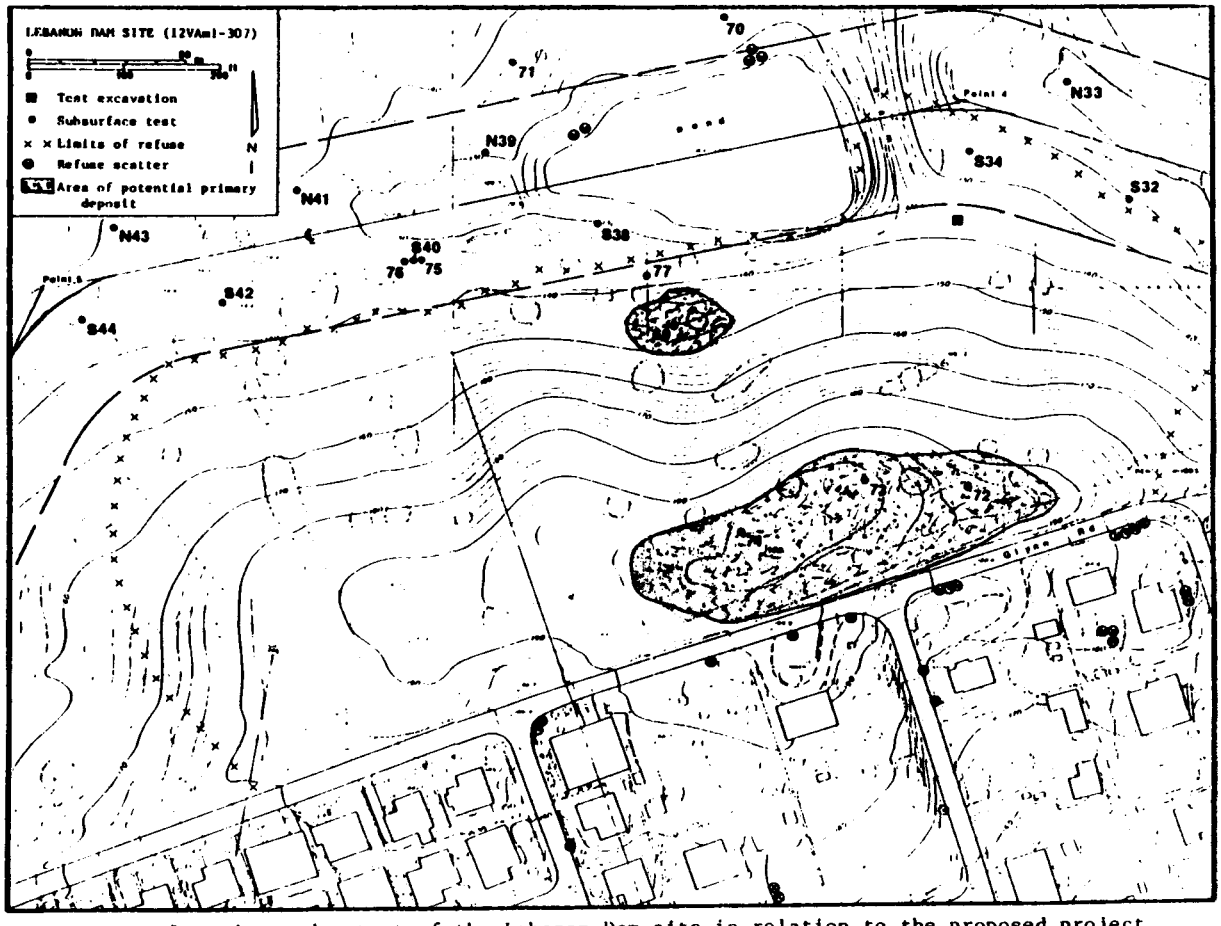


Figure 3g **Survey sections and test locations in the project corridor: western Estate Lebanon Hill access road to Point 8.**



Location and extent of the Glynn 1 archaeological site in relation to the proposed project corridor.



Location and extent of the Lebanon Dam site in relation to the proposed project corridor.

Figure 4

SECTION 205 DETAILED PROJECT REPORT

ESTATE MON BIJOU

ST. CROIX, U.S. VIRGIN ISLANDS

APPENDIX G

LOCAL COOPERATION AND PUBLIC INVOLVEMENT

APPENDIX G

LOCAL COOPERATION AND PUBLIC INVOLVEMENT

This appendix contains the Letter of Intent and acknowledgement of the draft Local Cooperation Agreement (LCA) prepared in conjunction with the project's local sponsor, the Public Works Department of the Government of the U.S. Virgin Islands. Also included within this appendix are comments received from those who have reviewed the draft report. These comments and those received during a public workshop on St. Croix at the John H. Woodson Junior High School on June 30, 1987, have been incorporated into this final report. Local press coverage of the workshop is also included.

IN REPLY ADDRESS
COMMISSIONER OF PUBLIC WORKS

Refer .....

GOVERNMENT OF
THE VIRGIN ISLANDS OF THE UNITED STATES
CHARLOTTE AMALIE, ST. THOMAS, V. I.
P.O.BOX 4400
PUBLIC WORKS DEPARTMENT

DIVISION Office of the Commissioner

November 16, 1987

Colonel Robert L. Herndon
District Engineer
U.S. Army Corps of Engineers
P. O. Box 4970
Jacksonville, FL 32232-0019

Dear Colonel Herndon:

We are reviewing the draft Local Cooperation Agreement (LCA) as proposed for the Estate Mon Bijou/Glynn Area of St. Croix.

As the local sponsor of the proposed flood damage reduction measure on St. Croix, we intend to fulfill our obligation as ultimately negotiated in the completed LCA.

Sincerely,

Gabriel St. Surin
Coordinator of Special Projects

GSS/alg

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION II
26 FEDERAL PLAZA
NEW YORK, NEW YORK 10278

OCT 18 1984

Mr. A.J. Salem
Chief, Planning Division
Department of the Army
Jacksonville District, Corps of Engineers
P.O. Box 4970
Jacksonville, Florida 32232

Dear Mr. Salem:

We have reviewed the feasibility study notice regarding the proposed flood control channel located at Estate Mon Bijou, St. Croix, U.S. Virgin Islands.

Based upon the brief project description and map provided, it is difficult to determine if the proposed channel modifications will impact wetland areas. If wetland areas are impacted by the proposed project, please be advised that 404 (b)(1) Guidelines will apply and further coordination between our respective agencies will be necessary.

If you have any questions relating to the above comment, please contact Mr. Christopher Militscher of my staff at (212) 264-0522.

Thank you very much for the opportunity to comment.

Sincerely yours,

Richard M. Walka

Richard M. Walka, Chief
Environmental Impacts Branch

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION II
26 FEDERAL PLAZA
NEW YORK, NEW YORK 10278

AUG 13 1987

Mr. A.J. Salem
Chief, Planning Division
Department of the Army
Jacksonville District, Corps of Engineers
P.O. Box 4970
Jacksonville, FL 32232-0019

Dear Mr. Salem:

The Environmental Protection Agency (EPA) has reviewed the draft definite project report and environmental assessment for the proposed flood control channel located at Estate Mon Bijou, St. Croix, Virgin Islands. Based on our review, we offer the following comments:

The environmental assessment states that valuable mangrove and salt pond wetlands located in the Salt River Bay will not be adversely affected by the project. Detailed information to support this conclusion should be provided. In addition, consideration should be given to our comments of July 21, 1982, concerning the clearing of lower channels leading into Salt River Bay as an addition to the proposed plan.

Appropriate measure should be employed during the construction and operation of the flood control channel to ensure that the vegetation that controls soil retention is not destroyed. In addition, care should be taken to ensure that the pre-historic sites at Glynn I and Lebanon Dam are not disturbed.

Thank you for the opportunity to comment. If you should have any questions, please contact Ms. Vicki J. Snitzler of my staff at (212) 264-6677.

Sincerely yours,

Robert W. Hargrove, Chief
Federal Activities Section
Environmental Impacts Branch

United States Department of the Interior
FISH AND WILDLIFE SERVICE
Division of Ecological Services
Mayaguez, Puerto Rico 00709

June 28, 1982

Mr. A. J. Salem
Acting Chief, Planning Division
U.S. Army Corps of Engineers
P.O. Box 4970
Jacksonville, Florida 32232

Re: Estate Mon Bijou
St. Croix, Virgin Islands

Dear Sir:

This constitutes a Planning Aid letter for the above referenced project. This is provided in accordance with the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.).

This letter is based on a review of the preliminary reconnaissance report including alternatives and a field review of the area conducted on June 17, 1982.

Description of the Project Area

Estate Mon Bijou is located in the north-central part of St. Croix and is located about 5 miles west of Christiansted. The area experiences severe flooding due to steep slopes that can create flash floods during periods of heavy rain. The fact that severe flooding occurs is evident in that several homes in Estate Mon Bijou have been abandoned due to the flooding conditions present within the drainage.

The upper portions of the Mon Bijou/Glynn watershed is characterized by a mixture of upland vegetation and open pasture areas. The most prominent structure within the watershed is the housing development. Vegetation in the upper portion is mostly grasses and some large trees such as Flamboyan (Delonix regia), thorn scrub (Acacia), gumbo-limbo (Bursera simaruba), mango (Mangifera indica) and tamarindo (Tamarindus indica). There are no wetlands in the upper portion of the drainage.

The most significant ecological area within the entire drainage is Salt River Bay, the receiving waters of the drainage. This area is characterized by mature stands of mangroves and salt ponds that provide significant habitat for aquatic wildlife. As now outlined, the proposed project would not impact the Salt River Bay area, at least from a construction standpoint. However, the determination remains to be made on whether changes in flow due to water retention will have any impact on the bay.

Surveys and conversations with personnel from the Virgin Islands government indicate there are no significant habitats or wildlife concentrations within the proposed project. Some songbird habitat will be impacted but the effects would not be considered significant. Virgin Islands Department of Conservation and Cultural Affairs (DCCA) personnel will conduct a complete survey of the project area once the final alternative is selected. The idea of the survey is to identify any significant trees or patterns of vegetation that should be protected. It is not expected that such areas will be significant.

Recommendations

During the recent survey, it was noted that the lower portions of Mon Bijou/Glynn watershed channel is severely silted up. The reconnaissance report does not address any plans to improve the lower channel, especially the channel area above the road before entering Salt River Bay. Serious consideration should be given to conducting a channel clearing in the lower section of the drainage in coordination with the proposed project. The lower section of Mon Bijou Gut will continue to flood unless the channel is cleared.

In discussions with DCCA personnel, it was pointed out that they would favor the construction of Plan 4 which would provide adequate storage for flood control. It was also pointed out that local farmers would be interested in obtaining water rights to water stored in any retention structure. This may or may not become a factor to consider in evaluating the project.

It is not anticipated that the project will have an adverse effect on fish or wildlife species.

Sincerely,

John A. Blankenship
Field Supervisor

cc: NMFS, Panama City
EPA, New York
DCCA, USVI
ARD-E, Atlanta

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION II
26 FEDERAL PLAZA
NEW YORK, NEW YORK 10278

21 JUL 1982

Mr. A. J. Salem, Acting Chief
Planning Division
Department of the Army
Corps of Engineers, Jacksonville District
P.O. Box 4970
Jacksonville, Florida 32232

Dear Mr. Salem:

This is in response to your letter dated June 10, 1982, inviting comments on the study being performed by the Corps on flood control measures at Estate Mon Bijou, St. Croix, U.S. Virgin Islands. Our agency has reviewed the information attached to your letter, and we offer the following comments:

1. The possibility of creating retention and storage capacity for flood waters should be explored due to present Virgin Islands water supply limitations.

2. Salt River Bay, the receiving water body of present drainage, is characterized by stands of mature mangroves and salt ponds. Both of these provide habitat for aquatic wildlife. Reduced freshwater inflow may have impacts on fish abundance, submerged aquatic vegetation, and water quality within the Bay by affecting mixing and/or flushing. The potential for such impacts should be assessed for each scenario or plan.

3. The U.S. Fish & Wildlife Service has indicated that their surveys of the area found heavy silt clogging of the lower channels leading into Salt River Bay. Plans should include a provision to clear these areas.

Please keep us apprised of any additional developments relative to this study.

Thank you for the opportunity to comment.

Sincerely yours,

Richard M. Walka

for Anne Norton Miller, Chief
Environmental Impacts Branch

OFFICE OF
THE COMMISSIONER



GOVERNMENT OF THE VIRGIN ISLANDS OF THE UNITED STATES

Department of Conservation and Cultural Affairs

P. O. BOX 4340
CHARLOTTE AMALIE, ST. THOMAS, V.I. 00801

September 23, 1987

Mr. A.J. Salem
Chief
Planning Division
Department of the Army
Corps of Engineers
P. O. Box 4970
Jacksonville, Florida 32232-0019

RE: Estate Mon Bijou/Glynn
Section 205
Flood Control Project
St. Croix, V.I.

Dear Mr. Salem:

The Division of Coastal Zone Management has reviewed the Draft Definite Project Report and Environmental Assessment for a Flood Control project at Estate Mon Bijou, St. Croix, Virgin Islands.

This project is in Tier II, and not within the Coastal Zone (Tier I). However, the Department has authority to make the determination for federal consistency pursuant to the provisions of Section 904-7 of the rules and regulations of Title 12, Chapter 21, V. I. Code, and the Coastal Zone Management Act of 1972, as amended (16 U.S.C. Section 1451, et.seq.) and the regulations governing such federal consistency determinations (15CFR Part 930) which became final June 25, 1979.

The proposed activity is consistent with the goals and policies of the Virgin Islands Coastal Zone Management Act. I find that the project will not directly impact the coastal zone, and do not object to the proposed project.

Additionally, attached find a copy of the Water Quality Review and Certification for said project.

Should you require further information please contact me or Mr. Benjamin I. Nazario, Director, Division of Coastal Zone Management, at (809) 773-5774 or (809) 774-3320 ext. 145.

Yours truly,

Alan D. Smith
Commissioner

ADS/rds

cc: James C. Savage-Commissioner, DPW
Benjamin I. Nazario, Director, DCZM
Project File

IN REPLY ADDRESS
COMMISSIONER OF PUBLIC WOR

Refer .....

GOVERNMENT OF
THE VIRGIN ISLANDS OF THE UNITED STATES

CHARLOTTE AMALIE, ST. THOMAS, V. I.
P.O.BOX 4400
PUBLIC WORKS DEPARTMENT

DIVISION Office of the Commissioner

April 2, 1987

Col. Charles T. Myers III
District Engineer
U.S. Army Engineer District,
Jacksonville
P.O. Box 4970
Jacksonville, Florida 32232-0019

RE: LETTER OF INTENT

Dear Colonel Myers:

The Department of Public Works for the U.S. Virgin Islands has reviewed the draft report on Mon Bijou and generally concur with the findings contained therein. The Government of the Virgin Islands is a public body legally capable of fulfilling the requirements of local cooperation for this project in accordance with Section 221 of the Flood Control Act of 1970.

This Letter of Intent, while not considered a binding contract, is furnished to document our support of this project and our intent to act as local sponsor for its implementation. We understand that following project approval but prior to construction, we will be asked to enter into a binding agreement to furnish certain items as outlined in the report. Specifically, we intend to:

a. Provide, prior to construction, an amount equal to not less than 25 percent of total project costs for flood control, at least 5 percent of which will be cash. The amount to be provided shall include the value or cost of all lands, easements, right-of-way, and utility and facility alteration and relocations necessary for construction and subsequent maintenance of the project including suitable burrow and dredged material disposal areas, as may be determined by the Chief of Engineers.

b. Provide without cost to the United States all lands, easements, and rights-of-way, including suitable disposal areas as determined by the Chief of engineers, necessary for construction and maintenance of the project.

c. Accomplish without cost to the United States all alterations and relocations of buildings, transportation facilities, storm drains, utilities, and other structures and improvements made necessary by the construction.

d. Hold and save the United States free from damages due to the construction works, not to include damages due to the fault or negligence of the United States or its contractors.

e. Maintain and operate all the work after completion in accordance with regulations prescribed by the Secretary of the Army.

f. In a form acceptable to the Chief of Engineers, enact ordinances and promulgate regulations to prevent encroachment on the floodplain storage areas, channels, and rights-of-way and to prevent an undue increase in the flood damage potential.

g. Assume all project costs in excess of the Government limitation of $5,000,000.

h. Comply with the provisions of Public Law 91-646, Uniform Relocation Assistance and Real Property Acquisition Act of 1970.

i. Comply with the conditions set forth under Title VI of the Civil Rights Act of 1964.

Sincerely,

James C. Savage
Acting Commissioner

JCS/GSS/csh

cc: Mr. Gabriel St Surin

IN REPLY ADDRESS
COMMISSIONER OF PUBLIC WORKS
Refer .....

GOVERNMENT OF
THE VIRGIN ISLANDS OF THE UNITED STATES
CHARLOTTE AMALIE, ST. THOMAS, V. I.
P.O.BOX 4400
PUBLIC WORKS DEPARTMENT

DIVISION OFFICE OF THE COMMISSIONER

August 12, 1987

Mr. A. J. Salem
Chief, Planning Division
U.S. Army Corps of Engineers
Jacksonville District
P. O. Box 4970
Jacksonville, FL 32232-0019

RE: MON BIJOU FLOOD CONTROL REDUCTION PROGRAM
ST. CROIX, U.S. VIRGIN ISLANDS

Dear Mr. Salem:

As requested, transmitted are our comments on the proposed "Local Cooperation Agreement " (LCA) for the referenced project. If they are agreeable to you, please incorporate them in the final LCA and forward three copies to us for execution.

The agreement should be signed by the Commissioner of Public Works. Therefore, paragraphs I and II can be neglected.

Sincerely,

Gabriel St. Surin
Engineer and Acting Director
of Planning & Development

Attachment

GSS/alg

cc: Mr. James C. Savage
Mr. Miguel Farrington
Mr. O'Neal Abel

GOVERNMENT OF
THE VIRGIN ISLANDS OF THE UNITED STATES
—o—
DEPARTMENT OF LAW
Norre Gade No. 46
Charlotte Amalie, St. Thomas, V.I. 00802

1987 JUL 24 AM 10: 03
PUBLIC WORKS DEPT.

In reply please refer to our
File No. _____

July 22, 1987

Hon. James C. Savage
Commissioner
Department of Public Works
St. Thomas, V.I. 00801

Re: Proposed Agreement with the Department of The Army

Dear Commissioner Savage:

The proposed agreement with the Department of the Army to construct a flood control project in Estate Mon Bijou, St. Croix has been reviewed and the following are my comments to same.

1. The first paragraph on page I should be modified by inserting after the words "Commissioner of" on the last line the words "Property and Procurement on behalf of".

2. The second WHEREAS cause on page I should identify more particularly what the Flood Control Act is.

3. I am unable to determine exactly what paragraph IIg means. I can not offer any comments on this subparagraph.

4. Paragraph IIi violates the provisions of 33 V.I.C. 3101 which prohibits the contracting for amounts in excess of appropriations. If there is an appropriation in existence, then a contract may be executed for an amount up to that appropriation.

5. Public works must have an appropriation to cover the cost of the items listed IIIb. This would be indicated on the contract by the inserting at the end of the contract the Account Code and the MED number.

6. Paragraph IIId provides that the Virgin Islands shall comply with the provision of Public Law 91-646. If there are any sums payable under this law are the funds available?

7. Article VI in so far as it deals with the Virgin Islands cash contributions is subject to the same limitations as set out in paragraph 4 above.

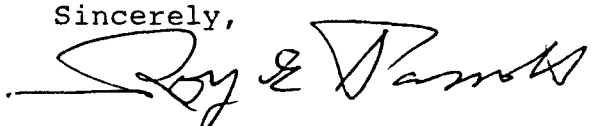
8. Article IX is subject to the limitations as set out in paragraph 4 above.

9. It may be that paragraph XVb should be expanded to include the Virgin Islands and it may resolve some of problems concerning the Virgin Islands contingent liabilities.

10. I find no where in the proposed agreement anything concerning the title to the work to be performed by the Army.

11. In addition to the items referred to in paragraph 5 above, provisions should be made at the end of the proposed agreement for the signature of the Acting Commissioner of Property and Procurement.

Sincerely,



ROY E. PARROTT
Assistant Attorney General

VIRGIN ISLANDS MAILING LIST

FEDERAL AGENCIES

Director
Office of Federal Activities
EPA, Region II
26 Federal Plaza
New York, New York 10278-0012

Area Supervisor
National Marine Fisheries Service
Environmental Assessment Branch
3500 Delwood Beach Road
Panama City, Florida 32407-7403

Director, Caribbean Area
Soil Conservation Service, USDA
GPO Box 4868
San Juan, Puerto Rico 00936-4868

Superintendent
Virgin Islands National Park
National Park Service
P.O. Box 806
St. Thomas, Virgin Islands 00801-0806

Territorial Representative
Federal Highway Administration
U.S. Federal Building, Room 114
Veterans Drive
St. Thomas, Virgin Islands 00801

Chief
Environmental Impacts Branch
U.S. Environmental Protection Agency
26 Federal Plaza, Room 400
New York, New York 10278-0001

Regional Director
U.S. Fish and Wildlife Service
75 Spring Street Southwest
Atlanta, Georgia 30303-3309

Field Supervisor
U.S. Fish and Wildlife Service
Caribbean Field Office
Post Office Box 491
Boqueron, Puerto Rico 00622-0491

San Juan Area Office
U.S. Army Corps of Engineers
ATTN: CESAJ-PG
400 Fernandez Juncos Avenue
San Juan, Puerto Rico 00901-3299

Chief, Caribbean District, WRD
U.S. Geological Survey
GPO Box 4424
San Juan, Puerto Rico 00936-4424

TERRITORIAL GOVERNMENT

Honorable Ron de Lugo
House of Representatives
Washington, D.C. 20515-0001

Honorable Alexander A. Farrelly
Governor of the Virgin Islands of the United States
Office of the Governor
Charlotte Amalie, St. Thomas,
Virgin Islands 00801

Executive Director
Virgin Islands Port Authority
P.O. Box 597
St. Thomas, U.S. Virgin Islands
00801-0597

Virgin Island Housing Authority
P.O. Box 979
St. Thomas, U.S. Virgin Islands
00801-0979

State Historic Preservation Officer
Virgin Islands Planning Office
Division for Archeology & Historic Preservation
Chinnery Building
129-133 Sub-Base
St. Thomas, U.S. Virgin Islands
00801-5000

Executive Director
Virgin Islands Urban Renewal Board
P.O. Box 2295
St. Thomas, U.S. Virgin Islands
00801-2295

TERRITORIAL GOVERNMENT Cont'd

Director, Public Relations Office
Government of the U.S. Virgin Islands
St. Thomas, U.S. Virgin Islands 00801

Commissioner
Virgin Islands Department of Commerce
P.O. Box 1692
St. Thomas, U.S. Virgin Islands
00801-1692

Commissioner of Public Works
Government of the U.S. Virgin Islands
P.O. Box 4400
Charlotte Amalie
St. Thomas, U.S. Virgin Islands
00801-4400

Assistant Commissioner
Department of Agriculture
P.O. Box 82
St. Thomas, U.S. Virgin Islands
00801-0082

Director of Tourism
P.O. Box 16921
St. Thomas, U.S. Virgin Islands
00801-1692

Mr. Brian Turnbull
Director
Virgin Islands Planning Office
Chinnery Building
129-133 Sub-Base
St. Thomas, U.S. Virgin Islands
00801-5000

Office of the Commissioner
Department of Conservation and
Cultural Affairs
179 Altona & Weigunst
Charlotte Amalie, St. Thomas,
U.S. Virgin Islands 00801

Mr. Benjamin Nazario, P.E.
Director
Coastal Zone Management Division
Department of Conservation and
Cultural Affairs
179 Altona & Weigunst
Charlotte Amalie,St. Thomas,
U.S. Virgin Islands 00801

Director
Virgin Islands Planning Office
Chinnery Building
129-133 Sub-Base
St. Thomas, U.S. Virgin Islands
00801-5000

Mr. Gabriel St. Surin
Special Assistant
Department of Public Works
Government of the U.S. Virgin Islands
P.O. Box 4400
St. Thomas, U.S. Virgin Islands
00801-4400

Mr. O'Neal A. Abel
Assistant Commissioner
Department of Public Works
P.O. Box H, Christiansted
St. Croix, U.S. Virgin Islands 00820

Department of Conservation and
Cultural Affairs
Division of Fish and Wildlife
Box 1878 Frederiksted
St. Croix, U.S. Virgin Islands 00840

IN REPLY ADDRESS
COMMISSIONER OF PUBLIC WORK
Refer .....

GOVERNMENT OF
THE VIRGIN ISLANDS OF THE UNITED STATES
CHARLOTTE AMALIE, ST. THOMAS, V. I.
P.O.BOX 4400
PUBLIC WORKS DEPARTMENT

DIVISION Office of the Commissioner

August 5, 1987

Mr. A. J. Salem
Chief, Planning Division
U.S. Army Corps of Engineers
Jacksonville District
P. O. Box 4970
Jacksonville, FL 32232-0019

RE: MON BIJOU FLOOD CONTROL PROJECT
St. Croix, U.S. Virgin Islands

Dear Mr. Salem:

We have reviewed the Draft Definite Project and Environmental Assessment Report for the referenced project and concur with your recommendations and the proposed alignment.

We would like to note the attached letter to and from the Federal Highway Administration regarding the construction cost of the new bridges. It appears that we could eliminate the installation of one bridge. This would reduce our local share and help us finance the project.

Please let us have your thoughts on this proposed change.

Sincerely,

Gabriel St. Surin
Engineer and Acting Director
of Planning & Development

Attachments

GSS/alg

cc: Mr. James C. Savage
Mr. Miguel Farrington
Mr. Aloy Nielsen

THE VIRGIN ISLANDS OF THE UNITED STATES
[illegible] ST. THOMAS, V.I.
P.O. BOX [illegible]
PUBLIC WORKS DEPARTMENT

DIVISION Office of the Commissioner

July 17, 1987

Mr. Steve Rapley
Territorial Representatives
Federal Highway Administration
Federal Building, Room 138
St. Thomas, V. I. 00801

Re: Mon Bijou Flood Control Improvements

Dear Mr. Rapley:

The Army Corps of Engineers has distributed the Draft Definite Project and Environmental Assessment Report to various concerned agencies for comments. We are in favor of the proposed plan. However, it calls for the installation of three (3) birdges, and we would like to know if the Federal Highway Administration can provide the funds for the construction of the three bridges under the "Bridge Replacement Program".

It is anticipated that the construction plans for the Nadir Gut Project will also include one bridge on Highway 30.

Sincerely,

Gabriel St. Surin
Engineer and Acting Director
of Planning & Development

GSS/alg

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
REGION ONE
Federico Degetau Federal Building
and U. S. Courthouse
Room 150, Carlos Chardon Street
Hato Rey, Puerto Rico 00918-2288

IN REPLY REFER TO:
HVI-01

July 28, 1987

Mr. James C. Savage, Commissioner
V.I. PublicWorks Department
P.O. Box 4409
St. Thomas, U.S. V.I. 00801

Attention: Mr. Gabriel St. Surin
Acting Director of Planning and Development

Dear Mr. Savage:

Subject: Mon Bijou Flood Control Improvements

The Virgin Islands do not receive an apportionment of Bridge Replacement Program funds. The three bridges required by the subject flood control project could be funded from either Territorial funds or Primary funds (if the roads are included on the Federal-aid primary system).

I have taken the liberty of discussing the subject project with both Mr. Emilio Colon and Mr. A. J. Salem of the Corps of Engineers. Mr. Salem has reported that execution of the agreement to fund the project by Commissioner Savage is the next action required to continue the design of this project.

I am available to meet and discuss FHWA participation in the construction of the roadway and bridge improvements, if you so desire.

Sincerely yours,

Stephen K. Rapley

Stephen K. Rapley
Territorial Representative

cc: Mr. Aloy Nielsen
Commissioner James C. Savage

JUL 23 PM 3:13
PUBLIC WORKS DEPT.

United States Department of the Interior
FISH AND WILDLIFE SERVICE

CARIBBEAN FIELD OFFICE
P.O. BOX 491
BOQUERON, PUERTO RICO 00622

June 17, 1987

Mr. A. J. Salem
Chief, Planning Division
Jacksonville District, U.S. Army Corps of Engineers
PO Box 4970
Jacksonville, Florida 32232

Re: Environmental Assessment,
Estate Mon Bijou, St. Croix,
U.S. Virgin Islands

Dear Mr. Salem:

This is in response to your May 29, 1987, letter requesting our comments on the Environmental Assessment for the Estate Mon Bijou flood control project. We have assigned Log #4-4-87-052 to this activity and would appreciate your referring to it in any future correspondence on this matter.

We concur with your determination that the project would have no adverse impact on Federally listed threatened and endangered species. No significant impact on wetlands is anticipated. We therefore do not object to the project as presently designed.

This does not constitute a Biological Opinion as described under Section 7 of the Endangered Species Act. However, it does fulfill the requirements of the Act and no further action is required. If modifications are made in the project, of if additional information indication potential impacts to listed species becomes available, consultation should be reinitiated.

Sincerely,

Robert T. Pace

Robert T. Pace
Acting Field Supervisor

cc:
COE, San Juan
EPA, New York
AWE, Atlanta

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
9450 Koger Boulevard
St. Petersburg, FL 33702

June 12, 1987 F/SER113/SD

Colonel Charles T. Myers, III
District Engineer, Jacksonville District
Department of the Army, Corps of Engineers
P.O. Box 4970
Jacksonville, FL 32232-0019

Dear Colonel Myers:

The National Marine Fisheries Service has reviewed Draft Report and Environmental Assessment for reducing flood damages in the Estate Mon Bijou and Glynn residential areas on St. Croix, U.S. Virgin Islands.

Since the project will not impact marine resources, we have no comments. We appreciate the opportunity to review and comment on this project.

Sincerely yours,

Edwin J. Keppner

for Richard J. Hoogland
Assistant Regional Director
Habitat Conservation Division

United States Department of the Interior

GEOLOGICAL SURVEY

GPO Box 4424
San Juan, Puerto Rico 00936

July 8, 1987

Mr. A. J. Salem
Chief, Planning Division
Department of the Army
Jacksonville District, Corps of Engineers
PO Box 4970
Jacksonville, Florida 32232-0019

Subject: Draft definite project report and environmental assessment for estate Mon Bijou, St. Croix, U.S. Virgin Islands.

Dear Mr. Salem:

Our technical staff has reviewed the subject report and agrees on Plan D as the best alternative. The proposed bypass channel will reduce flood damages and related problems in the area.

Sincerely,

Allen L. Zack
District Chief, WRD

AZ/ECD/an

GOVERNMENT OF THE VIRGIN ISLANDS OF THE UNITED STATES

Department of Conservation and Cultural Affairs
Division of Fish and Wildlife

BOX 1878, FREDERIKSTED
ST. CROIX, U.S. VIRGIN ISLANDS 00840

13 July 1987

A. J. Salem, Chief, Planning Division
Flood Control and Flood Plain Mgmt. Branch
Department of the Army
Jacksonville District, Corps of Engineers
P. O. Box 4970
Jacksonville, FL 32232-0019

Re: Draft Definite Project Report and Environmental Assessment, Estate Mon Bijou, St. Croix, Virgin Islands, dated May 1987.

Dear Sir:

The St. Croix staff of the V.I. Division of Fish and Wildlife (DFW) has reviewed the subject Report and Assessment as requested by your letter of May 29, 1987.

We find that the proposed project, as described in the subject document, is not expected to have any significant impacts, direct or indirect, on fish and wildlife.

We know of no published reports of, nor the existence of, any species, in the project area, currently listed or proposed to be listed as endangered or threatened by the U.S. Department of the Interior. This determination is made without benefit of field visits to the area, but rather through the knowledge of the known occurrences, habits and habitats of these species in the Virgin Islands.

We request that the St. Croix staff of DFW be retained on your mailing list for this project and that we be duly notified of all modifications or alterations to the plan as presented in the subject document.

DIVISION OF FISH & WILDLIFE
Room 203 Lagoon Street Complex
Frederiksted, U.S.V.I. 00840

Thank you for allowing us to review this plan.

Sincerely,

William J. Tobias
Fisheries Biologist II

OFFICE OF
THE COMMISSIONER

GOVERNMENT OF THE VIRGIN ISLANDS OF THE UNITED STATES

DEPARTMENT OF PLANNING AND NATURAL RESOURCES

179 ALTONA & WELGUNST
CHARLOTTE AMALIE, ST. THOMAS, V.I. 00802

July 31, 1987

Mr. A.J. Salem
Chief, Planning Division
Department of the Army
Post Office Box 4970
Jacksonville, FL 32232-0019

Re: Federal Consistency - Flood Control Diversion Channel for Estate Mon Bijou, St. Croix, U.S. Virgin Islands

Dear Mr. Salem:

We have reviewed the draft project report and Environment Assessment for the above referenced project.

This project while a direct federal activity is situated entirely within tier II zone and does not affect the Virgin Islands Coastal Zone (tier I). We find the project to be consistent with the Virgin Islands Coastal Zone Management (CZM) program and concur with the report pursuant to Section 904-7 (c) of V.I. Code, Title 12, Chapter 21 rules and regulations.

Enclosed for your information, I submit the Water Quality Review and Certification for this project.

Should you require further information, please contact me or Mr. Benjamin I. Nazario, Director, Division of CZM at (809) 773-5774 or (809) 774-3320, extension 145.

Yours truly,

Alan D. Smith
Commissioner

ADS/mm
Enclosure (1)

cc: Commissioner James C. Savage - PWD
Thyra Budsan, Chief - A-95 Clearinghouse
Gabriel St. Surin - PWD
Francine Lang - DNRM
Benjamin I. Nazario - DCZM

GOVERNMENT OF THE VIRGIN ISLANDS OF THE UNITED STATES

Department of Conservation and Cultural Affairs
Natural Resources Management

BUILDING 111 – APARTMENT 114 – WATER GUT HOMES
CHRISTIANSTED, ST. CROIX 00820
(809) 773-0565

COASTAL ZONE PERMIT APPLICATION
WATER QUALITY REVIEW AND CERTIFICATION

1. CZM Permit Application No.: N/A

2. Date of Application: 6/3/87

3. Applicant: U.S. Army Corps of Engineers, Jacksonville District

4. Short Title of Work: Flood Control Diversion Channel For Estate Mon Bijou

5. Water Quality Certification: Pursuant to Title 12, Ch. 7, Subch. 186 of the Environmental Laws and Regulations of the Virgin Islands there is reasonable assurance that the proposed project can be executed without violation of the water quality standards.

6. Additional Information Requested or Needed for Certification: N/A

7. Comments or Special Restrictions: N/A

8. Reviewers: M. Pacifico, Env. Sp. II

M. Taylor, Sup. Ambient Monitoring

Certified: F. Lang, Director N.R.M.

The St. Croix Avis

THE ONLY LOCALLY OWNED NEWSPAPER SERVING THE VIRGIN ISLANDS SINCE 1844

183rd YEAR | ST. CROIX, U.S. VIRGIN ISLANDS | WEDNESDAY, JULY 1, 1987 | No. 150 | 35¢

Some Workers Happy With Checks Others Complain It Is Not Enough



Joseph Daniels of Public Works shows off his check. Avis photo by James Weeks Jr.

By James Weeks Jr.
Avis Staff Writer

Thousands of workers received checks Tuesday as $8 million dollars in salary increases were officially released by the V.I. Government.

Some whooped with delight, but many others cringed in pain when they saw how much they were actually receiving.

Joseph Daniels, a Public Works employee with 22 years of Service, fell into the cringing category. He only received $148.96. "I don't know what kind of money this be," he shouted angrily. "I deserve more".

Daniels pointed out that he only makes $10,000 a year reading water meters, and he has to sell newspapers to supplement his income.

"That's not enough," said one Health Department employee who asked not to be identified. "Some people wanted money to send their kids to school. They gon' have bachanal in this place, me son".

But other government employees saw it differently. "I'm happy with what I got. I would have liked to get the whole damned thing but I'm still happy," said Henry Schuster, a 17 year employee

See WORKERS Page 24

Mon Bijou Residents Elated Flood Relief Within Sight

By Andre Edwin
Avis Staff Writer

More than 40 Mon Bijou residents attended a meeting last night to listen and ask questions about a flood-control proposal, which could save property in that area and, perhaps, even lives.

The proposal, the result of a study done by the Army Corps of Engineers, is estimated at $3.9 million and was requested by the Department of Public Works. Officials from both organizations attended the meeting at John H. Woodson Junior High School.

According to reports, between 1975-1980, three major floods occurred in the Mon Bijou area, causing widespread damage. The proposal calls for a "95" percent flood reduction over the next 100 years.

Officials said that the work should begin next year and completed within two years.

They explained that the plan calls for the flood water going around the undeveloped part of the Mon Bijou area instead of through the community. The Army Corps will pay for more than half of th project, and the local gove ment will fund the balanc officials contended.

Delroy Petersen, a resident, said, "I am elated that this is going to be done. What a lot of Mon Bijou residents haven't realized is that the floods have depreciated the value of their homes. "I think this is something that is long overdue. It should have been done years ago."

John Cruce, water resource planner and study manager for the Mon Bijou project, said the flooding is caused by several problems including large volumes of water coming down Blue Mountain and other, steep slopes in the area, existing culverts are too small to

See RESIDENTS Page 23

New Division Set For Human Services

By Jessica Thorpe Davis
Avis Staff Writer

Governor Farrelly issued his first executive order yesterday outlining the functional framework of the newly created Department of Human Services which will be headed by former Social Welfare Commissioner Juel Rhymer.

As specified by Act No. 5265, the recently passed Government and Consolidation Act of 1987, the Department had been designated as the umbrella agency for all state services pertaining to youth, children, the handicapped, the elderly and low-income adults and families authorized to receive funds under the Older Americans Act and Community Services Block Grant funds.

In agreement with Rhymer's earlier proposal to structure the new department into, six divisions and initiate personnel changes, Farrelly said in his order that the new Human Services will include: a Division of Adult Services; Senior Citizens Affairs; Children, Youth and Families; Financial Programs; Handicapped Services; and Volunteers and special programs.

The six departments will be headed by a governor appointed administrator reporting to an assistant commissioner. Programs within each division will be managed by a program director reporting to the division administrator.

Early last week Rhymer said the Social Welfare Department would be one of the

See NEW Page 23

$15 Million Complex Planned For Cane Bay

By John Commins
Associated Press Writer

CHRISTIANSTED, ST. CROIX (AP) – A St. Croix development company has submitted plans to the Coastal Zone Management office for a $15 million residential resort complex along Cane Bay, an official said Tuesday.

According to Virgin Islands law, the government office must determine if the plans are complete and then schedule a public hearing within 60 days.

Susan Bastress, Vice President of Antilles Investment Group, said the plan "is the best alternative for the land" because of the "relatively low population density" called for by project.

Antilles investment group,

See COMPLEX Page 23

Index: Postal Service Increases P. 3 Funds For Drug Fight P. 3

CARICOM... (Continued from page 5)

Rights Commission.

The Appeals Court would replace the London-based Privy Council, which now is the court of last resort for criminal cases that originate in Britain's former colonies.

"I would respectfully suggest that the maturity of our democracy requires that we have our own court of appeal, thus removing the necessity to go outside of our countries for final ajudication," Robinson said Monday at the summit's opening ceremony.

"This (The Privy Council) is an anomaly that can no longer exist side by side with independence," Robinson said. "We must not shirk the responsibility to be final arbiters of our own destiny."

The prime minister met in closed sessions for a second day Tuesday. A press briefing was scheduled for late in the afternoon.

The summit's final communique was to be issued on Friday.

On regional topics, Robinson said he favored the political unification proposed by the seven-member organization of Eastern Caribbean States.

On Trinidad and Tobago topics, Robinson says he sees no cracks in his ruling National Alliance for Reconstruction Coalition; his government is considering divesting five of Trinidad's approximately five dozen state industries; and his government is committed to diversification away from oil into natural gas, agriculture, tourism and manufacturing.

"We have in mind new (natural gas) projects we hope will come on stream in a matter of two to three years," he said. "We are developing the potential of our gas resources in order to have a smooth transition from dependence on petroleum, but not to dependence on gas.

"Our great weakness has been our dependence on one resource, petroleum," Robinson said. "What we are seeking to do now is to diversify...."

Heads of government of all 13 members of CARICOM were in attendance.

The members are Antigua-Barbuda, Dominica, Grenada, Montserrat, St. Kitts-Nevis, St. Lucia, St. Vincent and the Grenadines, Jamaica, Trinidad and Tobago, Belize, the Bahamas, Guyana and Barbados.

EDUCATION... (Continued from Page 2)

Office (Cruz Bay)

St. Croix: Curriculum Center (Kingshill); Early Childhood Office, Dept. of Education headquarters; Florence A. Williams Library (Christiansted); and the Petersen Public Library (Frederiksted).

The Pre-School Grant Proposal is a lengthy document and must be reviewed on site due to reproduction costs.

BRIEFS... (Continued from Page 2)

ballots (so-called "symbol votes") to the extent that the intent of the voters could be determined.

Stapleton prevailed in district court and a court-order recount of the ballots resulted in the defeat of former Senator James O'Bryan, a registered Democrat who ran as an independent, and the seating of democratic senator David Puritz.

In commenting on the need to modernize the election system in the Virgin Islands, Stapelton served warning that she will oppose any move to acquire so-called "tabulators" instead of electronic voting machines as provided for in the election reform act of 1984 because the problems of spoiled ballots and recounts would still be with us.

"With electronic voting machines, spoiled ballots which result in the disenfranchisement of hundreds (and sometimes thousands) of voters and the endless recounts and court challenges would no longer plague our electoral process," Stapleton said.

In conclusion, Stapelton said she is extremely pleased with Senator Puritz's appeals court victory which she expected all along. And she observed wryly: "If Jimmy O'Bryan had followed my advice and run as a Democrat, he would have been re-elected to a second term in the senate."

HANSEN... (Continued from Page 2)

buildings but to guide our school children. I will attempt to correct this oversight with my legislation, concluded Senator Hansen.

WOMEN'S... (Continued from Page 24)

men's side has been eliminated. Australian Peter Doohan — who upset two-time defending champ Boris Becker last week — lost to Slobodan Zivojinovic of Yugoslavia in straight sets.

OFFICIALS... (Continued from Page 24)

the policeman told authorities Knight slugged him.

Knight, while in Puerto Rico, was not taken into custody and refused to discuss the matter with authorities. He left San Juan at the end of the Pan American Games and returned to Indiana.

Two officials last Friday opposed such a move on the part of Puerto Rico's government.

Former Gov. Carlos Romero Barcelo, in office when the incident occurred, said " the case is dead and finished."

The other official, German Rieckehoff Sampayo, Puerto Rico's Olympic Committee President and a member of the International Olympic Committee, said he feared a negative reception in Indian of the more than 200 island athletes planning to participate in the Pan American Games set to start in Indianapolis August 8.

NEW... (Continued from Page 1)

areas most affected by the reorganization, which was signed into law last Wednesday and will cut the number of government agencies in two. The new Human Services agency, she said then, will absorb the previous Community Services, Community Action Agency, Youth Services Administration, Commission on Youth, Commission on Aging, Commission on the Handicapped, Developmental Disabilities Council and Board of Social Welfare.

Farrelly's official directive also established a Board of Appeals for all welfare programs and two advisory boards: the Disabilities and Rehabilitation Services Council to advocate the rights of persons with developmental disabilities; and an advisory council on Aging to provide input on all matters concerning the development of the Territorial plan for the aging.

RESIDENTS... (Continued from Page 1)

handle the amount of water, and the housing development is built in a flood plain.

Mon Bijou area residents said they were pleased that the flood problem will be reduced or perhaps eliminated.

Delroy Petersen, a resident, said, "I am elated that this is going to be done. What a lot of Mon Bijou residents haven't realized is that the floods have depreciated the value of their homes. "I think this is something that is long overdue. It should have been done years ago."

Another resident commented that it would be an understatement for him to say that he was happy for the flood-control project.

At least one person, however, said that the project should have been started sooner.

Ralph Mandrew, president of the Mon Bijou Homeowners Association, said, "I am disappointed about the presentation regarding the timetable to begin work on the project.

"We wanted to hear that they are ready to begin work on the project immediately. People have lost their homes because of the floods, and we are tired of band-aid gestures."

According to Public Works Commissioner James Savage, Gov. Alexander Farrelly was anxious to rapidly proceed with the project and, in his view, it is "high priority."

"The Army Corps of Engineers feels very strong that there must be participation from the citizens that the project benefits," said Lt. Col. Charles Cox, deputy district engineer for Puerto Rico and the Virgin Islands.

Among the local senators who attended the meeting were Douglas Canton, Alicia "Chucky" Hansen and David Puritz.

Canton said the project is unprecedented, while Hansen commented that it was a "positive effort."

COMPLEX... (Continued from Page 1)

she said, wants to construct 121 two-and-three bedroom townhouse units, with a recreation area and a restaurant. The project is planned on 42 acres of hillside property along the eastern portion of Cane Bay, according to plans submitted with the government coastal zone management office.

If the project is approved, construction will start in January and will take two years to complete.

She said the Antilles Investment Group has planned "the project with our ears open in an attempt to allay the fears" of established Cane Bay and nearby La Vallee residents.

"I think people fear that a development such as this built near them might cause displacement because of inflated property values," Ms. Bastress said. "This is becoming an issue surrounding all development in the Virgin Islands."

The Antilles Investment Corporation also operates Schooner Bay and Colony Cove Condominium complexes on St. Croix.

Obituary

KEITH CHAYNE ANTHONY PETERSEN, 18, a/k/a "Kiambo," of No. 84-A-61A Estate Carlton, died on Friday, June 26th in Fulton County Georgia.

He is survived by his father, Cornell Petersen Sr., and his mother, Maureen Williams. His grandparents, Hyacinth Williams and Ilma Clinton, three sisters, Khadija Matthew, Corlise and Chastidy Petersen, seven brothers, Khadil Williams, Cornel Jr., Corey, Calvin Craig, Cordell and Cliff Petersen; two aunts, Angela Nielsen and Ilma Frances, five uncles, James Petersen, Octave, Oscar, Gerald and Glenn Williams, numerous great aunts and great uncles; other relatives and friends.

Funeral services will take place at Holy Trinity Lutheran Church on Thursday, July 2nd, at 2 p.m. Interment will follow in the Frederiksted Cemetery. Funeral arrangements are by James Memorial Funeral Home Inc.

West End Residents...
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