PN-ABC-369

REPORT
ON
ENGINEERING REVIEW AND ASSESSMENT
OF
DESTROYED PUENTE DE ORO
EL SALVADOR

USAID/SAN SALVADOR

OCTOBER 1981

Prepared by:

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USAID/San Salvador

In collaboration with:

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Johnny M. Rucker, SFC, 518th Engineers
C. Roberto Gavidia, Engineer,
USAID/San Salvador

This report summarizes the findings of an engineering review and assessment, performed by the USAID/San Salvador Mission with the collaboration of a two-man military team from the U. S. Southern Command, Panama. The work was conducted in El Salvador during the period between October 17 and October 22, 1981. The findings are based on the results of two site visits, map and plan reviews, and discussions with the Ministry of Public Works and USAID personnel. No detailed field surveys or data collection operations were undertaken. Cost estimates represent general order of magnitude costs and would be considered reasonably realistic. The major portions of costs of the more feasible alternatives are those of materials and equipment procurement which are more predictable when compared to isolated bridge and related stream crossing construction.

BACKGROUND

The Puente de Oro, innaugurated in 1952, was a two-lane suspension bridge, about 2700 feet long, crossing the Río Lempa along the south coast road near San Marcos Lempa, 50 miles, southeast of San Salvador, see Figures 1 and 2. In the early hours of Thursday morning, October 15, the eastern tower of the middle span over the river channel was toppled by well placed explosive charges. During the tower collapse, longitudinal waves and vibrations, were apparently created throughout and along then unrestrained supporting cables, toppling and twisting the remainder of the bridge structure to total destruction beyond any possible repair. The attached photos, Figures 3 and 4, show the totality of the destruction.

Fortunately, the 700-meter (2,300-foot), single-track, narrow-gauge, through-

truss railroad bridge, completed in 1920 and located immediately upstream from the destroyed highway, was left undamaged, see Figure 2. To make a new highway connection across the river, the Ministry of Public Works (MPW) is now providing a deck of board planking across the railroad ties. The bridge will then serve as both a highway and railroad bridge. The work is being performed at a cost of about US $120,000.

Two existing streets at each end of bridge, about 1/4 mile in length and connecting the railroad with the highway, are being improved to carry projected increased traffic loads. The railroad bridge was designed for Cooper E-40 railroad loading, more than sufficient to carry the projected traffic loads. Actually, a Cooper E-40 loading implies a capacity greater than an H-20 highway bridge loading, that of a three or five-axle, loaded 20-ton trailer truck. However, since highway traffic will be supported on newly placed wooden planking and by a structure about whose construction characteristics and physical condition little is known, a limitation of only one tractor-trailer or other three-axle truck on the bridge at any time would appear advisable. Other lighter traffic would have no limitations.

Counts of the traffic, made by the Ministry of Public Works in 1979, the latest date for which information is available, show an average daily traffic flow of 1600 vehicles, consisting of 36% (576) heavy trucks, 29% (464) light trucks 9% (144) buses, and 26% (416) passenger cars. This number of vehicles, together with the passage of 2 trains per day, should present no particular problem, although some delay in traffic movement may result. These relatively high counts were inconsistent with nearby truck weighing station information which indicated much lesser truck counts of about 75 to 100 per day, resulting in an average vehicle count of 200 to 300 vehicles per day. Attempts to clarify these discrepancies were unsuccessful up to the time of report completion.

Attachment 1 is a report prepared by Major McGee, a member of the present assessment team, following a site visit to the Río Lempa in November 1980. His report demonstrates the use of a Bailey bridge as a possible interim emergency crossing measure and proposes increased security measures to protect the bridges against terrorist action.

SITE VISITS

Two site visits were conducted using Salvadorean Air Force helicopters. The first visit of Saturday, October 17, was performed with the Minister of Public Works accompanied by Col. Saenz, U. S. Milgroup, Major McGee and Sgt. Rucker, U. S. Southern Command, and Mr. Roberto Gavidia, Engineer, USAID/San Salvador. A second visit on Monday, October 19, was performed with the Subsecretary of Public Works accompanied by Peter Askin, Director, USAID/San Salvador, Roberto Gavidia, Engineer, and Charles Stevens, Consultant.

On Saturday, it was noted that the MPW was tightening the rail spikes driven into the wooden iron ties, preparatory to installing lumber decking. On Monday, decking work was in progress.

At the current rate of progress, completion of decking was projected for Thursday, October 22.

However, decking for only 200 meters of the 700-meter length of bridge was on hand. Efforts were being made to locate and purchase planking as available within country. However, it was realized that this would not suffice, and imports from Honduras would be required.

The need for imports would result in a delay for completion of an unknown

length of time beyond the Thursday date heretofore projected, and this would be dependent upon lumber planking deliveries.

By Saturday, passenger traffic across the railroad bridge had been initiated. The connecting roads between the highway and the railroad were essentially completed on Tuesday.

A rail mounted motor bus was carrying passengers across the bridge at a charge of 25 cents local currency (US 10 cents) each way, see Figure 5. Buses were discharging passengers at one end and picking up at the other. Charges were being assessed for bus passage up to the bridge and again from the bridge to the final destination.

ALTERNATIVE BRIDGE CROSSINGS

The basis for assessing and evaluating alternative crossings was the presumption that the decking of the railroad bridge provided a river crossing capable of meeting the immediate highway traffic needs.

This could serve as the interim crossing until a new bridge would be constructed. However, in view of other country needs and the present limitations on available financial resources, it was considered that any new bridge construction could be deferred, and the provisional combined railroad highway crossing could continue to be used during the immediate future. Therefore, the principal criterion in evaluating alternatives became the requirement for an emergency and immediate crossing in the event that the railroad bridge would be lost.

Thus, the idea of a new bridge was eliminated immediately. MPW cost estimates are in the order of U.S. $ 16.0 million, an amount which is comparable to the cost for similar work in other areas. The assessment team

projected an implementation period under the best of conditions of three to four years, to include consultant selection and contract negotiation (6 months), planning and design (6 months to one year), bidding and construction (2 years). MPW projects 2 years.

Other alternatives included the use of a Bailey and/or M4T6 aluminium floating pontoon bridge, both of the military type. Both of these bridges types can be installed rapidly. They would, however, require installation above high water to protect against their loss and damage at flood times. A typical installation is shown in Figure 6.

It is reported that high water levels following heavy rains only last one or two days. This is due to the relatively small watershed area of the Río Lempa, and as a result, the river water levels can experience rapid fluctuations, both up and down.

To minimize costs, any prefabricated bridge, Bailey or floating, would be installed over the approximate 150-foot river channel and for the Bailey, on abutments above the projected high water, as shown in Figure 6. A ramp would be constructed from both banks to the bridge location. The ramp would consist of compacted fill material (sand, gravel and/or clay) obtained from adjacent riverside sources and placed to a height of about 2 meters above the exposed sandbars. Near the bridge, the ramp would be raised to heights of about 5 meters above the sandbars. Culvert pipe would be placed through the ramp to permit the passage of all but extreme flood flows. The top width, 7.20 meters, would permit one lane of traffic. The height, 2 meters, would protect the gravel surfaced access roadway from inundation except during heavy flood periods.

Heavy rip-rap and/or gabion basket protection would be provided both upstream and downstream of the access roadway ramp fill. The protected ramp would constitute an overflow section during flood periods and resultant extremely high river levels.

Estimates costs (U.S. dollars) for these two bridge alternatives (each about 150 ft long) would be as follows:

(a) Bailey bridge*

Structure (2 sets)	$ 110,000
Transportation (25 % ±)	$ 30,000
Total Structure	$ 140,000
Ramp fill	$1,000,000
Total crossing	$1,140,000

(b) Floating (M4T6) bridge:

Structure (1 set)	$ 224,211
Erection set (1 each)	$ 9,805
Low draft erection boats (2 each)	56,446
Subtotal	$ 290,462
Transportation (25 % ±)	$ 72,616
MTT (3-man mobile training team)	$ 6,300
Total Structure	$ 369,378
Ramp fill	$ 500,000
Total Crossing	$ 869,378

Under this alternative, the ramp fill and abutments need not be constructed to a level higher than one meter above the usual river water level. Under high water conditions, this type of bridge would then serve as a raft or barge.

* No provisions for MTT support since already included under Bailey bridge purchase now being executed, see below.

The MPW has on order 4 sets (240 meters) of Bailey bridges at a delivered cost as follows:

Structure (4 sets)	$ 217,208
Erection sets (2 each)	$ 47,102
Subtotal	$ 264,310
Transportation (25 % ±)	$ 61,000
MTT (3 man mobile training team)	$ 6,300
Total Crossing	$ 331,610

These bridge materials are scheduled for delivery in mid November. They have been ordered for emergency repairs to over 30 small highway bridge crossings destroyed throughout various zones of the country. Under extreme emergency conditions needed panels of these Bailey materials could be diverted to the Río Lempa.

However, even though bridge materials, whose deliveries are subject to 3 or 4 month lead times, could be provided almost immediately under the Bailey bridge alternative, no particular advantage would be gained.

The earth fill access ramp and approach would require 6 to 8 months to complete, and during that period, bridge materials could be purchased and installed. In fact, such projected lengthly time requirements for construction, together with the somewhat excessive cost for an interim solution, have resulted in the elimination of this alternative from further consideration.

Another alternative bridge crossing which utilized the M4T6 floating pontoon system across the entire 1200-foot length of flood plain was also examined. Under high water conditions, with waters covering the entire flood plain, the entire span would be floating. As the high waters receded to the width of the central stream channel, the pontoon spans in the flood plain would be in

the dry and the floating spans limited to the approximately 150' bridge section within the channel. This bridge is designed to operate under both conditions.

The estimated cost for a floating pontoon bridge over the width of the 1200-foot flood plain would be as follows:

Structure (9 sets)	$	2,017,899
Erection sets (9 each)	$	88,245
Erection boats (3 each)	$	84,669
Subtotal	$	2,190,813
Transportation (25 % ±)	$	500,000
MTT (3-man mobile training team)	$	6,300
Approaches	$	100,000
Total Crossing	$	2,797,113

The construction time for this alternative would be 30 days with a material delivery schedule of 90 days, resulting in a total implementation time of 4 months. Although time could be gained by purchasing and storing the pontoon bridge materials, excessive costs for an interim solution has resulted in its elimination.

ALTERNATIVE RAFT/BARGE CROSSINGS

Alternatives considered for emergency raft/barge crossing units, in the event of a loss of the railroad bridge, have included a section of a M4T6 pontoon floating bridge to be operated as a raft and a simple wooden steel-drum supported raft fabricated with local materials on-site. These floating units would provide traffic service by crossing the approximate 150 foot main river channel during low flow periods. As the river levels would rise during flood periods, the transit distance would vary in accordance with water level conditions. An access roadway would need to be shaped and maintained through

the flood plain of the river. Two-axle truck traffic (5 to 7 ton loaded vehiches) would be carried, probably in units of two trucks or 4 lighter vehicles per crossing. Small and lighter, low-draft, 15 to 20 foot motorized barges could serves as passenger carriers.

For both alternates, an overhead wire to serve as a guiding and control cable across the river would appear advisable. Materials for this cable could be salvaged from the destroyed Puente de Oro. Both schemes would involve a raft/barge channel crossing. The prefabricated M4T6 pontoon raft crossing could be effected with assistance from the erection boats. The steel-drum supported raft could be provided with winches for control and power, if needed, to effect the river crossing. Usually, crossing could be effected with assistance from the river current, and transit could be controlled by a barge cable attached to the overhead control wire.

(a) A4T6 Aluminium Pontoon Raft. This would be assembled from a set of the A4T6 military type floating pontoon bridge. The bridge comes in an approximate 141' length per set. The pontoon rafts of about 50-foot lengths could be assembled from this set, and the remaining panels reserved for repairs and replacements.

The estimated cost for this military type of pontoon raft would be as follows:

Structure (1 set)	$	224,211
Erection set (1 each)	$	9,805
Erection boats (2 each)	$	56,446
Subtotal	$	290,462
Transportation	$	72,616
MTT (3 man mobile training team)	$	6,300
Total two rafts	$	369,378

Overhead control wire across the river	$ 10,000
Entry/exit and access roads across flood plain	$ 15,000
Total Crossing Facilities	$ 394,378

In addition a grader and/or bull-dozer would be needed to shape and maintain the access roadway. This alternative would also need a compressor to keep the steel pontoons filled with air. The erection boats to provide crossing assistance would also need to be maintained and fueled.

This alternative could be erected and implemented in less than one week, provided the M4T6 floating pontoon bridge set were stock piled in country. Otherwise, a longer implementation period of about 100 days would be indicated to allow for a material procurement lead time of about 90 days.

The advantages of this alternatives would include:

(1) Hand erectable in a few days with minimum (20 persons) of trained local labor;

(2) Flexible and mobile, usuable at most any location along the river;

(3) Durable, non-corrosive, and re-usable;

(4) Parts are interchangeable and replaceable;

(5) Lengths can be varied for varying river conditions;

(6) Can be used as a dry span out of water.

The disadvantages of this alternative would include:

(1) Relatively high cost for a temporary interim solution;

(2) Relatively complicated operation and maintenance with compressor and river boats;

(3) Need for training of personnel for erection and

operation;

(4) Heavy road equipment (grader and/or bull-dozer) to maintain river entry/exit and access roadways across the flood plain;

(5) Need for 90-day lead time for off-shore materials procurement.

(b) WOOD RAFT. This could be fabricated on site using local lumber and skilled labor (carpenters). It would consist of a 50-foot wooden raft supported on steel drums with limited wood surface planking and vehicle ramps. The estimated cost would be as follows:

One wood barge	$	15,000
Overhead control wire across river	$	10,000
Entry/exit and access roads across flood plain	$	15,000
Two motorized winches		5,000
Total Crossing facilities	$	45,000

This alternative represents the simplest and least complicated interim solution. It could be implemented in 7 to 10 days, provided materials were stock-piled near site. Otherwise, a 15 to 20 day period would be needed to allow for a 7 to 10 day lead time for the procurement of the local materials to effect the wood raft erection.

The advantages os this alternative would include:

(1) Low cost and simple;

(2) Use of local materials and labor;

(3) Short implementation period of 7 to 10 days with nearby stock piling of materials;

(4) Flexible and mobile, usable at most any location on river;

(5) Durable and non-corrosive;

(6) Vehicles only machinery in operation.

The disadvantage of this alternative would include:

(1) Heavy road equipment (grader and/or bull-dozer) to maintain river entry/exit and roadways across flood plain;

(2) Bulky and cumbersome for operation and maintenance.

MINISTRY OF PUBLIC WORKS

In a review with the Minister of Public Works, he indicated that the construction of a new bridge represented an urgent need of utmost necessity. He reiterated that it would be required in order to respond to the regional social/economic needs, national interests, and military security operations. The area that the bridges serves is now isolated, and it is not the intent of the government to abandon its inhabitants.

The MPW staff is also studying alternative remedial and permanent crossing measures. A group of local consulting engineers have volunteered and offered their services at no charge. This group is working with the MPW staff.

The Minister recognized that the permanent solution would not be the result of an immediate decision. Feasibility studies would be required to determine the most responsive and most cost effective solution and to assess alternative river crossings national interests, and development needs. He raised the question of why was the original bridge built in the first place. Even as of now, a development need must have been envisioned and foreseen even in the late 40's.

We informed the minister that we too foresaw the eventual need for a new bridge. However, a usable crossing doesexist, and it respondes to the immediate needs. Therefore, the limited available funding could best be utilized in resolving and meeting other more urgent problems and needs, and a new bridge deferred at this time. We advised that it was our impression that AID was not prepared to finance a new bridge at this time. However, we advised that this could best be discussed and reviewed between Government and USAID authorities.

The Minister asked about the cost estimate ($45,000) for the wooden raft crossing alternative. He asked for any plans available for the fabrication of such a wooden raft. These we advised would be sought and provided as available.

CONCLUSIONS AND RECOMMENDATIONS

(1) With the decking of the railroad bridge, a temporary highway traffic crossing capable of meeting most transportation needs along the South coast road over the immediate future has been provided

(2) In view of the current vulnerability of highway access to the eastern and southeastern zones of the country, the government should prepare itself to undertake, and implement immediate emergency measures to maintain highway communication in the event that this railroad bridge or the remaining upstream Cuscatlán bridge crossing should be lost.

(3) The least cost, most flexible, and simplest solution, with an accelerated speed for implementation, is the provision of a steel-drum supported wooden barge/raft guided and controlled by a steel cable strung across the Lempa River.

(4) Local materials and labor would be utilized, and by stock piling the lumber and other materials near the river crossing site, implementation could be effected in 7 to 10 days at a cost of about $50,000.

(5) Other alternative emergency crossing, utilizing military-type prefabricated raft (M4T6 pontoon section), can equally be effected within a 7 to 10-day implementation period at a cost of nearly $400,000.

(6) On basis of cost and simplicity of operation and maintenance, steel-drum supported raft is recommended.

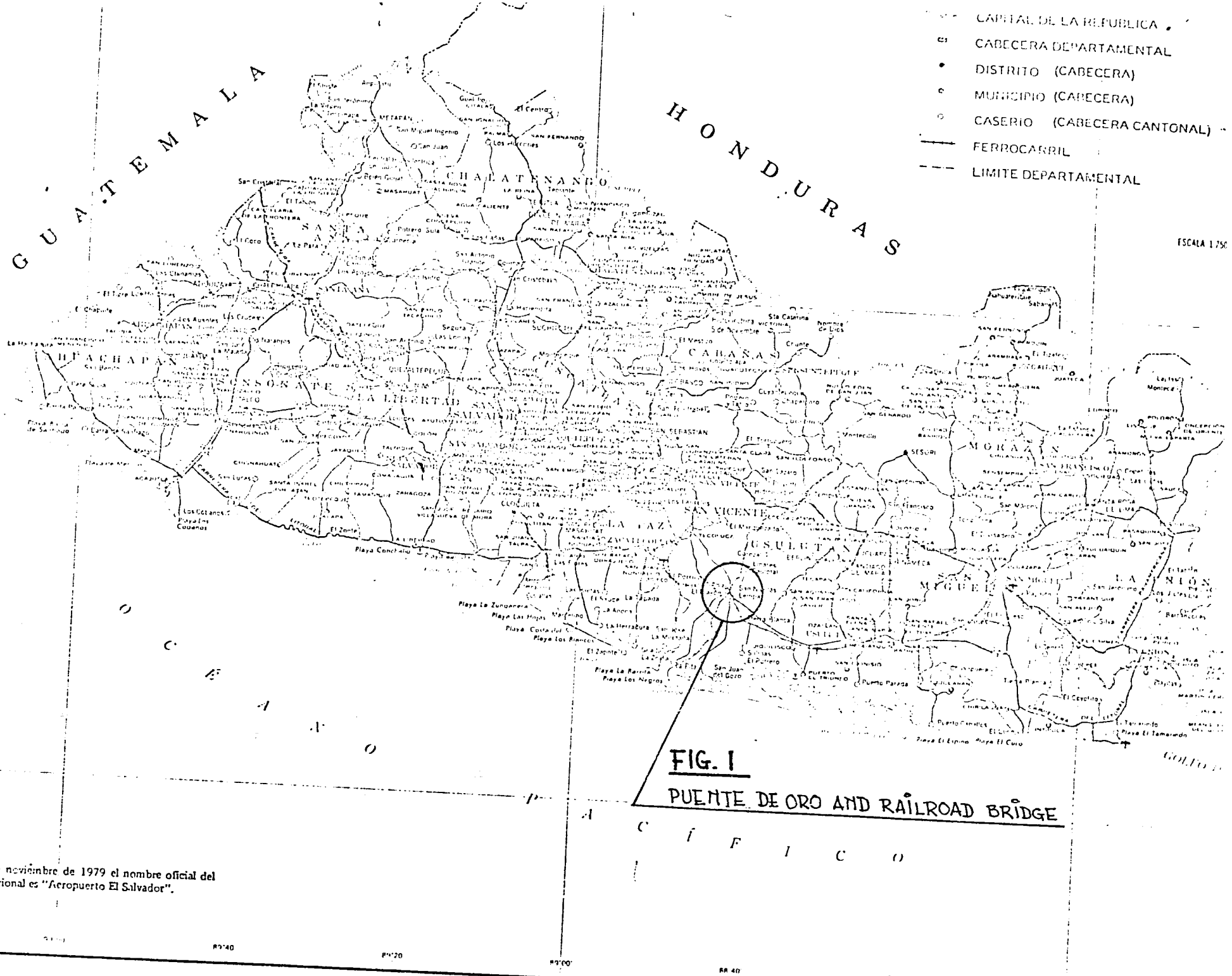

FIG. 1

PUENTE DE ORO AND RAILROAD BRIDGE

*A partir del 14 de noviembre de 1979 el nombre oficial del aeropuerto internacional es "Aeropuerto El Salvador".

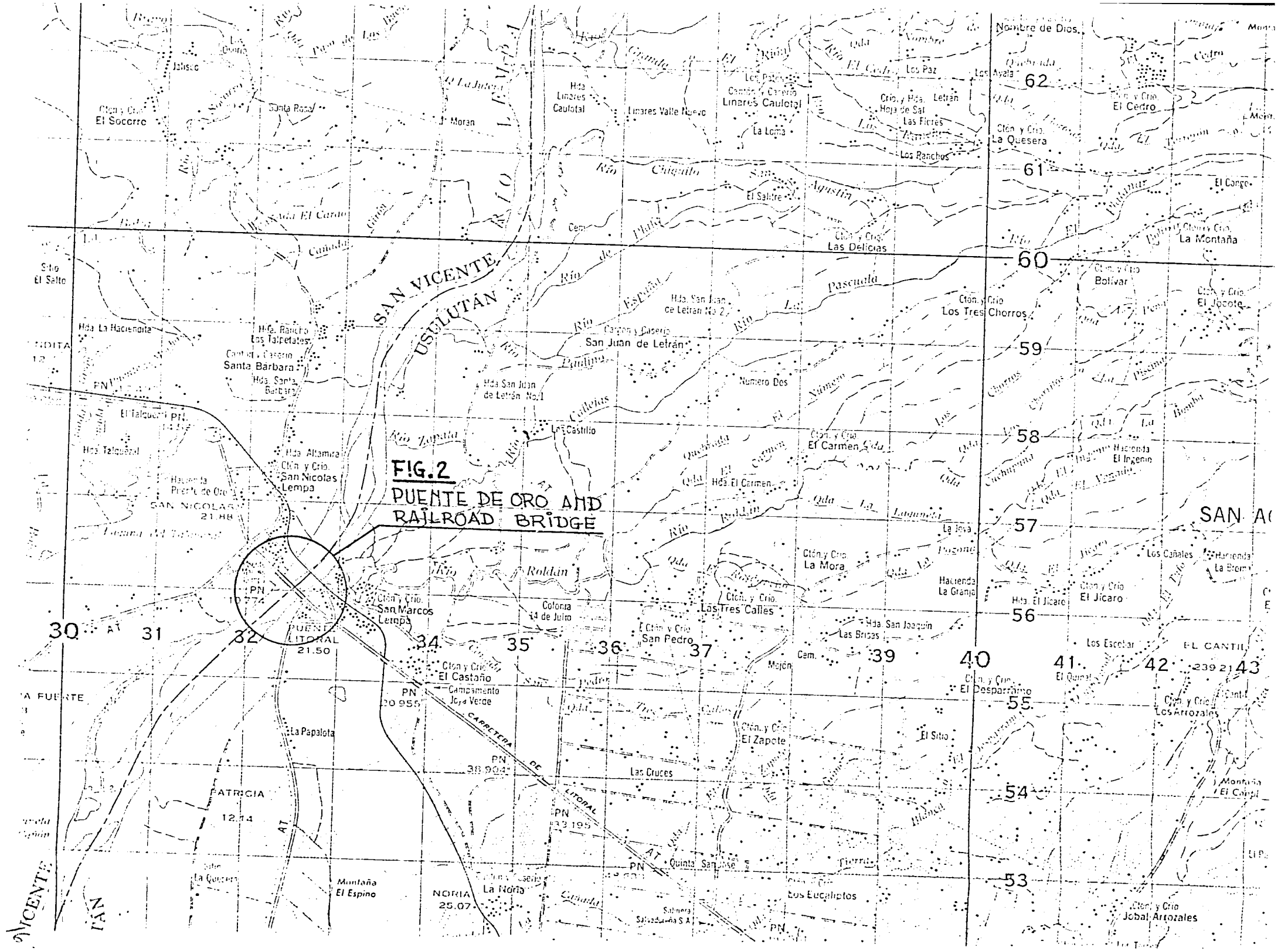
FIG. 2
PUENTE DE ORO AND RAILROAD BRIDGE
SAN VICENTE
USULUTAN
Nombre de Dios
El Socorro
Santa Rosa
Moran
Limares Caulotal
Limares Valle Nuevo
La Loma
Los Ranchos
La Quesera
El Cedro
El Congo
El Salitre
Las Delicias
La Montaña
Bolivar
El Jocote
Los Tres Chorros
San Juan de Letrán
Numero Dos
Santa Barbara
Hda. Rancho Los Talpetates
Hda. La Hacienda
Hda. San Juan de Letrán No 2
Hda. San Juan de Letrán No 1
Los Castillo
El Carmen
Hda. El Carmen
Hda. Altamira
San Nicolas Lempa
Hda. Talquezal
El Talquezal
Hacienda Presa de Oro
SAN NICOLAS
La Joya
La Mora
Hacienda La Granja
Los Cañales
Hacienda La Brema
El Jicaro
Hda. El Jicaro
Los Escobar
EL CANTIL
Los Arrozales
Jobal Arrozales
El Desparramo
El Quinal
Hda. San Joaquin
Las Brisas
Los Tres Calles
San Pedro
Colonia 14 de Julio
San Marcos Lempa
El Castaño
Campamento Joya Verde
PUENTE LITORAL 21.50
La Papalota
PATRICIA
Las Cruces
El Zapote
El Sitio
Quinta San José
Los Eucaliptos
Montaña El Espino
NORIA 25.07
La Noria
Salinera Salvadoreña S.A.
CARRETERA DE LITORAL
Río Grande
Río Chiquito
Río Zapata
Río Roldán
Río Pascuala
Río Paulino
Río Estrella
Río Las Cañas
Río Las Piscinas
Río Bombita
Río Cuchuyuta
Río Tres Calles
Río Jiquilisco
Río Tigre
Río Tepe
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FIG. 3

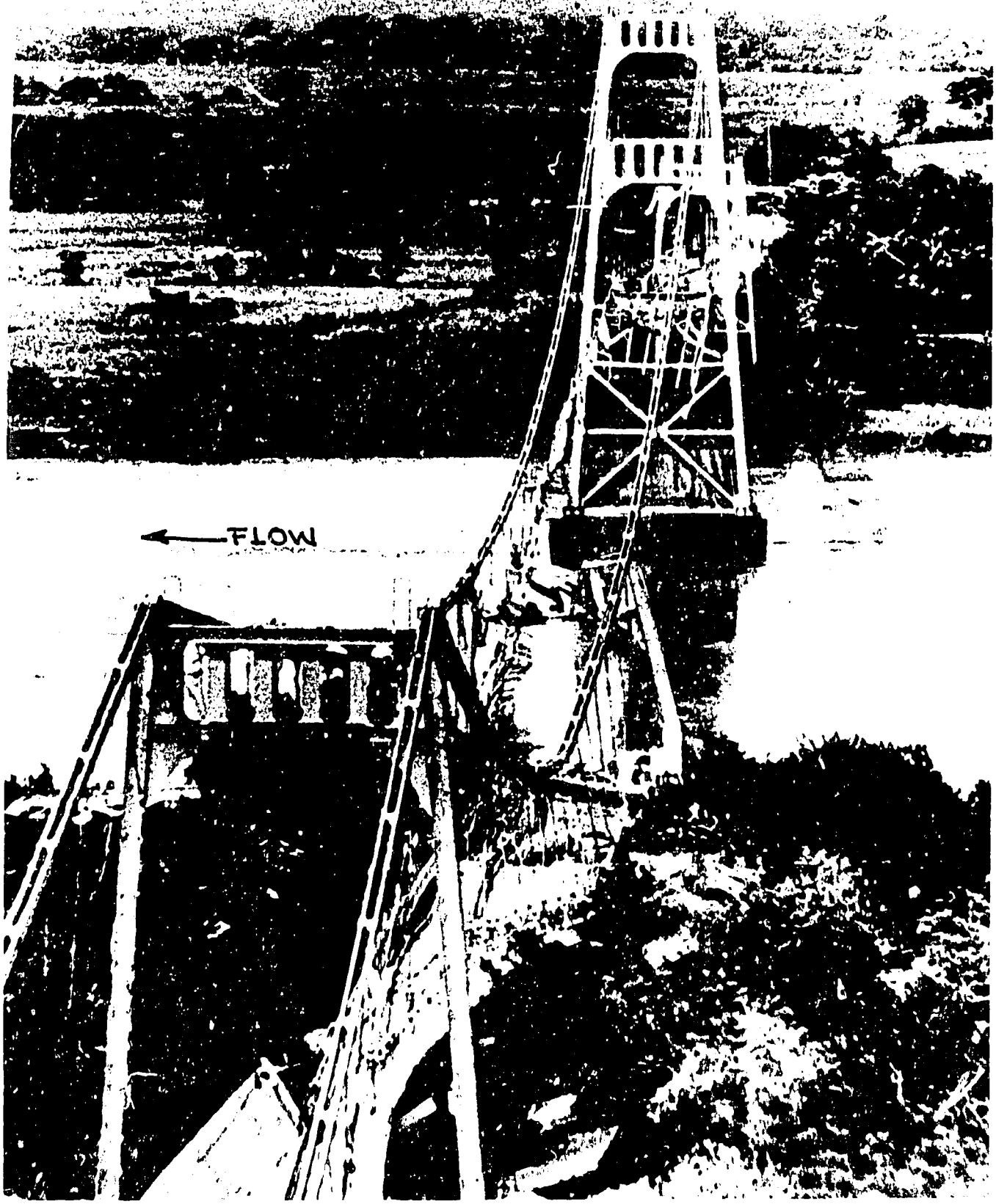


FIG. 4

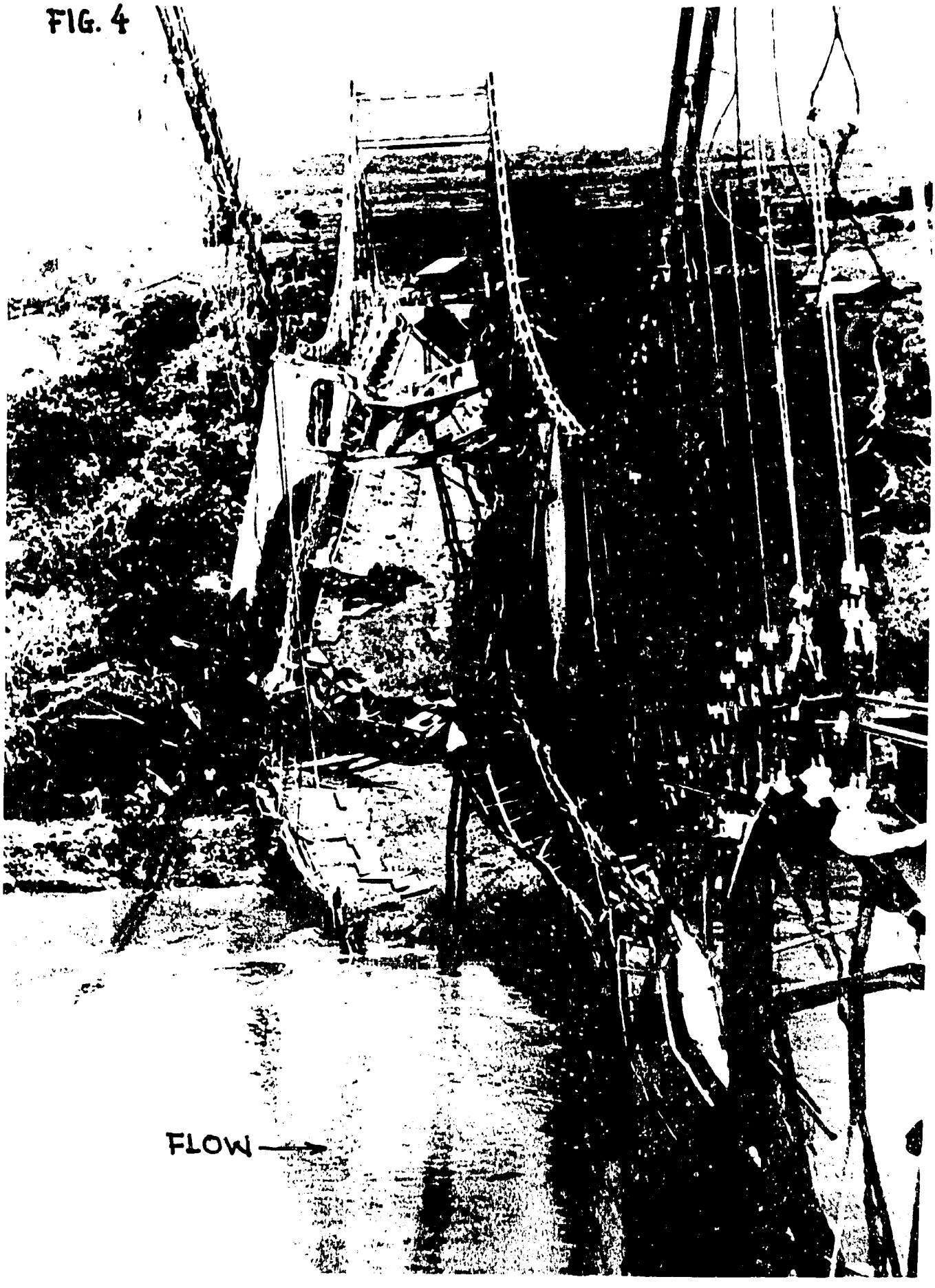


FIG. 5

EL DIARIO DE HOY - WEDNESDAY, OCTOBER 21

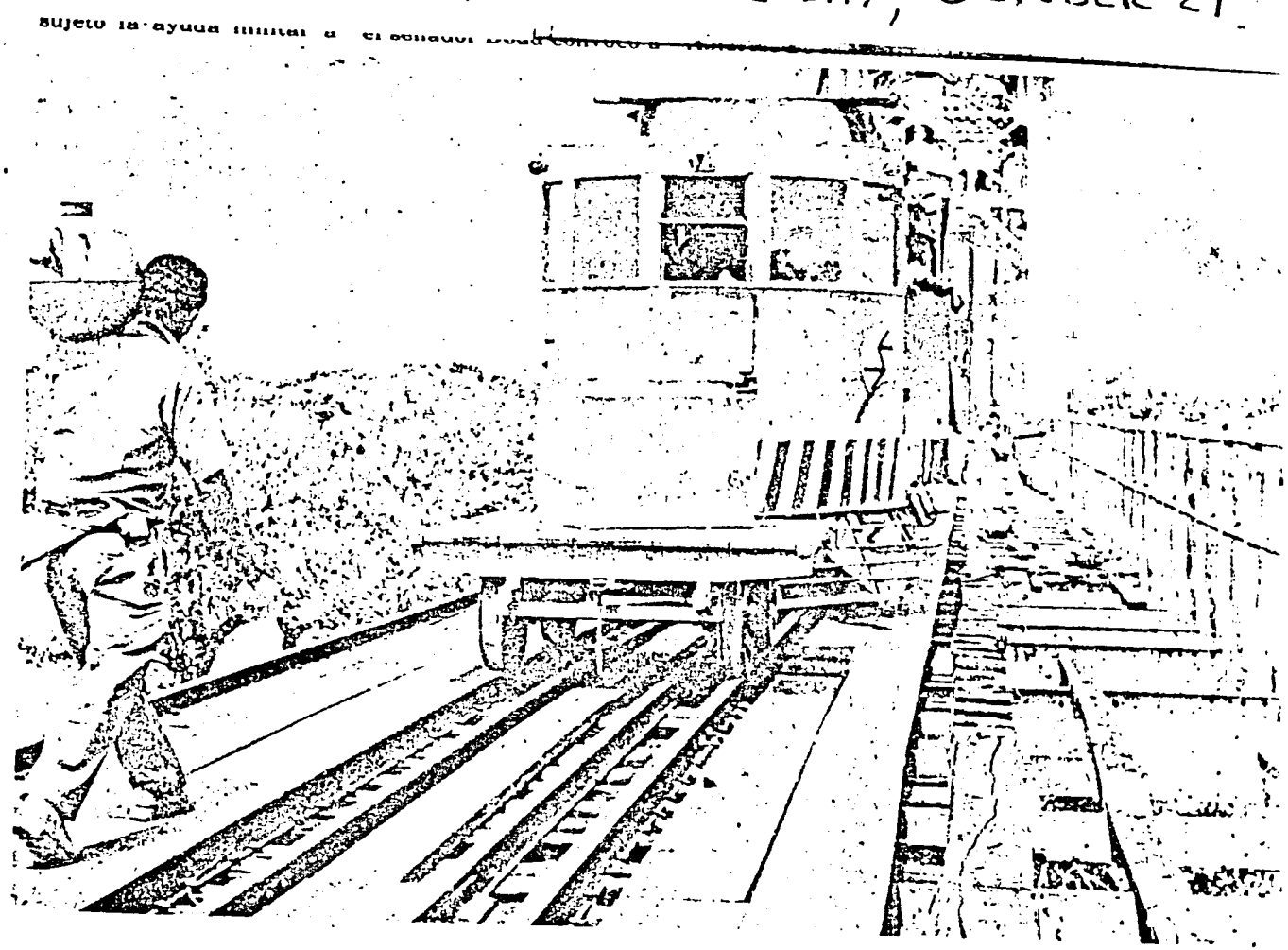
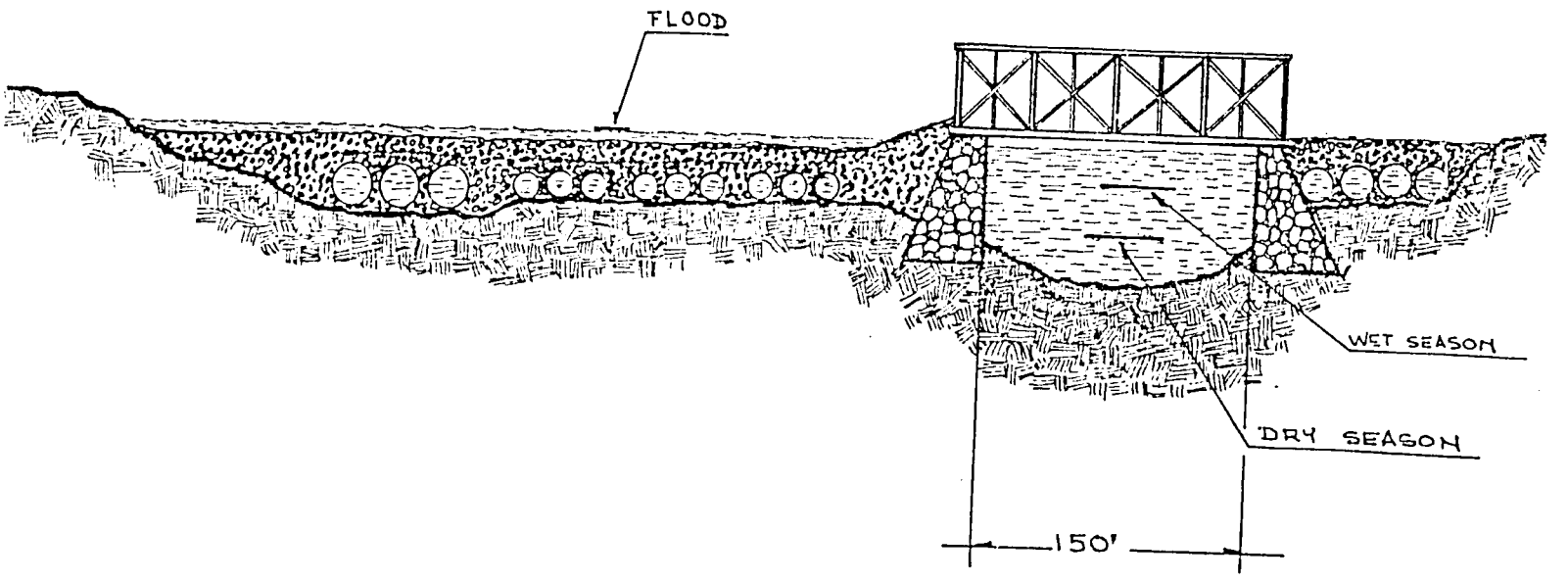


FIG. 6 TYPICAL RIVER CROSSING
BAILEY OR FLOATING BRIDGE.



ATTACHMENT I

DEPARTMENT OF THE ARMY
HEADQUARTERS, 193d INFANTRY BRIGADE (PANAMA)
APO MIAMI 34004

REPLY TO
ATTENTION OF:

AFZU-FE-PM

14 NOV 1980

SUBJECT: Final Report of Engineer Survey Team, El Salvador, 3 Nov 80 - 7 Nov 80

Commander
USMILGP El Salvador
APO Miami 34023

1. PURPOSE:

a. Survey the bridges of the Rio Lempa, El Salvador, to determine vulnerability to terrorist action, and determine alternate means of crossing the river by civilian vehicle traffic.

b. Survey the capabilities of the Engineer Brigade/Center of the Army of El Salvador in constructing alternate means of crossing the Rio Lempa.

2. TEAM MEMBERS:

George K. McGee, MAJ, CE, 338-36-5210
Ronald R. Wiseman, CWZ, 230-60-7772

3. PERSONNEL CONTACTED:

COL Castillo, Chief of Staff, Army of El Salvador
LTC Morales, Executive Officer of Engineer Brigade, El Salvador
MAJ Lopez, S-2/S-3, Engineer Brigade, El Salvador
ING Gavida, USAID Engineer Section, US Embassy

4. ACTIVITIES:

a. 4 Nov 80 Inspection of Engineer School/ Center at Zacatecoluca including personal interviews and equipment survey. Reconnaissance of the bridge of the Carretera de Litoral called alternately the "Puente Litoral" or "Puente de Oro" and the adjacent railroad bridge, including overflight in FAS helicopter.

b. 5 Nov 80 Reconnaissance of the bridge of the Panamerican Highway called "Puente Cuscatlan", and overflight of the Rio Lempa to the sea, including the bridges inspected on the 4th. Came under small arms fire, vic. 358692 (sheet 2456 II, 1:50,000).

c. 6 Nov 80 Inspection of field maintenance shops at San Salvador and interviews with USAID personnel.

5. FINDINGS:

a. The bridges over the Lempa River are not guarded.

b. The bridges appear to be in excellent condition, although USAID reports that the load limit on the Puente de Litoral has been reduced due to overstressing of the main suspension cables (see Incl 1-3).

c. The configuration of the sand bars in the Rio Lempa on 4-5 Nov 80 appears to be essentially the same as those illustrated on the available 1:50,000 maps with data as of Dec 74 (See Incl 4 & 5).

d. The construction of the power dam immediately upstream from the Puente Cuscatlan is well underway. A rock causeway is constructed across the river, leaving a gap of approximately 80 feet.

e. The Engineer Brigade/Center at Zacatecoluca has a primary mission for area security and a secondary mission to provide engineer support to the rest of the Army (see inclosure 6 for equipment status list).

6. ANALYSIS/CONCLUSIONS:

a. The suspension spans (highway bridges) are EXTREMELY vulnerable to terrorist action (see Incl 1&3). Since any damage to the main tension cables endangers the whole structure, and cutting the cables results in total destruction of the bridge, the vulnerability to terrorist attack cannot be overemphasized. The cables can be attacked with: explosives, acid, intense heat(torches, POL fires, thermite grenades), and mechanical means such as axes, hacksaws etc.

b. The railroad bridge is less vulnerable than the highway bridges and requires more expertise to destroy with explosives. Damaged members may be individually replaced. The bridge is capable of carrying wheeled, as well as, rail traffic if decked,(see Incl 2).

c. Although the Engineer Brigade is more suited for its Infantry mission, the equipment status, field maintenance capability at San Salvador, and the professional engineer knowledge of LTC Morales should render the unit capable of constructing the alternate crossing means outlined in Incl 1 and 3. Special purpose equipment, not part of the Brigade, could be rented or contracted from local contractors.

d. Alternate means of crossing the Rio Lempa are possible as outlined on inclosed bridge fact sheets (Incl 1-3) and maps (Incl 4 & 5). Crossing could be achieved in dry season within a week, if fixed spans are available and the construction of the required causeway to connect the fixed spans with the river banks could be more deliberate.

7. RECOMMENDATIONS:

a. Guard the bridges and construct physical security barriers around the cable anchors, to include lights, barbed wire, etc.

b. The construction materials for the culverted causeways should be prepositioned and the required fixed spans planned. Since Bailey Bridge is not available, recommend the design and prefabrication of the required fixed spans, by the Ministry of Public Works for emplacement by the Engineer Brigade.

c. Pre-stock the timber and spikes required to deck the railroad bridge.

d. Alter present maintenance procedures to evacuate engineer equipment to Field Maintenance at San Salvador to place repair burden where it belongs, and free engineer mechanics for critical on site repair.

e. Extract the engineer cadre and equipment from the Brigade/School to create two units:

1) An Infantry unit with area security mission at Zocotecoluca.

2) A mobile combat engineer unit to support the entire Army in the following tasks:

a. Clearing heliocopter landing zones.

b. Demolition

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SUBJECT: Final Report of Engineer Survey Team, El Salvador, 3 Nov 80 - 7 Nov 80

c. Expedient bridging.

d. Mine/Counter mine operations.

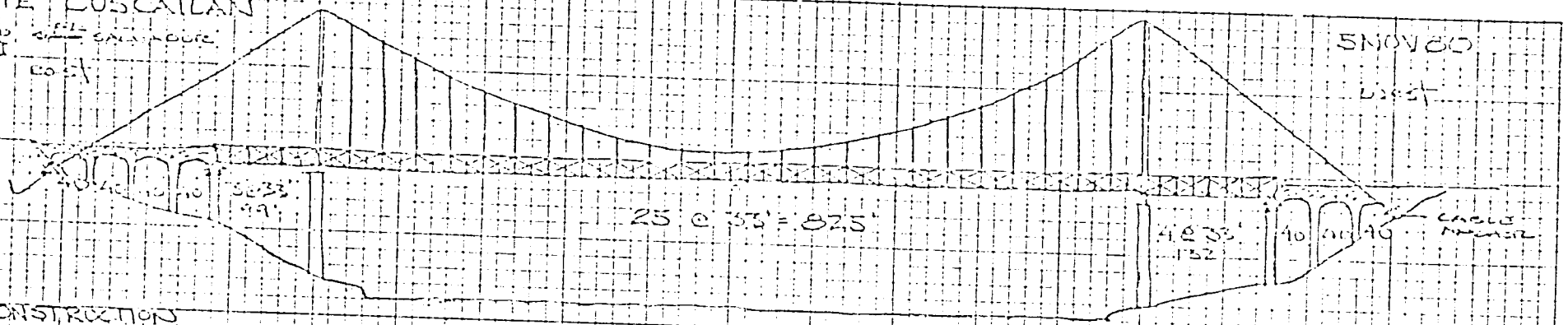
e. Repair of supply routes.

The separation, perhaps, would be easier if the heavy equipment (D-8 bulldozers) were left with the Zacatecoluca Brigade as part of a vertical construction mission in conjunction with area security, but a light, mobile engineer force is necessary as a force multiplier for support of road/heliborne operations.

6 Incl
as

GEORGE R. McGEE
MAJ, CE
Ch, Engineer Survey Team

PUENTE COSCATLÁN



CONSTRUCTION

REINFORCED-CONCRETE PIERS

CONTINUOUS ARCHED CONCRETE TRUSS IN APPROACH SPANS

STEEL SIMPLE-SPAN THROUGH TRUSSES

CENTER SPAN SUSPENDED FROM STEEL TOWERS ON CONCRETE PIERS. ROADWAY CARRIED ON THROUGH TRUSSES. CONTINUOUS SUSPENDED ON VERTICAL STEEL CABLES @ 33 FT. CENTERS

SUSPENSION CABLES, 16 AND 2 INCHES ROUND

VULNERABILITIES:

CUTTING OF CABLES — 64 FT TO ACH TO RESTORE CENTER SPAN

MECHANICAL DAMAGE WOULD REQUIRE EXTENSIVE REPAIR w/ CONTRACTOR EXPERTISE

EXTREME HEAT WILL WEAKEN CABLES TO EXTENT THAT THE SPAN WILL COLLAPSE.

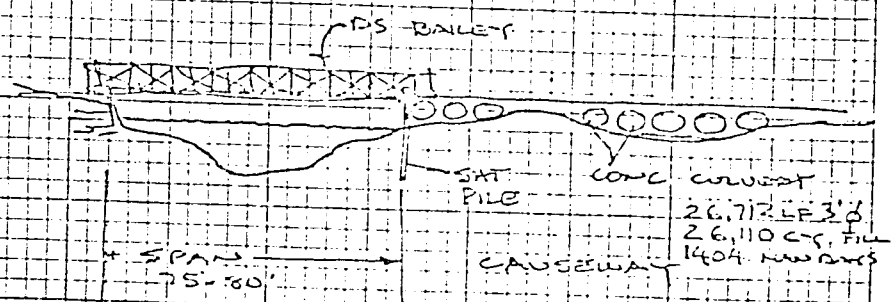
BY-PASS IN ORDER OF EFFORT

a. FORD LEMPA @ 459749 w/ IMPROVEMENTS TO ACCESS ON BRIDGE FLOOR

b. BRIDGE @ DAM CONSTRUCTION SITE IMMEDIATELY UP FROM BRIDGE. ~75 FT BAILEY DOUBLE SINGLE (OR 1 SAT ROAD)

c. CONSTRUCT CAUSEWAY / BRIDGE @ VIL 435745

c. CONSTRUCT CAUSEWAY / BAILEY COMBINATION TO REDUCE SPAN REQUIRED FOR BRIDGE. CAUSEWAY @ SAND w/ SAND BAG STABILIZER BANKS, CULVERT SECTIONS AND w/ SAND BAG HEADWALLS.



SECURITY RECOMMENDATIONS

a. LIGHTS ON ANCHORAGES & ALONG SPAN

b. GUARDS ON DECK @ ANCHORAGE / PIERS

c. REMOVAL OF FAMILY FROM UNDER STRUCTURE WHO MAY BE SYMPATHETIC

d. FIRE FIGHTING EQUIPMENT

INCL 1

GEORGE K. M'GEE
MAJOR, CORPS OF ENGINEERS

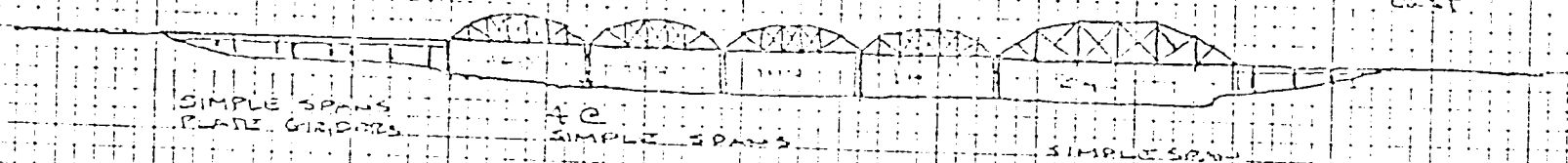
PUENTE DEL LITORAL RAILROAD BRIDGE

1:50,000 EL SALVADOR 2456 II

SANDIEGO

west

east



CONSTRUCTION

MASSIVE REINFORCED CONCRETE PIERS

APPROACH SPANS - SIMPLE PLATE GIRDERS

CENTER SPANS: 4 ea THROUGH TRUSSES - SIMPLE SPANS
1 ea THROUGH TRUSS - SIMPLE SPAN

5 INCH RAIL ON WOOD TIES ON PLATE GIRDERS

VULNERABILITIES

CUTTING OF TOP AND BOTTOM CHORD OF ANY TRUSS ON ONE SIDE WILL RESULT IN FULL DESTRUCTION IN ROTATION OF SPAN - 26 LBS

CUTTING OF PLATE GIRDERS WILL DROP APPROACH SPAN - 54 LBS

BY-PASS

NONE. THIS STRUCTURE MUST BE REPAIRED / REPLACED IN ORDER TO RESTORE RAIL TRAFFIC

SECURITY

a. GUARDS

b. LIGHTS

c. BARRIERS AROUND PIERS

d. REMOVE FAMILIES UNDER / ADJACENT TO BRIDGE

e. FIRE FIGHTING

REPAIR:

a. REPLACEMENT OF MEMBERS OKAY POSSIBLE

b. REPLACEMENT OF SIMPLE PLATE GIRDER OR THROUGH TRUSS w/ B: 4R SIMILAR MEMBERS

INCL 2

GEORGE K. McGEE
MAJOR, CORPS OF ENGINEERS

PUENTE DEL LITORAL (PUENTE DE PRO.)

1:50,000 EL SALVADOR
2456II

5 NOV 80

CONSTRUCTION:

TOWERS OF BUILT-UP ROLLED STEEL SECTIONS W/ CONCRETE IN CENTER OF MID STREAM TOWER

APPROACH SPANS CONTINUOUS STEEL STRINGERS WITH CONCRETE DECK

5 SUSPENSION SPANS WITH LONGEST CENTER SPAN OVER EAST HALF THE LEMPA RIVER

ROADWAY CONCRETE DECK ON STEEL STRINGERS SUSPENDED FROM DIAGONAL STEEL HANGERS SUSPENDED FROM 26 ea. 1 1/2" ϕ STEEL CABLES

VULNERABILITIES:

CUTTING OF CABLES WILL RESULT IN TOTAL DESTRUCTION OF 5 SPANS - 10 LB TNT/EA

MECHANICAL DAMAGE TO CABLES WOULD REQUIRE PROFESSIONAL REPAIR - OR DROP ALL 5 SPANS

EXTREME HEAT WILL ALSO WEAKEN CABLES TO DESTRUCTION

BYPASS IN PRIORITY OF EFFORT REQ'D

a. FORD OF LEMPA RIVER IMMEDIATELY SOUTH OF BRIDGE. VIC. 305535 - ACCESS IMPROVEMENTS REQUIRED - MAY REQ FLOAT BRIDGE.

b. DECK ADJACENT AND PARALLEL RAILROAD BRIDGE IAW TM 5-312 FOR VEHICLE TRAFFIC

c. CAUSEWAY/BAILEY COMBINATION VIC. 305535

SECURITY RECOMMENDATIONS:

a. GUARD AT CABLE ANCHORS

b. DECK GUARDS

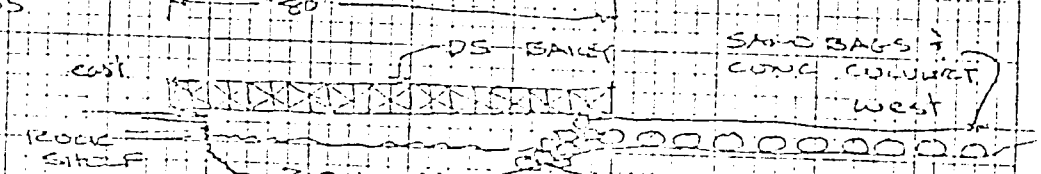
c. LIGHTS - PHYSICAL BARRIERS

d. REMOVE FAMILIES UNDER TRAIN

e. FIRE FIGHTING EQUIP

b. DECK ADJACENT RR BRIDGE

75000 BOARD FT DECKING (2x4, 3x4)
12,000 BOARD FT 4x12 CURB
87,000 BOARD FT TOTAL



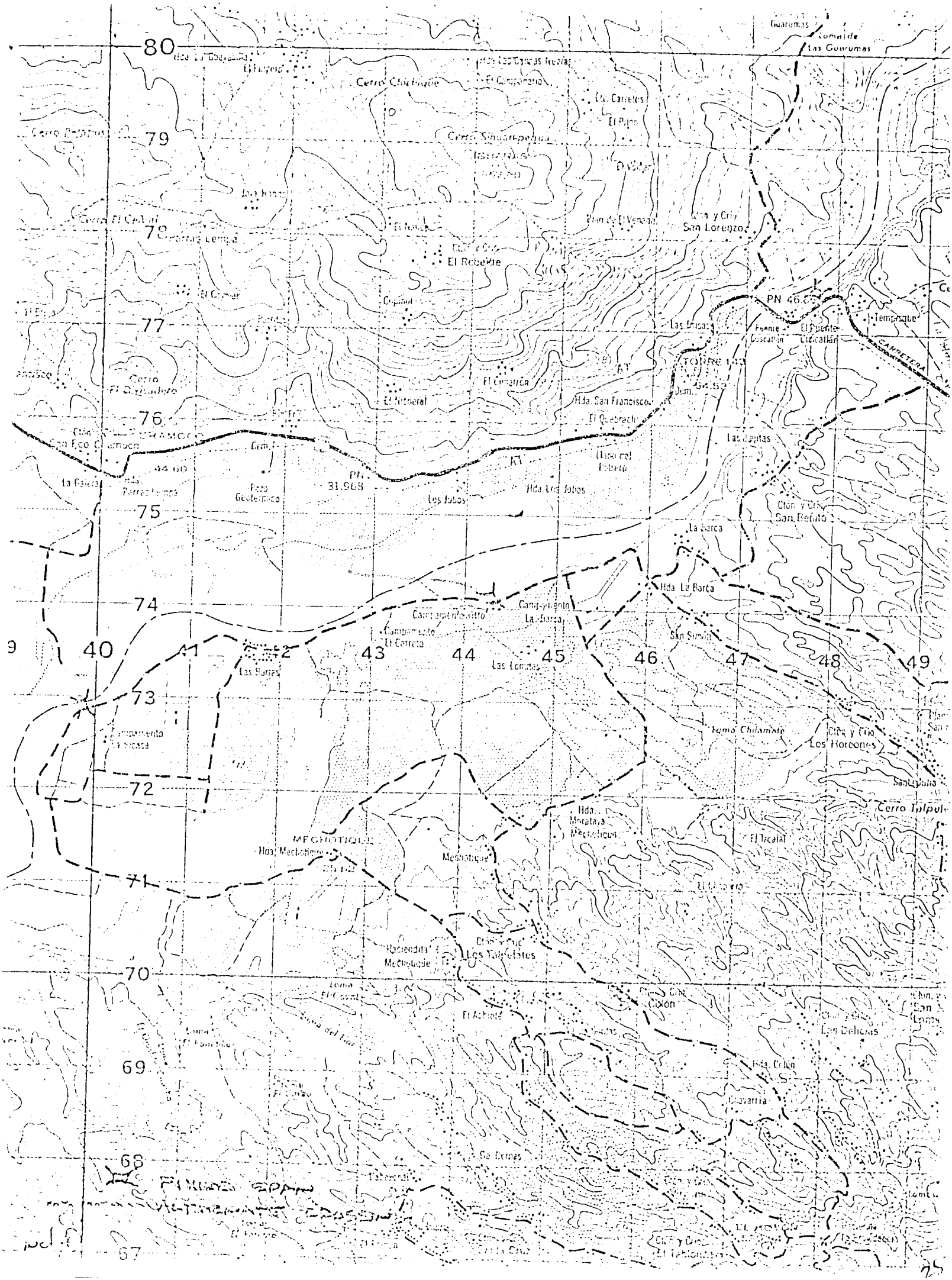
REQ'D
10794 LF 3'
10565 CY
561 MAN DAYS

c. CULVERTED CAUSEWAY / BAILEY BRIDGE

SET BAILEY ROAD CULVERT LOCAL ON ECONOMY

INCL 3

GEORGE K. McGEE
MAJOR, CORPS OF ENGINEERS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Cerro Chichiquite
Cerro Sibustepeque
El Rebelde
PN 46.60
Las Lisas
Temascaque
El Puente
Cucatlán
CARRETERA
TOLUCA
El Cimarrón
Hda. San Francisco
El Quebrachito
Las Lajitas
Cerro El Quebrachito
El Mineral
Cerro Chamuco
PN 31.968
Los Jobos
Hda. Los Jobos
Ctón y Cría San Benito
La Barca
Hda. La Barca
Campamento La Barca
Campamento El Carreto
San Simón
Las Lomas
Las Barras
Lomo Chilamate
Ctón y Cría Los Horcones
Cerro Talpule
Hda. Moratayá Mechicique
El Tacatal
MECHOTIQUE
Hda. Mechotique
Mechotique
Hacienda Mechotique
Ctón y Cría Los Talpetates
Ctón y Cría Cocón
El Achiote
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Hda. Cocón
Guarumas
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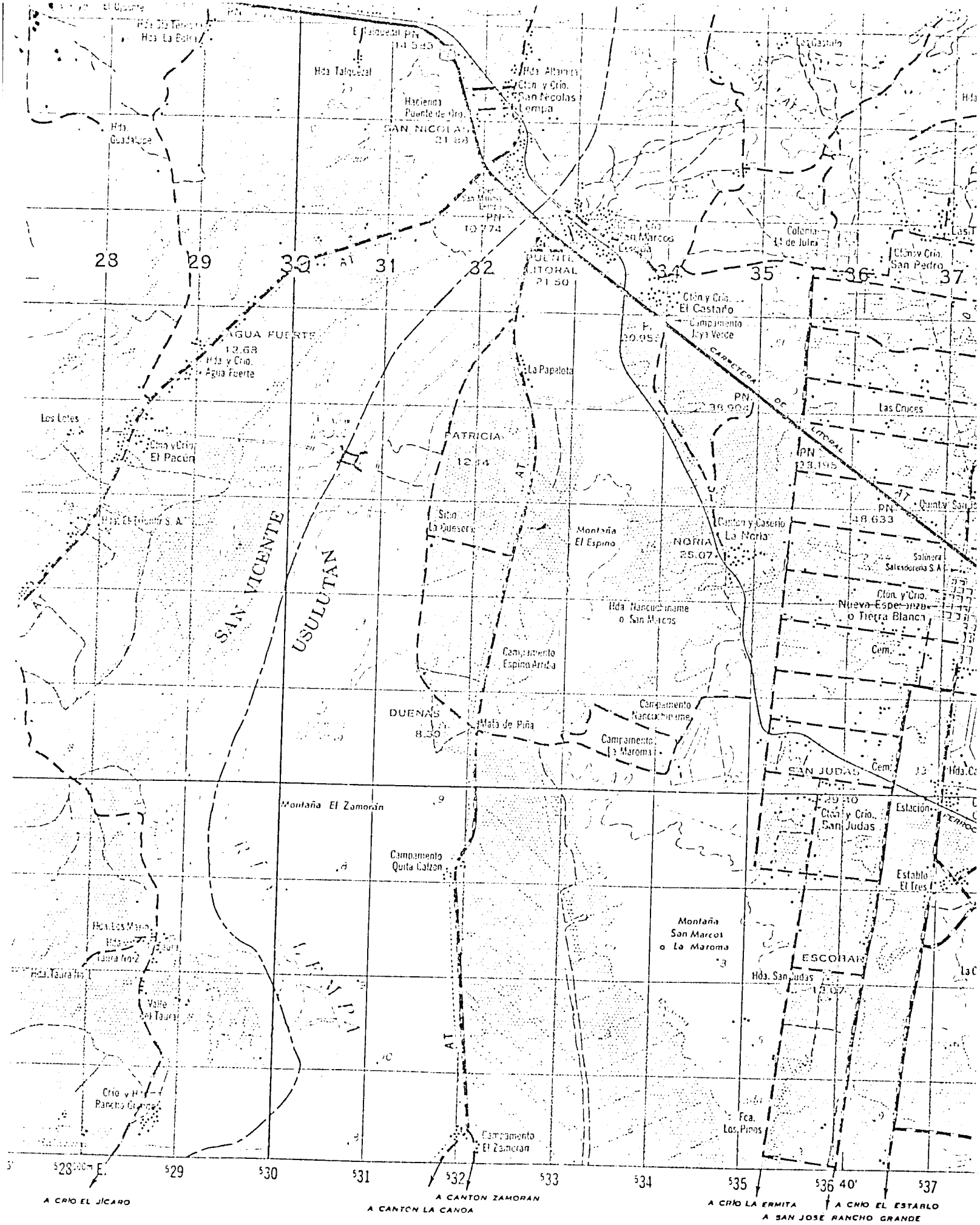

Incl 5

REPÚBLICA DE EL SALVADOR

FIXED SPAN

ALTERNATE CROSSING

29

ENGINEER EQUIPMENT STATUS

ITEM	NO.	STATUS		REMARKS
		Good	Bad	
Crawler Tractor D-8, Cat	3	1	2	
D-6, Cat	1	1		
D-5, Cat	1	1		
D-4, Cat	1	1		
TD-20 Cat	2	1	1	
Grader Cat-12	3	3		
Front Loader 645 M	1		1	
Crane 25 T	1		1	
Trailers 25T (Low Boys) M172A1	2	2		
Truck Tractors (Prime Movers)	3	2		
Truck Dump M51 (5T)	8	3	5	1 ea used as gun truck