70
204
1250

CHIPARE PROJECT

INTERTECT Project Book

For Office Use Only

DO NOT REPRODUCE

INTERTECT

Need to do:

1. Review Flood control data & develop design for levee & alternatives
2. Develop map of clipare (N.C. basin)
3. Write up recommendations
4. Obtain Aerial photos of region
    1. Get LANDSAT images — did we write to Brazil
    2. Contact Aeroservices - have we heard from them

Outline of Report

I Summary of Problems:

- A. Erosion — - Difficult to control; - can undercut levee
- B. Downstream flooding
- C. Lack of close topo data
- D. Lack of funds for extension action
- E. " " personnel " "

II Options:

- A. Erosion
    1. Stabilize bank
    2. Allow stream to meander
    3. upstream cuts or diversion
    4. River barrages
- B. Flood protection
    1. Road/Levee System ← Progression area & major advantages & disadvantages
    2. Intermediate Flood ~~post~~ escape
    3. Evacuation
    4. ~~5. Rive~~ Farm Levees

options:
A. INT.
B. Road Dept.
C. oil co.

III Action Recommendations ~~Strategies~~

- A. Research ~~[illegible]~~
    1. Why research is needed
    2. What will be examined
    3. Does this mean action stop now?
    4. To determine up stream flood potential
- B. Actions
    1. Survey of ground site
    2. Installation of flood warning system.
    3. Flood Fighting Team
    4. ~~Raising of Houses~~ Non Structural
    5. ~~Dike house~~ improvements in Farm dikes

IV Strategies for Financing

- A. Use portion of grant for chipone twins.
- B. Contact gov't for asst. on roads
- C.

Outline of Report (cont.)

IX. ~~Summary of Problems~~

Appendices

A. ~~Cross section~~ Map of Cheyenne, Topo - Red Baron
B. Geological map of Region - Loren
C. Aerial Photos
d. Satellite photo
✓ e. Levee designs - Corps of Eng. manual)
f. Area wide embankment schematic
g. Estimated costs of levee improvement

International Disaster Specialists

P. O. Box 10502

Dallas, Texas 75207 U.S.A.

Tel.: (214) 521-8921

INTERTECT

May 2, 1978

Mr. Ed Ruddell
World Neighbors
Lima, Peru

Dear Ed:

Despite all the trials and tribulations of no ticket and no passport, I managed to get back to Texas without too much problem after you left. Please thank your contact at the church in La Paz for helping me out with traveler's checks. It was a big help and really made it possible for me to collect my gear and get out without too many additional problems.

Just thought I would keep you posted on what has been happening on the project since I left. When I got back to the office, we contacted the Texas A&M University Remote Sensing Center to see about obtaining satellite images of the area. We know that, since 1973, photographs have been taken of that region, so we are going to research the files to find out if we can get a series of photos taken at regular intervals over the last five years. These should indicate the changes in the stream bed and will give us a basis for predicting what might happen in the near future, especially as it relates to the constant erosion of the western bank of the river and the undercutting of the plateau that is now being occupied and farmed.

Next we are going to get a list of dates during the rainy season when photographs were taken which might have captured either the floods themselves or the signature of the mud left by the floods. (There are several ways to do this by looking at different color spectrums.)

Third, we have learned that a new LANDSAT has recently been put into orbit with a microwave radar unit on board. The advantage of the microwave radar is that it can actually cut through cloud cover and produce a computer photograph of conditions on the ground. While it is too late to capture past floods, you should tell the folks down there to let us know as soon as possible if any new flooding occurs during the next year so that we can try to catch a picture of it on the radar.

We are trying to locate maps of the different soils in the region so that we can put together an accurate soils map to give us an idea of where we might be able to best place the flood protection system. Until the flood protection system can be built and raised to a level where it will be effective, we are trying to locate some simple sensing devices to be placed in the river stream which will give off a warning that can be relayed to the settlement in order to give everyone time to be prepared for a flood coming from upstream. There are several devices available, but we are trying to find one which is cheap, reliable, and easy to maintain.

Last weekend, Loren Raymond and I met to discuss my initial recommendation that an elevated road system be built to serve the dual purpose of improving access as well as providing a flood barrier. He generally concurs that this would be the simplest and most economic route to pursue, and one which could be built by the residents themselves. However, he is concerned that the soils may not be adequate to prevent scour (erosion of the base), and that the meandering of the stream might be a greater long-term danger than the actual flooding. We are trying to obtain more soil information, both from the LANDSAT images and from records of surveys which have been carried out by oil companies in that area, which may be available through resources here in the U.S.

As far as the actual design of an elevated flood barrier is concerned, I have been checking on design criteria developed by a number of agencies working in India and Indonesia, and going through our library trying to come up with some recommendations. There are a number of options available, even if the soils are bad, and I think that such a system could be built by the people over a period of years which would be effective as well as affordable. I have also recently heard of some new techniques which have been employed in Holland and Bangladesh using low-cost plastic sheeting (which OXFAM, CWS and other major Volags have in almost unlimited quantity) that I think could be used quite effectively to prevent the scour.

Concerning funding, the type of agency which would be involved in this is somewhat limited. Most of the people to whom I have talked have said that it is really the role of the Government of Bolivia to carry out this type of program. The major international agencies (such as the U.N., the World Bank, the Inter-American Development Fund, etc.) might be willing to put up the money, but the actual request would have to come from the Bolivian Government. U.S.A.I.D. might be willing to fund CWS directly to do this project, were they to receive a proposal. And, in fact, they have done several projects of this type in Bangladesh and other countries in Asia. Generally, however, U.S.A.I.D. prefers also to go through the government.

This brings us back to square one; but I don't think at this stage we should be worrying about how to fund the program, but rather trying to develop the approach in such a way that we not only demonstrate feasibility and necessity, but also show that it can be carried out for a very small capital investment. In the meantime, we can continue to brainstorm other funding possibilities. (Shouldn't some of the big international engineering companies like Bechtel, Brown & Root, etc., be interested in this type of project, as they have made public commitments to turning portions of the money that they earn in developing countries back to those countries? It is something that they can understand and relate to, and the engineers on their board might even be excited about this type of self-help project. This may be a fertile field as yet unploughed.)

Last week I got back the pictures we took on our flight over the Chipare region. The color slides that you took were all over-exposed, and only one or two are usable. The color slides that I took are better, but they do not show the actual Nueva Canaan settlement area. The black-and-white films came out O.K. and we will be able to use them without any problem. We will send you copies of the most important ones soon.

There are several things that we need from you and/or Combasi in order to move ahead. First, we need a list of all the exact dates on which flooding occurred since 1973. Second, we need to obtain that copy of the topographic map that we tried to locate from the highway engineers when you and I visited

Nueva Canaan. As soon as we get these, we will be able to proceed with the LANDSAT part of the program and to finish the topographic map of the Nueva Canaan settlement area.

There is one final thing. As I mentioned to you when we were in Bolivia, we are very interested in helping with this project because it will give us an opportunity to explore all the possibilities of using the LANDSAT imagery. To help defray our costs in the project, INTERTECT is preparing a proposal to submit to various possible funding sources, including the National Science Foundation, the U.S. Coast and Geodetic Survey, and the National Academy of Sciences. At present, I have drafted the first part and Loren Raymond is going over the second part in detail. As soon as it is complete, I will send you a copy for your comment. The main reason for mentioning this is that I know World Neighbors is reluctant to work on projects directly funded by U.S.A.I.D. (as we are ourselves). Before we submit the proposal, I wanted to make sure that it is alright with you for us to submit it to these funding sources. These are the only ones that we know of at this time who offer money for research and applications in the field of remote sensing. If you would prefer that we not submit the proposal to these organizations, then we will need to examine some alternate possibilities for funding with you.

If you have any questions or comments about any of the above, I will be glad to go over these in detail with you when I see you in Lima. Until then,

Best regards,

Frederick C. Cuny

FCC:jwp

cc: Oramel Green
Loren Raymond

Reports

PART II

CHAPTER 4

RAISING EXISTING STRUCTURES

Description

Existing structures in flood hazard areas can often be raised in-place to a higher elevation to reduce the susceptibility of the structure to flood damage. Specific actions required to raise a structure include,

- Disconnect all plumbing, wiring, and utilities which cannot be raised with the structure.
- Place steel beams and hydraulic jacks beneath the structure and raise to desired elevation.
- Extend existing foundation walls and piers or construct new foundation.
- Lower the structure onto the extended or new foundation.
- Adjust walks, steps, ramps, plumbing, and utilities and regrade site as desired.
- Reconnect all plumbing, wiring and utilities.
- Insulate exposed floors to reduce heat loss and protect plumbing, wiring, utilities and insulation from possible water damage.

These actions are intended to place the structure at a higher elevation at its existing site and to protect plumbing and utilities below the first floor from water damage. Because the hazard is not eliminated, but only the damage potential reduced, it is important that the potential for flooding below the first floor be recognized in the raising. Where wave action is likely, the structure should be raised an additional height above the design level to prevent inundation by waves. Lateral stability of the structure should be insured by designing the foundation walls or piers in a way that a hinge effect is not created between the superstructure and foundation. Also, flood flow velocity should be accounted for in the design. All ground to house utility lines (sewer, electrical, gas, water, telephone) should be protected against water, wind and extreme temperature exposure which may be brought about by elevating the structure. Access to and from the structure during high water should be insured when raising walks, steps, ramps, and when regrading the site. This is important to insure occupant safety in the event the design flood is exceeded. Figure 4-1 illustrates the concept of raising in-place.

Physical Feasibility

The principal consideration for physical feasibility is that the structure can be raised economically. Generally, the technology exists to raise almost any structure, even multistory buildings, however, the more difficult the raising the more costly it becomes. Within the normal range of expected annual flood damage, raising-in-place from a practical viewpoint is most applicable to structures which can be raised with low cost conventional means. Generally, this means structures, 1) which are accessible below the first floor for placement of jacks and beams, 2) which are light enough to be jacked with conventional house moving equipment, and 3) which are small enough that they do not have to be partitioned. Wood frame residential and light commercial structures with first floors above the ground (normally with an 18" crawl space beneath the first floor) are particularly suited for raising. Wood frame structures with basements below the first floor are also accessible and light weight, however, raising the superstructure

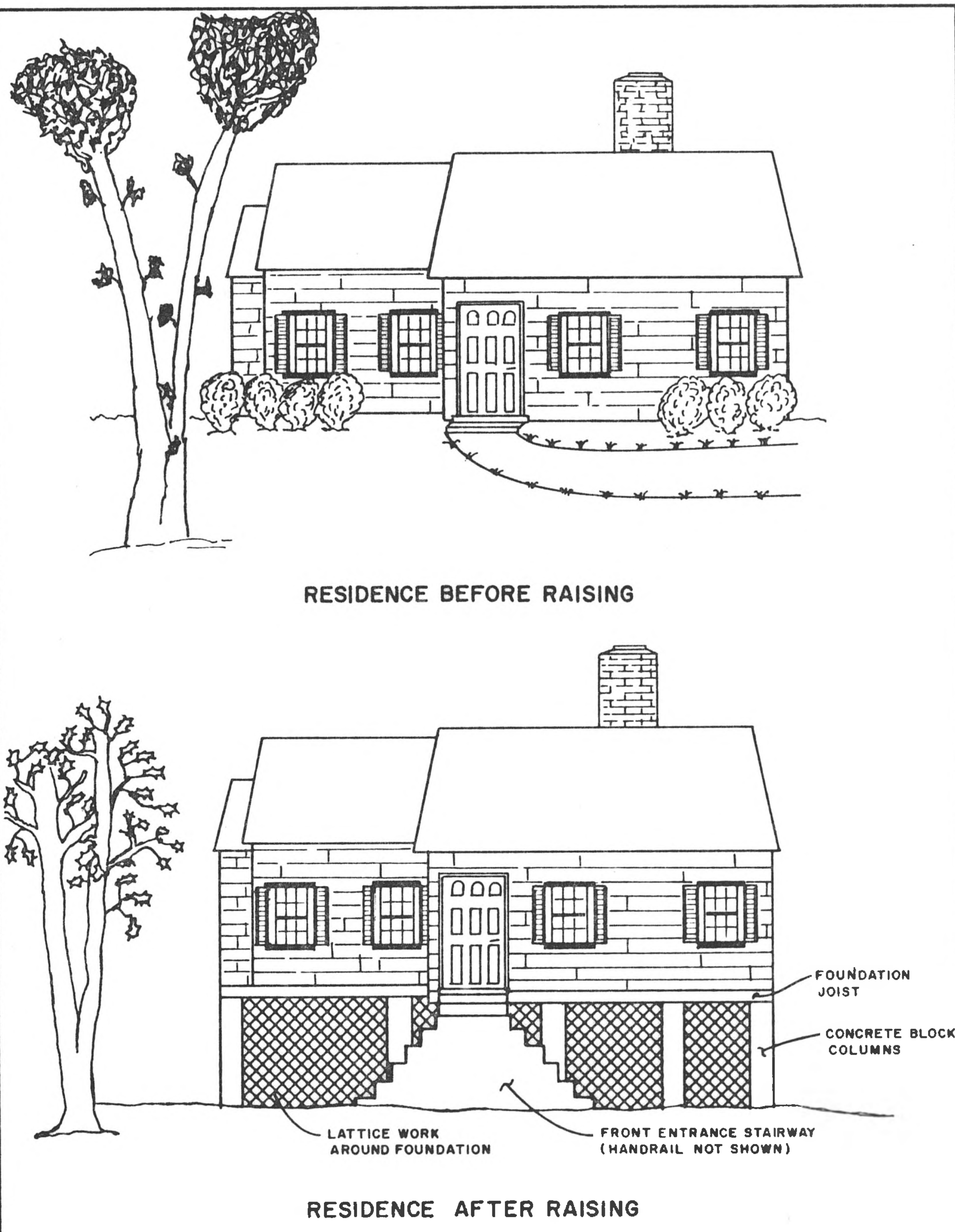


Figure 4-1. Raising Existing Structure
(Adapted from Reference 1)

does not protect the basement and it is doubtful many basement walls or floors could be reinforced to take the hydrostatic head economically. A more likely approach if it were necessary to raise a structure with basement would be to minimize the damageable property in the basement and allow flooding. Brick, brick veneer, and masonry structures, while heavier and more difficult to handle can also be raised. Structures with concrete slab floors on the ground (slab-on-grade) and structures with common walls (row structures) are not feasible to raise without special equipment and additional expense. While it is physically possible to raise many types of structures, it is often not practical for the reasons mentioned above. Where raising in-place is in fact being done it seems to be principally to wood frame type structures on raised foundations (no basement).

As to height of raising, residential structures have been satisfactorily raised up to nine feet (1). Aesthetics, intended use, 100 year flood elevation and structural stability are factors which often influence the height selected. Generally the additional cost to raise a structure an additional foot or so is small compared to the initial set-up cost.

Costs

Base cost items to raise a structure in-place include,

- Brace, jack, and reset structure (including disconnecting utilities and temporary connections).
- Extend existing or construct new foundations.
- Extend and reconnect all utilities.
- Reconstruct walks, steps, ramps.
- Relandscape site (including plant replacement and siding).
- Architectural/Engineering fees.

Additional cost items may be applicable depending upon the specific site conditions. Examples of these items include,

- Removal and disposal of sidewalks, curbs, ramps, driveways not used in the reconstruction.
- Updating structure foundation and utilities to code.
- Additional bracing for stucco, or brick sidings or structures in poor condition.
- Reconstruction of chimney and fireplace.
- Temporary housing during raising.
- Additional aesthetic work.

Engineer's cost estimates were made for raising a 1600 square foot structure without basement, on a raised foundation, three feet. These data are summarized in Table 4-1. Only base cost items were included so the estimate would represent a minimum cost. The Table shows a total estimated first cost of $7,750, and an annual cost of $621. As a percentage of total structure value for a $30,000 structure the annual cost is 2.1 percent. Lesser valued structures may cost less to raise, either because they are of smaller size, or simpler architecturally. However, because they are of lesser value the lower cost may be offset and the percentage remain the same.

questionable in the 10 to 15 year range. For a two story structure without basement, raising three feet or five feet generally appears feasible below the 7 year flood plain, not feasible above the 10 year, and questionable between the 7 to 10 year flood plains. Because the cost data intersects the damage reduced functions where they are generally at a moderate slope the general feasibility conclusions stated above are not particularly sensitive to changes in cost. For example, a 50 percent increase in cost would only change the flood plains indicated by three years or so.

Advantages and Disadvantages

Table 4-2 below summarizes the advantages and disadvantages of raising a structure in-place.

TABLE 4-2

ADVANTAGES AND DISADVANTAGES OF RAISING AN EXISTING STRUCTURE

Advantages	Disadvantages
Damage to structure and contents is reduced for floods below the raised first floor elevation.	Residual damages exist when floods exceed the raised first floor elevation. Minor damage may occur below the first floor depending upon use.
Particularly applicable to single and two story frame structures on raised foundations.	Not generally feasible for structures with slab-on-grade foundations or structures with basements (unless basement flooding is tolerated).
Structures have been raised to heights up to nine feet. The greater heights are probably most acceptable in wooded areas of steep topography.	Landscaping and terracing may be necessary if the height raised is extensive.
The means of raising a structure are well known and contractors are readily available.	
Raising in-place allows the user/owner to continue operations at the existing location.	
Flood insurance premiums are reduced.	

References

1. U.S. Army Engineers, "Flood Proofing: Example of Raising a Private Residence", South Atlantic Division, Technical Services Report, March 1977.

CHAPTER 5

SMALL WALLS OR LEVEES AROUND NEW OR EXISTING STRUCTURES

Description

Flood walls and levees along rivers and streams have been used for centuries to exclude water from flood plain land. Often they extend for miles along a river. In the context of nonstructural measures a much more local use is intended. Wall and levee heights are generally less than six feet, they are designed to protect one or several structures, and they are built to be compatible with local landscape and aesthetics. Walls may be of brick, stone, concrete or other material designed to resist the lateral and uplift pressures associated with flooding. In urban areas where space is limited, walls running along property lines may be low (3 feet) so as not to hide store fronts, or high (6 feet) to create patio or garden areas for apartments or townhouses. On suburban sites a wall may be attached to a structure, for example, by running along a porch, or detached and located at the property line as a fence. Levees are usually constructed with an impervious inner core to prevent seepage and with slope protection if erosion is a problem. Serpentine levees along the backside of a lot can be designed to be compatible with many landscapes and at the same time serve to exclude flood waters.

Where access openings are necessary, provisions must be made to close these openings during floods. This generally means providing a flood gate which can either be stored at the opening and installed when needed, or constructing it on hinges or rollers for automatic or semi-automatic closure. A watertight seal is formed by use of a rubber gasket between the shield or gate and opening frame.

During flood conditions it is possible for precipitation, seepage, and runoff from roof drains to cause water to accumulate inside a wall or levee and cause water damage to the property being protected. This problem can be reduced by providing interior drainage facilities to remove the water. Generally this includes a low lying sump area to collect the drainage and a pump to remove it. The pump discharge level should be located above the design flood level. The capacity pump required will depend upon the interior storage, site grading, lift, and rainfall intensity anticipated. As part of interior drainage, sewer backup can be prevented by installing a gate valve in the line.

Figure 5-1 illustrates the adjustments associated with this protection measure and Reference 1 contains examples of its use.

Physical Feasibility

One particular advantage of a wall or levee is that it is not limited to a particular type or size of structure and therefore is feasible for any residential, commercial or industrial building. The question of physical feasibility centers more on site conditions; topography, available space, compatibility with existing use, soil and ground water conditions; and on the nature of flooding velocity and location relative to the structure, depth, and warning time. Both walls and levees offer considerable flexibility in design to make them compatible with both site and use: Wall and levee heights can vary, natural land topography can be followed, walls can be constructed

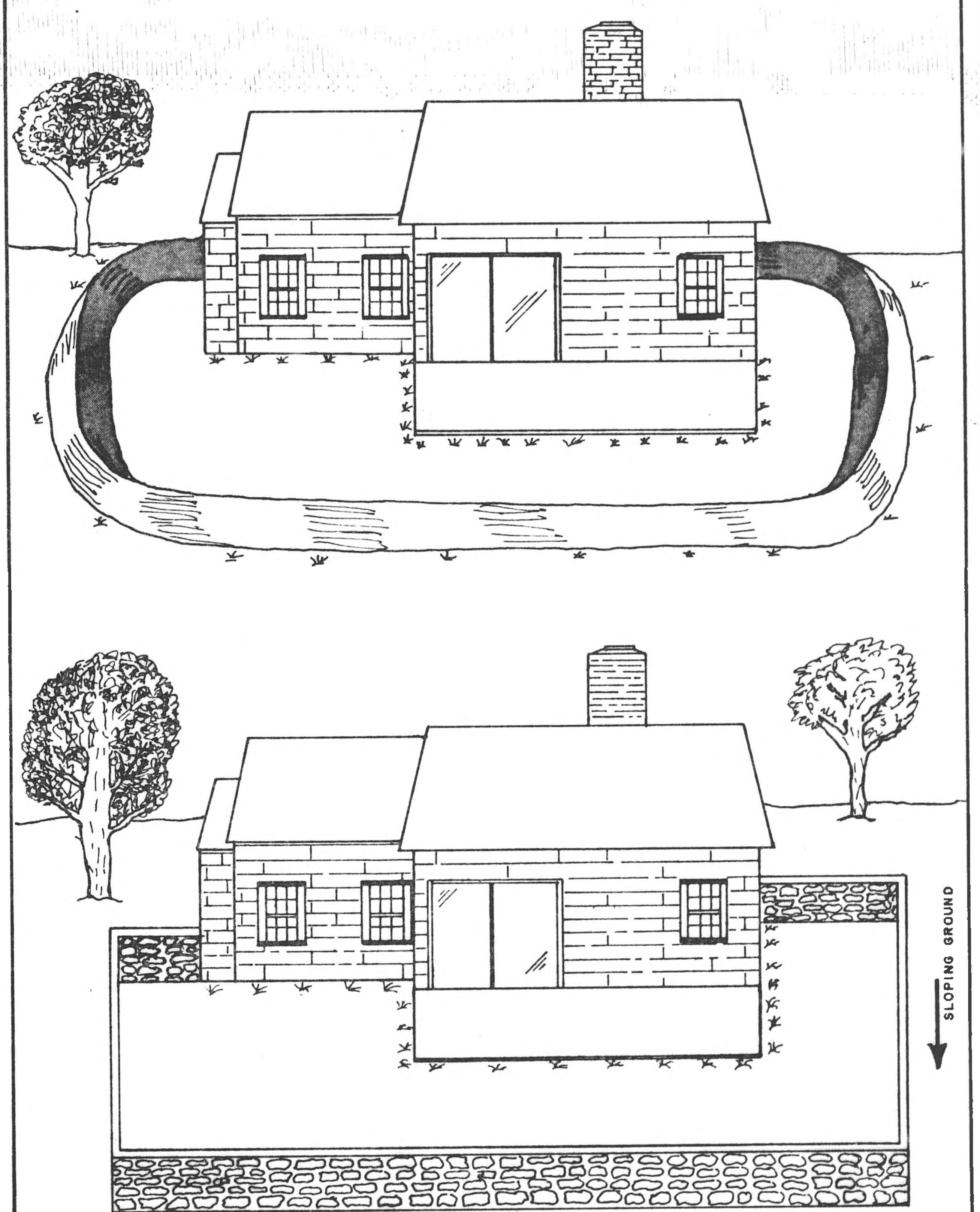


Figure 5-1. Small Walls or Levees

of attractive building materials, and levees landscaped. Soil conditions must be capable of supporting loads transmitted to the foundation. While both walls and levees can be designed for marginal soil conditions, the cost of such measures may be prohibitive.

The nature of flooding is important in determining feasibility in several ways. High velocity flows cause erosion which could endanger a wall or levee unless protected, and erosion protection adds to the cost. In addition, velocity adds a dynamic pressure to the design which may further increase cost. The location of flood waters relative to the structure is also important. If only the backside of a structure need be protected the selection of means and number of openings required may be different than if the entire structure or front is protected. When the depth of flooding is greater than that for which protection can be provided it precludes use of the measure or requires adopting a different level of protection. This, of course, is true of any flood proofing measure. Generally, for a small wall or levee, six feet is the practical limit although designs are feasible for greater heights. If access openings are necessary automatic closures should be used or ample warning time should be available to install shields and gates. Warning times vary greatly for different hydrologic and local community conditions. Both daytime and nighttime operation should be planned for when selecting the method of closure.

Costs

The principal base cost items for small walls and levees are,

- Construction of wall or levee.
- Drainage for the interior, enclosed area.
- Protection against sewer back-up.

The principal variables in estimating the costs of the first item is the length and height of wall or levee. Generally, the nature of the flood hazard will determine the length and height. Structures built on topography sloping up from a river or creek can often be protected by providing a wall or levee on the backside only. Costs in this situation will be considerably less than if the entire structure must be protected. Interior drainage can usually be handled by installing a sump pump and sewer backup by a gate valve. Engineer's estimates of these basic cost items are presented in Table 5-1. For a $30,000 structure the costs as a percentage of structure value range from 0.5 to 1.6 percent depending upon whether a wall or levee is used and its height.

TABLE 5-1

ESTIMATED COST TO PROTECT A STRUCTURE WITH A SMALL WALL OR LEVEE[1]

Item	Estimated Cost			
	Wall		Levee	
	3 Feet	5 Feet	3 Feet	5 Feet
Construct Wall or Levee	$3220.	$4900.	$ 800.	$1600.
Provide Sump Pump	950.	950.	950.	950.
Install Sewer Gate Valve	300.	300.	300.	300.
Total First Cost	$4470.	$6150.	$2050.	$2850.
Annual Cost[2]	$ 358.	$ 493.	$ 164.	$ 228.
Annual Cost as Percentage of Structure Value	1.2	1.6	.5	.7

[1] Estimated for a 1600 square foot, $30,000 structure with or without basement. Protection assumed along backside of lot—140 feet for a wall and 216 feet for a levee. Costs include 25 percent for contractor's bonds, overhead, profit, and engineering.

[2] Amortized at 7 percent for 30 years.

There can be other cost items associated with these measures depending upon specific site requirements. These items include,

- Access closures for walkways and driveways.
- Relandscaping lot for aesthetic and/or interior drainage.
- Decorative stone or brick for walls and plantings for levees.
- Maintainence of wall or levee in water tight condition.
- Levee erosion protection.
- Power used for pumping.
- Removal and replacement of walkways, driveways or patios to accommodate a wall or levee.

Economic Feasibility

A small wall or levee if constructed away from the structure will prevent damage to both structure and contents. Damage is prevented up to its design height. If its level of protection is exceeded, immediate inundation is usually assumed and damage occurs to that level. Damage reduced is measured as the difference in damage with and without the wall or levee. Detailed analysis of damage reduced by providing three foot and five foot protection to one and two story structures with and without basements is discussed in Appendix A. Figures 5-2 through 5-9 show the results of these analyses.

Economic feasibility was estimated by plotting the minimum cost estimates presented in Table 5-1 on each Figure. The cost for a three foot wall and levee was 1.2 and 0.5 percent respectively (expressed as a percentage of structure value). A five foot wall or levee was estimated to cost 1.6 and 0.7 percent respectively. A comparison of minimum cost and damage reduced shows a small levee (three feet and five feet) to be economically feasible for all flood hazard factors, all locations in the flood plain, and all type structures except a two story, no basement structure. For this latter structure a three foot levee appears to be feasible below the 15 year flood plain and a five foot levee below the 20 year flood plain (see Figures 5-3 and 5-7). Above these locations feasibility depends upon the event at the first floor and flood hazard factor.

A small wall, because of its higher cost is somewhat less feasible. Protection of a one story, no basement structure appears to be feasible for both a three foot and five foot height below about the 15 year flood plain, infeasible above the 25 year and questionable between the two. See Figures 5-2 and 5-6. A two story, no basement structure appears feasible below about the 7 year, infeasible above about the 15 year and questionable between the 7 and 15 year events at the first floor. This is illustrated in Figures 5-3 and 5-7. Three foot and five foot walls are generally economically feasible for one and two story structures with basements at any location in the flood plain provided the flood hazard factor is less than about 8.0 feet. For higher flood hazard factors economic feasibility varies with type structure, height of protection and location in flood plain.

Advantages and Disadvantages

Table 5-2 summarizes several advantages and disadvantages of small walls or levees.

TABLE 5-2

ADVANTAGES AND DISADVANTAGES OF PROTECTING A NEW OR EXISTING STRUCTURE WITH A SMALL WALL OR LEVEE

Advantages	Disadvantages
Not dependent upon the size, type, or condition of property being protected.	Dependent upon site conditions: Topography, property lines, available space, soil and ground water conditions, velocity and depth of flooding, and location of flood water relative to structure.
Protects property outside a structure.	May require access openings which must be closed during a flood. If the closures are manual a warning time is necessary.
Can be aesthetically pleasing and provide privacy and security in addition to flood protection.	

References

1. Dexter, James, "Planning a Program for Flood-Proofing Technology Transfer to Flood-Plain Residents", Ph.d. Dissertation, Department of Civil Engineering, Georgia Institute of Technology, 1977.

CHAPTER 6

REARRANGING OR PROTECTING DAMAGEABLE PROPERTY WITHIN AN EXISTING STRUCTURE

Description

Within an existing structure or group of structures damageable property can often be placed in a less damageable location or protected in-place. It is something every property owner can do to one degree or another depending upon the type and location of damageable property and upon the severity of the flood hazard. Examples of this action are described below and illustrated in Figure 6-1.

- Protecting furnaces, water heaters, air conditioners, washers, dryers, shop equipment and other similar property by raising them off the floor. This may be appropriate for shallow flooding conditions.
- Relocating damageable property (furnaces, water heaters, air conditioners, washers, dryers, etc.) to higher floors. Moving property from the basement to the first floor or second floor would be an example. This action usually requires altering ducts, plumbing, and electrical wiring and making space available at the new location.
- Relocating commercial and industrial finished products, merchandise and equipment to a higher floor or adjacent and higher building.
- Relocating finished products, materials, equipment and other moveable items located outside a structure to an adjacent, less flood-prone site.
- Protecting commercial/industrial equipment, especially motors, by placing them on a pedestal, table or platform.
- Anchoring all property which might be damaged by movement from flood waters. Combustible fuel stored in any form should be placed where it is above flood waters or secured in place.

In some flood hazard areas, such as behind levees, if inundation should occur during rare events it could be severe enough to completely fill a basement or even a first floor. While this is a rare condition it has occurred and the damage potential to the **structure** is great. Air uplift has the potential of moving a structure off its foundation and floating it to another location or causing structural failure of the roof. Studies have been done on ways to anchor a structure to its foundation and its roof to its superstructure (1). In the context of protecting structures at existing sites if this hazard does exist, appropriate anchorage and vents can be installed to reduce structural damage.

Physical Feasibility

The degree to which property can be rearranged and protected is site specific. It depends on the flood hazard, principally depth and frequency of flooding, upon the damageable property, its type, value, location and moveability, upon the availability, and adaptability of adjacent, less flood-prone locations, and upon whether the rearrangement can be maintained over a succession of flood-free years. Every structure has some property which can be either relocated or protected: the more there is, the more damage to be reduced. Shallow flooding allows the

CHAPTER 9

ELEVATING NEW STRUCTURES

Description

New residential structures or substantial additions to existing structures to be built on flood hazard sites are required, under the National Flood Insurance Program, to have their lowest floor elevated to or above the base flood level. In coastal zones it is the lowest portion of the structural members of the lowest floor which must be elevated to this elevation. Nonresidential structures have the option of making a structure watertight or elevating. The idea of elevating a structure is not new, however. Numerous residential and commercial structures built in flood hazard areas have been elevated for years (1). The means used varies depending principally upon aesthetics, the type and use of structure, availability of materials, and upon the nature of the flood hazard. Commonly used methods include: earth fill, concrete walls, and wood, steel, concrete or masonry posts, piles or piers. Figure 9-1 shows several structures elevated in this manner and Reference 1 describes the methods in detail.

Physical Feasibility

Earth fill is commonly used in residential subdivisions, shopping centers, industrial parks, as well as for individual structures. It is especially suited for use over large areas because not only can the structures be elevated, but utilities, roads and storage areas are elevated as well. It has the added advantage of being placed and contoured in a manner which makes it harmonize with natural terrain. It is applicable to individual structures although the landscaping has to be unique for each structure.

The principal factors which govern the use and height of earth fill are:

- Availability - adequate amounts and quality of fill material must be available locally.
- Settlement - foundation material upon which fill is placed and the fill itself must be capable of supporting both fill and structure within acceptable limits of settlement.
- Erosion - slopes exposed to erosive flow must be protected.
- Compensatory Storage and Flow Cross-Section - when extensive areas of the flood plain fringe are filled it may be necessary to provide compensatory storage or flow cross section to prevent increased peak flows downstream and higher flood stages upstream. Both must be maintained and kept free from sediment encroachment.
- Aesthetics - the height and location of earthfill should be compatible with the natural landscape. Often this is a limiting factor regarding height of fill. Placement (location and height) can also influence the market value of adjacent land.

Columns, piers, posts and piles are structural members commonly used as foundation supports for residential, commercial and industrial buildings. The selection of the appropriate type is influenced by the following factors:

- Settlement - foundation material upon which the support rests and the support itself must be capable of carrying the load of the structure and any other design loads.
- Scour - foundations must be capable of being designed to be protected against scour.

- Debris - where debris accompanies flood flows support members must be protected and designed to withstand associated impact forces.
- Aesthetics - architectural considerations frequently determine the type, height and arrangement of support members.

Earth fill and support members are applicable to a wide range of structures and flood hazard conditions. They may be used to elevate structures to most any height although local site conditions and architectural considerations usually impose practical limits. They may be used separately or together depending upon the need. While they both achieve the same purpose, that of elevating a structure to a less flood susceptible level, earth fill can also be used to elevate other damageable property — utilities, roads, bridges, storage areas — at the same time that structures are elevated. It has the additional advantage of reducing the susceptibility to scour and debris by keeping flood waters away from the structure.

Costs

The cost of elevating a new structure is measured as the difference between constructing a structure on a low foundation and the cost of constructing it elevated. If the same structure is to be built, but in an elevated position, the principal cost items are the fill and/or support members, access ramps and stairways, and additional duct work, wiring and plumbing. Frequently, however, the fact that the structure will be located in a flood hazard area results in the selection of a structure which is architecturally and functionally compatible with the hazard and not just a flood-free-site structure elevated. In this situation the cost of flood protection should be estimated using the structure types likely to be used with and without the hazard. Cost is also a function of height. Elevating to greater heights will normally increase labor and material costs.

Cost estimates using nationwide data show increased cost of elevating structures range from $1.10 to $2.32 per square foot of structure depending upon the type of foundation (Reference 1, Table 4-1). Slab-on-grade to concrete pier yielded the maximum increased cost and crawl space to wood pile the least. The height raised ranged from 6'0" to 7'2" depending upon the type of foundation. For purposes of this study, minimum costs for elevating a 1,600 square foot, $30,000 structure three feet and five feet were estimated to be $1.10 and $1.50 respectively. Table 9-1 shows the approximate annual cost as a percentage of structure value.

Costs to raise a new structure five feet are shown in Table 9-1. This value is shown plotted on Figures 9-6 through 9-9. A comparison of cost and damage reduced shows raising five feet to be economically feasible for all locations in the flood plain, all flood hazard factors, and all type structures.

Advantages and Disadvantages

Advantages and disadvantages of elevating new structures on earth fill or columns are presented in Table 9-2 below.

TABLE 9-2

ADVANTAGES AND DISADVANTAGES OF ELEVATING A NEW STRUCTURE

Advantages	Disadvantages
Damage to structure and contents below the elevated elevation is prevented.	Flooding of surrounding areas still occurs with possible damage to other facilities and services, and often making emergency access difficult.
Architectural design, and construction techniques are well known.	
Allows occupancy of flood plain site and use of surrounding infrastructure.	

References

1. U.S. Department of Housing and Urban Development, "Elevated Residential Structures", Federal Insurance Administration, 1977.

Proposals

Proposals

Preliminary Proposal:

THE USE OF REMOTE SENSING FOR FLOOD CONTROL PLANNING

July 1978

INTERTECT
P.O. Box 10502
Dallas, Texas 75207
(214) 521-8921

Preliminary Unsolicited Research Proposal
Submitted to: ____________________

Name of Organization: INTERTECT
(International Disaster Specialists)
P.O. Box 10502
Dallas, Texas 75207 U.S.A.

Title of Proposed Project: The Use of Remote Sensing for Flood Control Planning

Amount Requested: ____________________

Proposed Duration: Two Years

Requested Starting Date: 1 January 1979

Name of Principal Investigator: Dr. J. Clifford Harlan, Jr.

Social Security No. ____________________

Title: Associate Research Scientist

Telephone: (713) 845-5422

Organizational Affiliation: Texas A&M University Remote Sensing Center

Name of Project Manager: Frederick C. Cuny

Social Security No. 449-68-2291

Title: Senior Planner and Executive Chairman

Telephone: (214) 521-8921

Organizational Affiliation: INTERTECT

Endorsements: Principal Investigator	Other Endorsements (Formal Proposals)	Approving Administrative Official
Name J. Clifford Harlan, Jr.		
Signature		
Title Asso. Research Scientist		
Date		

This Organization is a small business concern.

Preliminary Proposal:

THE USE OF REMOTE SENSING FOR FLOOD CONTROL PLANNING

Table of Contents

Preliminary Proposal:

THE USE OF REMOTE SENSING FOR FLOOD CONTROL PLANNING

I. Background

The purpose of this project is to explore the use of remote sensing as a tool for planners in assisting remote, rural areas of the developing countries to examine existing and potential flood problems and to determine options for disaster mitigation.

The use of LANDSAT imagery for planning flood control and flood prevention measures in developed countries has been demonstrated in numerous instances.[1] LANDSAT imagery has been used to locate sites for dams, levees, dikes and other devices for flood control; and it has been utilized in studies of large regional watersheds. However, to date it has not been demonstrated whether LANDSAT imagery can also be used to assist small, rural communities in isolated areas in the development of simple and affordable flood control schemes.[2]

The area selected for this study is the Chapare region of Bolivia, which lies approximately 90 kilometers northeast of Cochabamba. The region is a jungle area which rests on a flat plateau at the base of a high ridge on the eastern slope of the Andean Mountains. The Government of Bolivia has offered free land to settlers who will move from the populous mountain plateaus into the Chapare region, and new settlements have been formed throughout this area during the past 15 years. A settlement called Nueva Canaan serves as a distribution center for a number of small farms in the surrounding area. Approximately 2,500 people have moved into this area during the last 15 years, and they are attempting to establish small farms.

The primary crop in this area is bananas, although recently tea has been introduced. Other crops which have been tried have failed due to the flooding which occurs every year during the rainy season.

The population is largely made up of Quechua-speaking Indians who moved here in search of land. Previously, most had been landless peasants working on marginal land in the Altiplano. The average income in the area is approximately $150 per year.

In other resettlement schemes in the surrounding area, a variety of crops have been introduced which have proven successful, and incomes in these regions are slightly higher.

The primary problems in the area are largely due to the flooding; each farmer faces the fact that substantial portions of his crop will be wiped out when the river overflows its banks and inundates much of the farm land. This has led several families to return to the highlands, and others are now considering relocation.

With the exception of the flood problems, Nueva Canaan is ideally situated as it lies adjacent to a hard-surface road which connects the settlement to markets both in Cochabamba and the river port. Furthermore, a number of small gravel roads have been built by the residents, enabling carts and small trucks to reach the farms.

The regional flooding poses two main problems. First, the flooding waters threaten not only the crops but also the population, as heavy rains upstream often cause flash flooding. Parts of the area have been known to flood to a depth of two meters, and the water has destroyed not only crops and trees but also numerous houses.

The second problem caused by the flooding is the rapid erosion in areas lying adjacent to the river course. Within the past ten years, the stream bed has widened over 400 meters. Families who live near the river banks worry that their farms may be destroyed by this erosion.

In April of 1978, a representative of INTERTECT visited the area at the request of a voluntary organization which is working with the residents of Nueva Canaan. In the course of the discussions and on-site investigation of the problem, it was clear that development of a flood control plan was hampered by several factors:

A. Lack of geologic and hydrologic data about the region;

B. Lack of topographic information about the region;

C. Lack of information about land use patterns upstream;

D. Lack of historical information about the flooding in the area;

E. Lack of information relating to the environmental and ecological consequences, should flood control measures be put into effect;

F. Lack of basic information needed to establish flash flood warning systems and flood control measures.

During this visit, it was determined that the only historic photographic evidence of flooding and stream bed changes would be available from remote sensing imagery taken over the last seven years. It was determined that LANDSAT imagery, as well as new radar sensing techniques and conventional aerial photography, might provide information upon which to base recommendations for flood control measures, at a cost affordable to both voluntary agencies and the Government of Bolivia. Therefore, it was decided to attempt to explore the capabilities of remote sensing as a planning tool. A number of the private voluntary organizations working in Bolivia, as well as the Government of Bolivia, will cooperate in providing information for the study.

II. Project Objectives

The primary goal of this project will be to explore the use of LANDSAT imagery as a tool for analyzing flood problems and for the development of effective low-cost flood protection measures for the Nueva Canaan settlement of the Chapare region of Bolivia. The objectives are:

A. To demonstrate the use of LANDSAT imagery as a tool in disaster prevention and mitigation;

B. To demonstrate to private voluntary organizations the use of remote sensing for practical applications in development activities;

C. To demonstrate the use of radar imaging as an addition to LANDSAT;

D. To develop a methodology for the concurrent use of LANDSAT imagery with other data sources in planning simple and practical flood control measures;

E. To provide Bolivian personnel with an orientation to remote sensing and to transfer a variety of remote sensing skills to the participating organizations.

III. Project Plan

In order to prepare final flood control recommendations, five activities must be completed:

A. Analysis of historical flood data.
When exact dates of past floods are known, a search of the LANDSAT records will be made to determine what images are available on those dates, and also whether images are available for the immediate days after the floods. (Flooding is often caused not by rains in the immediate area, but by rains in the mountains.) The available images will be analyzed to determine:

1. The general boundaries of the flood plain (outside timbered areas);
2. The extent of the erosion of any one flood (by using aerial photos before and after);
3. Changes in the stream bed;
4. Factors which increase or reduce flooding in the stream course, through land use changes;
5. Predictions of possible flooding boundaries based on stream changes.

B. <u>Acquisition of cloud-free images in order to study land use patterns</u>.

Cloud-free images will be obtained of the entire Chapare watershed in order to determine land use patterns, deforestation patterns and other upstream developments which might affect future flooding conditions.

C. <u>Acquisition of radar images</u>.

LANDSAT satellites utilize only direct, visual and infrared wave lengths. Therefore, during periods of high cloud cover, flooding is usually obscured, and studies of the exact flood situation are not feasible. Microwave radar systems provide the capability of imaging through the cloud cover and thus give a more complete picture of the flooding.

A program for radar imaging for the flood-affected region will be developed, and an attempt will be made to acquire images of a flood in progress. The radar imagery will be compared with multi-spectral scanner (MSS) imagery, and composites will be made which are hoped will provide a new tool for use in the study of flood problems.

D. <u>Acquisition of Aerial Photography (from existing sources)</u>.

In the past decade, a number of organizations (both governmental and private) have taken extensive aerial photos in Bolivia, and some of these may include all or part of the project area. While these photographs were taken for purposes (such as natural resource exploitation, cartography, etc.) other than to obtain data in relation to flooding, if the area has been photographed, the information provided could prove valuable to the study. Among the organizations that have conducted aerial surveys are:

1. Various oil companies;
2. Various timber companies;
3. The Inter-American Geological Survey (IAGS).

E. Ground Truth Plan.

Continuous on-site verification of the remote sensing data will be carried out by INTERTECT with assistance from the staff of COMBASE (an interdenominational Protestant social service organization that provides various services to the Nueva Canaan community) and World Neighbors (an American international service agency also active in the area).

A ground truth plan will be jointly developed to provide field data which will serve as both baseline data and verification of remote sensing-derived data. The development of the ground truth data will be carried out in conjunction with a small-scale training program to demonstrate to Bolivian personnel the capabilities and methodologies of using remote sensing.

IV. Organization and Management

A. Management:

Overall responsibility for coordination of the project will be assigned to INTERTECT. The project manager will be Frederick C. Cuny of INTERTECT. The principal investigators for the project will be Dr. J. Clifford Harlan, Jr. (Associate Research Scientist, Texas A&M University Remote Sensing Center); Dr. John P. Claassen (Associate Research Engineer, Texas A&M University Remote Sensing Center); and Dr. Bruce J. Blanchard (Hydrologic Engineer and Director, Texas A&M University Remote Sensing Center).

B. Participating Organizations:

The following organizations will participate in the project:

1. The Texas A&M University Remote Sensing Center
2. INTERTECT
3. COMBASE (an interdenominational Protestant social service organization in Bolivia)

4. World Neighbors

5. The Government of Bolivia

A curriculum vitae for the project manager and for each of the principal investigators is attached as Appendix A.

V. Schedule of Activities

The proposed work schedule for the project is attached as Appendix B.

VI. Budget

The budget for the project is attached as Appendix C.

FCC:jwp

APPENDIX A

International Disaster Specialists

P. O. Box 10502

Dallas, Texas 75207 U.S.A.

Tel.: (214) 521-8921

INTERTECT

INTERTECT is an international cooperative of consultants who specialize in problems associated with disaster relief and reconstruction. Established in 1971 as a professional organization, the group provides specialized support to those relief and development agencies which seek to be more effective in their humanitarian work.

Scattered worldwide, there are ten consultants and approximately twenty associates operating within the INTERTECT network. Each has his or her own professional concern and an on-going commitment to the field of disaster relief and pre-disaster planning.

Four types of services are provided: (1) counseling in the design and management of disaster-related programs; (2) technical assistance to answer special needs; (3) design and implementation of feasibility and evaluation studies; and (4) provision of training in disaster management. Typical services in the past have included the provision of architects and planners for the development of ultra low-cost housing methodologies; urban and regional planners for the design of refugee camps; civil engineers for the installation of emergency water supply and drainage facilities; artists for the design and preparation of educational materials for use in training programs in other cultures; social anthropologists for the carrying out of evaluation surveys to determine the effects of a disaster, and the impact of aid, on the life of a community; and sociologists for the analysis of institutional factors which inhibit effective aid-giving.

The INTERTECT style is characterized by a low-key approach to problem-solving -- one which is unusually thorough but which encourages the local staff to take responsibility for the work at hand. In emphasizing the intimate interrelationship between disasters and underdevelopment, every effort is made to ensure that relief activities are compatible with and reinforce on-going development efforts. Conscious learning from experience is encouraged throughout. INTERTECT consultants are noted for their commitment to work which has as its objective the transfer of decision-making power to less privileged people.

In 1977, work by INTERTECT members was undertaken with, or was financed by, the following organizations: The American Friends Service Committee; The Building Research Institute, Technological University (Ankara, Turkey); Carnegie-Mellon University; Church World Service; The Commonwealth Association of Architects (U.K.); The Government of Peru, Oficina de Investigación y Normalización; The Institute for Environmental Studies, University of Toronto; The Mennonite Central Committee; The National Academy of Sciences, Committee on International Disaster Assistance; OXFAM-America; OXFAM-International; The Save the Children Alliance; The Save the Children Federation/Community Development Foundation; The United Nations Disaster Relief Office; The U.S. Agency for International Development; and World Neighbors.

Further information detailing recent projects and the present deployment of INTERTECT consultants is available from Mrs. Jean Parker at the above address. The Executive Chairman for 1977-1979 is Mr. Frederick C. Cuny.

CURRICULUM VITAE:

FREDERICK C. CUNY

Present Position: Executive Chairman, INTERTECT

Permanent Address: P.O. Box 10502, Dallas, Texas 75207, U.S.A.

Birth Date: November 14, 1944

Citizenship: U.S.A.

Areas of Training and Experience:

1. Disaster Operations and Management
2. Pre-Disaster Planning
3. Disaster Policy Development
4. Post-Disaster Housing and Emergency Shelter Programs
5. Housing Education
6. Housing Research and Design (Earthquake and High Wind Resistant Construction)
7. Urban and Regional Planning
8. Village and Regional Development
9. Post-Disaster Damage Assessment
10. Refugee Camp Planning

Professional Registration: Registered Planner, State of Texas

Education:

	Institution	Date	Major	Minor	Degre
1.	Texas A & M University	'62-'64	Government (Latin American Studies)	Sociology	---
2.	Texas A & I University	'64-'66	Government (Latin American Studies)	Sociology	BA
3.	Inter-University African Studies Center, University of Houston & Rice Univ.	'66-'67	Political Science (Intern'l Development)	Physics	BS
4.	Rice University	1967	Public Administration and Planning	Graduate Level Work	

CUNY VITAE

Work Experience:

1.	Houston Council on Human Relations Houston, Texas	Community Organizer
2.	Model Cities Program Eagle Pass, Texas	Acting Director, Program Planner
3.	Carter & Burgess, Engineers and Planners Fort Worth, Texas	City Planner, Systems Engineer
4.	Frederick C. Cuny & Associates, City Planning Dallas, Texas	President, City and Regional Planner
5.	INTERTECT Dallas, Texas	Executive Chairman

Project Experience:

1.	Community Desegregation Activities Houston, Texas	1967-68	Community Organization, Education
2.	Houston Institute on Black Identity Houston, Texas	1967	Lecturer
3.	Elementary School Principals Desegregation Project Houston, Texas	1968	Community Organizer, Leader of Project
4.	Eagle Pass Model Cities Program (Physical and social planning) Eagle Pass, Texas	1968	Administration, Planning, Community Organization
5.	Neighborhood Development Program (for Urban Renewal Authority) Truman, Arkansas	1969	Consultant on Physical and Social Planning
6.	Neighborhood Development Program (for Urban Renewal Authority) Hot Springs, Arkansas	1969	Consultant on Physical and Social Planning
7.	Provision of Post-War Assistance Study, Biafra, Nigerian Civil War	1969	Researcher
8.	Analysis of Red Cross Biafran Airlift, Biafra, Nigerian Civil War	1969	Researcher, Systems Analyst
9.	Model Cities Program (Seconded to New Orleans Community Improvement Agency for 1 year), New Orleans, Lousiana	1969-72	Consultant on Physical and Social Planning

10.	Analysis of Mass Transit Systems and Design Constraints for Dallas-Fort Worth Airport, Fort Worth, Texas	1970	Research and Preliminary Design
11.	Urban Renewal Project (for Urban Renewal Authority) Tucumcari, New Mexico	1971	Consultant on Physical and Social Planning
12.	Neighborhood Development Program Gallup, New Mexico	1971	Consultant on Physical and Social Planning
13.	Case Study: Role of the Military in Nigerian Politics 1965-1970	1969-70	Researcher
14.	Urban Renewal Project (for Health and Education Authority, State of Lousiana), New Orleans, La.	1971	Community Organizer
15.	Urban Environmental Design Project (Special demonstration project) Victoria, Texas	1971	Project Leader, Community Organizer, Physical and Social Planning
16.	Bedford Environmental Design Project Bedford, Texas	1971	Project Leader, Community Organizer, Physical and Social Planning
17.	Refugee Camp Construction Program W. Bengal, India (OXFAM)	1971	Planning and Engineering Advisor
18.	Neighborhood Socio-Economic Analysis for City of Kingsville, Texas	1971	Team Leader, Data Analyst
19.	Neighborhood Relocation Program for City of Olney, Texas	1972	Team Leader, Data Analyst
20.	Neighborhood Socio-Economic Study for City of Fort Smith, Arkansas	1972	Team Leader, Data Analyst
21.	Relief Operations Management Studies (as part of preparations for INTERTECT's Relief Operations Guidebook)	1972-Present	Researcher, Editor
22.	Nicaraguan Post-Earthquake Relief Operations (OXFAM)	1972	Advisor on Refugee Camp Design and Administration
23.	Ultra Low-Cost Emergency Shelters Project in conjunction with Carnegie-Mellon Univ., Pittsburgh, and the Univ. of Texas, Austin; Peten, Guatemala	1973	Consultant

24.	Engineering & Public Affairs Program, Carnegie-Mellon University, Pittsburgh, Pennsylvania	1973	Visiting Professor of Engineering
25.	Watershed Management Program, Girty's Run Project, Pittsburgh, Pa.	1974	Consultant
26.	Study of Housing Programs after Hurricane Fifi, Honduras	1974	Research Team Leader
27.	Feasibility Test of Emergency Shelter Units in Bangladesh Refugee Camp Environments (Participating organizations: Carnegie-Mellon Univ., OXFAM, Save the Children/Community Development Foundation, Mennonite Central Committee, Bangladesh Red Cross)	1975	Team Leader
28.	Seminar on International Disaster Preparedness, Office of Foreign Disaster Assistance, U.S. Agency for International Development, Dept. of State, Washington, D.C.	1976	Lecturer
29.	Post-Earthquake Reconstruction Program, OXFAM/World Neighbors (Programa Kuchuba'l), Guatemala	1976-77	Housing Program Advisor
30.	Post-Earthquake Reconstruction Program, Save the Children Alliance, Guatemala	1976-77	Housing Program Advisor
31.	Study on the Provision of Emergency Shelter and Post-Disaster Housing, United Nations Disaster Relief Office (UNDRO)	1976-77	One of three primary consultants
32.	Study: Strategies and Approaches for the Provision of Emergency Shelter (in conjunction with Carnegie-Mellon University for U.S. Dept. of State)	1976-77	Research Consultant, Editor of final report
33.	Post-War Reconstruction Program: Lebanon (Save the Children Fed.), Beirut and Upper Baalbek regions	1976-77	Program Planning Advisor
34.	International Disaster Preparedness Seminar, OFDA, USAID, Dept. of State, Washington, D.C.	1977	Lecturer on housing programs and management

35.	Committee on International Disaster Assistance, National Academy of Sciences, Washington, D.C.	1977	Lecturer: housing sub-committee
36.	Earthquake Preparedness Planning: Peru, (in conjunction with Carnegie-Mellon Univ. and U.S.A.I.D., for Ministry of Housing and Peruvian Civil Defense Agency)	1977-Present	Team Leader in housing vulnerability analysis, development of housing education program
37.	Post-Disaster Reconstruction: Andhra Pradesh, India (OXFAM)	1977-78	Consultant: staff orientation, training, program administration, wind resistant construction

Individual Research:

1. Role of the Military in Developing Countries (Case studies of Mexico, Turkey, Nigeria)

2. Israeli Resettlement Schemes (The resettlement of Moslem communities from Israeli border areas; technical assistance to resettlement schemes in Africa)

3. Israeli New Towns (Studies in Carmiel, Shimma, Kyrint, Arnt)

4. Israeli Programs for Absorption and Orientation of Refugee Immigrants

5. Israeli Rural Development Programs

6. Israeli Kibbutzim

7. Proliferation of Arms in Developing Countries

8. Problems of Partition (India-Pakistan; Ireland; Palestine)

9. Impact of Food Aid on Agricultural Development in the Third World

10. Refugee Camps & Camp Planning (on-going INTERTECT research)

11. Relationship of Development and Increased Vulnerability to Natural Disaster

Professional Affiliations:

1.	National Association of Housing and Redevelopment Officials	1969-71
2.	American Society of Planning Officials	1969-72
3.	American Institute of Planners	1970-71
4.	American Academy of Political Science	1971
5.	Society for International Development	Current

Other Affiliations:

1.	Soaring Society of America	Current
2.	U.S. Seaplane Pilots Association	Current
3.	National Aeronautics Institute	1975
4.	Arms Control Association	1972

Miscellaneous Experience:

1.	Candidate for Texas State House of Representatives	1967
2.	Literary Critic, Houston Post	1967-68
3.	President, Quetzal Aircraft Company (High Performance Gliders)	1977

Non-Formal Training and Education:

1.	U.S. Merchant Marine (Gulf-South American Steamship Company)	1963
2.	Officers Candidate School, U.S. Marine Corps, Quantico, Virginia	1964-65
3.	Systems Engineering Course, TRW Systems Corp.	1969
4.	Aerial Applicators Course, Slaton Flight School, Slaton, Texas	1973
5.	Seminar on Watershed Management, Dallas, Texas	1978

Recent Publications:

Cuny, F.C., Refugee Camps & Camp Planning Series (Reports I-IV), INTERTECT, Dallas, Texas.

__________, Editor, Relief Operations Guidebook, INTERTECT, Dallas, Texas.

__________,"Refugee Camp Planning: The State of the Art", Disasters, Vol. 1, No. 2, Pergamon Press, 1977.

__________, Report on the Coyotepe Refugee Camp, Masaya, Nicaragua, INTERTECT, Dallas, Texas.

__________; Perez, Julian; Parker, Jinx, Report on the Refugee Camp and Housing Program in Choloma, Honduras, for the Refugees of Hurricane Fifi, INTERTECT, Dallas, Texas.

__________; Ressler, Everett, Issues Related to the Provision of Emergency Shelter in Drought Conditions, INTERTECT, Dallas, Texas, 1977.

__________; Weesner, Carolyn, Post-Disaster and Related Low-Cost Housing: A Summary of Issues and Linkages Presented at the U.N. Conference On Human Settlements, Vancouver, 1976, INTERTECT, Dallas, or Advanced Building Studies Program, Carnegie-Mellon University, Pittsburgh, Pennsylvania.

__________; Goodspeed, C.; Hartkopf, H.,"Refugee Housing for Developing Countries", ERDA Proceedings, 1975.

__________; Goodspeed; Hartkopf; Singh, Feasibility Test of An Approach and Prototype for Ultra Low Cost Housing, INTERTECT, Dallas, or Advanced Building Studies Program, Carnegie-Mellon University, Pittsburgh, Pennsylvania.

__________; Davis, Ian; Krimgold, Frederick, The Provision of Emergency Shelter Following Natural Disasters (twelve-volume study in preparation for the United Nations Disaster Relief Office, Geneva.

__________, Editor, The OXFAM/World Neighbors Housing Reconstruction Program: Guatemala, 1976-1977, INTERTECT, Dallas, Texas.

BIOGRAPHICAL DATA

Social Security Number 061-14-3272

BLANCHARD Bruce J. January 1978

DATE OF BIRTH: June 10, 1921 MARITAL STATUS: Married, 3 children
BIRTH PLACE: Naples, New York

EDUCATION: B.S., Agricultural Engineering, Oklahoma A&M, 1949
M.S., Civil Engineering, University of Oklahoma, 1966
D. Engr., Civil Engineering and Environmental Science, University of Oklahoma, 1974

CURRENT POSITION:

Director, Remote Sensing Center, and Associate Professor in the Agricultural Engineering Department, Texas A&M University

PROFESSIONAL EXPERIENCE INCLUDES:

Hydraulic Engineer, Southern Great Plains Watershed Research Center, USDA, Agricultural Research Service, Chickasha, Oklahoma, September 1962 to 1975.

Experience has included cooperative and consulting work with: University of Oklahoma Research Foundation, Norman, Oklahoma; Geology Department, Oklahoma State University, Stillwater, Oklahoma; Geology Department, Oklahoma University, Norman, Oklahoma; Soil Conservation Service State Office, Stillwater, Oklahoma; Soil Conservation Service Regional Office, Fort Worth, Texas; Soil Conservation Service Administration, Washington, D.C.; NASA Goddard Space Flight Center, Greenbelt, Maryland; NASA Johnson Space Center, Houston, Texas; NASA Jet Propulsion Laboratory, Pasadena, California; University of California, Santa Barbara, California; University Space Research Association, Houston, Texas.

PROFESSIONAL AFFILIATIONS AND ACTIVITIES:

Associational Memberships:

American Society of Civil Engineers
American Water Resources Association
American Society of Photogrammetry
American Society of Agricultural Engineers

Registered Professional Engineer, Oklahoma, #7415

Licensed Private Pilot, #2040433

Co-Sponsor with Dr. D.G. Decoursey, Workshop on Testing of Alternative Flood Routing Formulations, 1969

President, Oklahoma Section American Water Resources Association, 1970

ERTS-1 Review Panel (Water Resources Research Proposals), 1972

Co-coordinator, Regional ERTS Users Conference, Oklahoma State University, January 31-February 1, 1974

Member, NASA, Active Microwave Systems Working Group, 1974

Advisory Capacity on Projected Hydrology Satellite (HYDROSAT)

Current Active Committees (1978):

Member, NASA, Jet Propulsion Laboratory, Users Committee for Shuttle Microwave Systems, 1974 - present

Member, Shuttle Imaging Radar Working Group

Member, Inland Water Resources Applications Survey Groups

Member, Program Planning Team - Shuttle Imaging Radar

Member, Peer Review Committee for University Space Research Association

Member, Seasat-Synthetic Aperture Radar Experiment Team

ACADEMIC EXPERIENCE:

Developed a graduate course entitled "Remote Sensing Application in Water Resources," taught the course twice and submitted it to the Graduate College for approval (approved as Ag En 616).

Served as committee member for three (3) M.S. and one (1) Ph.D. that have completed their programs. Currently serving on five committees.

PARTICIPATION IN RESEARCH PROGRAMS:

Agricultural Research Service Line Projects

Line Project No. SWC-2-e4-Okla-Ch-6 - Study of recharge, storage and flow of roundwater and its discharge to streams in agricultural watershed, 1962

Line Project No. SWC-6-e2-Okla-Ch-7 - Seepage from earthen dams, causes and effects, 1962

SWC-2-e3, 2-e4, 3-e1-Ch-11 - Hydraulic and hydrologic relationships of watershed runoff, 1966

SWC-2-e3-, 2-e4-Ch-15 - Evaluation of the effect of pond detention on watershed runoff, 1966

SWC-023-eCH-6 - Use of remote sensing techniques to measure hydrologic characteristics of watersheds, 1969

7319-12370-001 - Remote sensing measurement of hydrologic variables, 1973

7319-12370-002 - Use of space data for characterizing the runoff potential of watersheds in the Great Plains, 1973

NASA Sponsored Research:

Principal Investigator: Aircraft SRT Program, investigation of remote sensing techniques for measurment of hydrologic characteristics of watersheds, 1969-1973

Principal Investigator: Landsat-1, Use of space data for characterizing the runoff potential of watersheds in the Great Plains, 1973

Co-Investigator: Joint soil moisture microwave studies (Phoenix test site), January 1974

NASA Sponsored Research (Continued):

Principal Investigator: Landsat-2, Spectral measurement of watershed runoff coefficients in the Southern Great Plains, 1974 to present

Co-Investigator: Continuation, Joint soil moisture microwave studies (Phoenix test site), December 1974

Principal Investigator: Demonstration of microwave techniques for characterization of watershed runoff, 1975

Principal Investigator: Analysis of synthetic aperture radar (SAR) Imagery, 1975

Co-Principal Investigator: Joint soil moisture studies, 1976-77

Co-Principal Investigator: Investigation using data from heat capacity mapping mission (HCMM), 1976-77

Principal Investigator: Measurement of soil moisture with scatterometers, 1976

Principal Investigator: Measurement of hydrologic characteristics with scatterometers, 1977

Co-Principal Investigator: Temporal correlations of antecedent precipitation with Nimbus-5 ESMR brightness temperature, 1977

PUBLICATIONS:

1. Blanchard, B.J., Development of a design formula for a V-notch weir. Multilithed, Master's thesis. Oklahoma University, August 1966

2. Hartman, M.A., Ree, W.O., Schoof, R.R. and Blanchard, B.J., Hydrologic influences of a flood control program. Proc. ASCE 93(HY3), May 1967

3. Blanchard, B.J., Anchoring automobile bodies for stream bank protection. USDA, ARS 41-138, November 1967

4. Hartman, M.A., Ree, W.O., Schoof, R.R. and Blanchard, B.J., Closure discussion "Hydrologic influences of a flood control program." Journ. of the Hydralics Div., Proc. ASCE 94(JY5): 1341-1342, 1968

5. Blanchard, B.J., and DeCoursey, D.G., A technique for measuring rapidly changing streamflow. USDA, ARS 41-145, November 1968

6. Hartman, M.A., Blanchard, B.J., et al. Washita River watershed research findings. Proc. of the 63rd Meeting of the Arkansas-White-Red Basins Interagency Committee, Austin, Texas, 1968

7. DeCoursey, D.G. and Blanchard, B.J. Flow analysis of ASCE 96(HY7): 1435-1454, July 1970

8. Blanchard, B.J. and DeCoursey, D.G. A design for low flow control. Jour. of AWRA Water Resources Bulletin 6(2): 222-228, April 1970

9. Blanchard, B.J. and Wiegand, C.L. Measuring hydrologic characteristics of watersheds remotely. In Spectral Survey of Irrigated Region Crops and Soils, 1970 Annual Report to NASA

10. Blanchard, B.J. and Gander, G.A. Remote sensing in hydrology. Arkansas-White-Red Basins Interagency Committee, Austin, Texas, January 1972

11. Blanchard, B.J. Measurements from aircraft to characterize watersheds. Earth Resources Program Review, Vol. 5, Houston, Texas, January 1972

12. Blanchard, B.J. Investigation of use of space data in watershed hydrology. Type II Report, NASA-CR-130974, NTIS E 7310359, EROS Data Center, Sioux Falls, South Dakota, March 1973

13. Blanchard, B.J. Investigation of use of space data in watershed hydrology. Type I Report, ERTS Contract S70251AG March 1973

14. Blanchard, B.J. and Leamer, R.W. Spectral reflectance of water containing suspended sediment. Remote Sensing and Water Resources Management, American Water Resources Association, Urbana, Illinois, pp. 339-348, 1973

15. Blanchard, B.J. Measuring watershed runoff capability with ERTS data. Third Resources Technology Satellite Symposium, Vol. 1, Sec. B, pp. 1089-1098, 1973

16. Pionke, H.B. and Blanchard, B.J. The remote sensing of suspended sediment concentration of small impoundments. Water, Air and Soil Pollution. D. Reidel Publishing Co., Dordrecht, Holland, pp. 19-32, 1975

17. Blanchard, B.J. Passive microwave measurement of watershed runoff capability. Dissertation for D. Engr., University of Oklahoma, September 1974

18. Blanchard, B.J., Rouse, J.W. and Schmugge, T.J. Classifying storm runoff potential with passive microwave measurements. American Water Resources Association, Water Resources Bulletin Vol. II, No. 5, pp. 892-907, October 1975

19. Blanchard, B.J. Contribution to Active Microwave Workshop Report: Watershed Runoff and Soil Moisture portions of Earth/Land Panel. National Aeronautics and Space Administration, NASA SP-376, Washington, D.C., 1975

20. Blanchard, B.J. Summary report: Measurement of soil moisture for microwave studies in Phoenix, Arizona, 1974

21. Blanchard, B.J. Remote sensing techniques for prediction of watershed runoff, Proceedings of the NASA Earth Resources Survey Symposium, Vol. ID, Houston, Texas, pp. 2379-2406, June 1975

22. Schmugge, T.J., Blanchard, B.J., Burke, W.J., Paris, J.F. and Wang, R. Results of soil moisture flights during April 1974, NASA Technical Note (TN D-8199) National Aeronautics and Space Administration, Washington, D.C., May 1976

23. Blanchard, B.J. A new concept in watershed modeling, Technical Bulletin, TEES, Texas A&M University, College Station, Texas, July 1976

24. Schmugge, T.J., Blanchard, B.J., Anderson, A., Wang, J. Soil moisture sensing with aircraft observations of the diurnal range of surface temperature. In press.

25. McFarland, M.J. and Blanchard, B.J. Temporal Correlations of Antecedent Precipitation with Nimbus-5 ERMR Brightness Temperature, American Meterological Society, Toronto, Canada, October 1977

J. CLIFFORD HARLAN, Jr.

June 1, 1978

SUMMARY: Earth Resources Remote Sensing Scientist. Application of visible, infrared and microwave remote sensing techniques to research concerning renewable earth resources. Investigation of sensor response to changes in conditions of, or affecting, natural and cultivated vegetation.

EDUCATION: B.S., Physics, Texas A&I University, 1967; M.S., Physics, Oklahoma State University, 1969; Ph.D., Remote Sensing, Colorado State University, 1972.

EXPERIENCE:

1976 - Present

Texas A&M University, Remote Sensing Center
Associate Research Scientist - Director, Spectral Characteristics Laboratory. Responsible for natural and cultivated vegetation studies.

1974 - 1976

Texas A&M University, Remote Sensing Center
Assistant Research Scientist - Responsible for development and coordination of applications research in the areas of visible, infrared and microwave earth resource studies.

1972 - 1974

Lockheed Electronics Company, HASD.
Principal Engineer - Responsible for the development of remote sensing techniques from ground-based field investigations, and their application to earth resources studies.

1971 - 1972

Martin-Marietta Corporation, Denver Division
Remote Sensing Consultant - Responsible for providing general remote sensing information to groups working on shallow lake modeling, data banks and atmospheric corrections.

1968 - 1972

Colorado State University - Department of Earth Resources
Graduate Research Assistant - Remote sensing of environment. Responsible for research concerning atmospheric aerosol effects on infrared remote sensing.

AFFILIATIONS: Society of Sigma Xi
American Society of Photogrammetry

J. CLIFFORD HARLAN, Jr.

PUBLICATIONS:

"A Study of the Attenuation of Atmospheric Particulates of Thermal Infrared Radiation", William E. Marlatt and James C. Harlan, Proceedings of the Seventh International Symposium on Remote Sensing, 1791-1806, 1971.

"Haze Effects on Infrared Remote Sensing in the Tropical North Atlantic", James C. Harlan, Ph.D. Dissertation, Colorado State University, 125 pp., 1972.

"Haze Effects on Infrared Remote Sensing in the Tropics of the North Atlantic", J. C. Harlan and W. E. Marlatt, Proceedings of the International Radiation Symposium, 300-303, 1972.

"The Effects of Atmospheric Particulate Layers on Infrared Radiation Transfer Through the Atmosphere", Cole, H. L., J. C. Harlan and W. E. Marlatt, Proceedings of the Conference on Atmospheric Radiation, 31-34, 1972.

"Solar Radiation Affects Radiant Temperatures of a Deer Surface", H. Dennison Parker, Jr. and James C. Harlan, USDA Forest Service Research Note RM-125, 1972.

"Data acquisition for a Remote Sensing Field Measurement Program at NASA/JSC", J. C. Harlan, C. A. Morgan and R. W. Newton, Proceedings of the National Telecommunications Conference, B81-8, 1973.

"A Biological and Physical Oceanographic Remote Sensing Study Aboard the Calypso", J. C. Harlan, J. M. Hill, H. A. El-Reheim and C. Bohn, Proceedings of the Tenth International Symposium on Remote Sensing of Environment, 1975.

"Remote Sensing of Peanut Foliar Diseases", J. C. Harlan, D. H. Smith and R. W. Toler, Annual Proceedings of the American Phytopathological Society, 1975.

PUBLICATIONS (Continued): "Photographic and Multispectral Remote Sensing of a Virus Disease of Turfgrass", W. C. Odle, J. C. Harlan and R. W. Toler, Annual Proceedings of the American Phytopathological Society, July 1976.

"Radiometric Monitoring of Peanut Foliar Diseases", R. C. Hines, J. C. Harlan and D. H. Smith, Proceedings of the American Peanut Research and Education Association Conference, July 1976.

"On Winter Wheat Yield from Landsat and Landsat Follow-On Satellites", J. C. Harlan, Proceedings of W. Nordberg Memorial Symposium, COSPAR, June 1977.

"On Determining Unharvested Winter Wheat Acreage from Landsat", J. C. Harlan and W. D. Rosenthal, Proceedings of 4th Machine Processing of Remotely Sensed Data Symposium, Purdue University, June, 1977.

"Effective Use of Landsat for Range Monitoring and Management: An Example on a Regional Scale," D. W. Deering, J. C. Harlan, J. W. Rouse, Jr. and R. H. Haas, Proc. of the Wm. Nordberg Memorial Symposium: Contributions of Space Observations to Global Food Information Systems, Tel Aviv, Israel, June 1977.

"Remote Sensing in a Global Wheat Inventory," J. C. Harlan, Texas Agricultural Progress, Vol. 23, No. 2, 8-9, Spring 1977.

"Determining Definitive Disease Losses of Cotton Root Rot Employing Aerial Remote Sensing," B. D. Smith, J. C. Harlan, R. W. Toler and H. T. Eaton, Proc. of the 6th Biennial Workshop on Color Aerial Photography in the Plant Sciences, Fort Collins, Colo., August 1977.

"Aerial Remote Sensing: An Aid to Cotton Root Rot Control," B. D. Smith, R. W. Toler, J. C. Harlan, and H. T. Eaton, Annual Proc. of the American Phytopathological Society, Lansing, Mich., August, 1977 (published as an abstract).

PUBLICATIONS (Continued): "Estimating Defolitation of Peanuts from Spectral Data," Harlan, J.C., W.D. Rosenthal, and D.H. Smith, Peanut Science, 5:10-12, 1978.

"Winter Wheat Yield Estimation from Landsat and and Simulated Landsat Follow-On Data," Harlan, J.C., and W.D. Rosenthal, Proceedings of the 69th Annual Meeting of the American Society of Agronomy, Nov. 1977.

May, 1977

BIOGRAPHICAL DATA

JOHN P. CLAASSEN

Associate Research Engineer, Remote Sensing Center, Texas A&M University

Birth Date: 5/2/36 Citizenship: U.S. S.S.No. 317-36-9605

EDUCATION:

Ph.D. Electrical Engineering, University of Kansas, 1975
M.S. Math, St. Mary's University, 1969
M.S. Electrical Engineering, Purdue University, 1960
B.S. Electrical Engineering, Purdue University, 1959

EXPERIENCE:

Educational

Assistant Professor, Texas A&M University, 1975-

Instructor, Purdue University, 1959-1961

Industrial

Associate Research Engineer, Remote Sensing Center, Texas A&M University, 1975-

Senior Research Engineer, University of Kansas Space Technology Center, 1970-1975

Senior Research Engineer, Southwest Research Institute, 1964-1970

Research Assistant, Purdue University, 1961-1962

Military

1st Lieutenent, U.S. Army Signal Corps, 1962-1964

PROFESSIONAL SOCIETIES AND RECOGNITION:

Institute of Electrical and Electronics Engineers
Professional Engineer, RN: 40732
Sigma Xi

JOHN P. CLAASSEN

PATENTS:

U.S. Patent No. 3.792.348 Method of Determining Stress in a Ferromagnetic Member

U.S. Patent No. 3,612,986 Sensing Apparatus for Use With Stress Measuring Method

PUBLICATIONS:

"The Theory and Measurement of Non-Coherent Microwave Scattering Parameters", IEEE Transaction on Antennas and Propagation. To be published in November, 1977.

"Active and Passive Microwave Measurement of Sea Surface Winds by Skylab S-193 RADSCAT", The 1975 USNC/URSI-IEEE Meeting, 1975.

"Preliminary Analysis of Skylab Radscat Results Over the Ocean", Proceedings of the URSI Specialist Meeting on Scattering and Emission from the Earth, 1974.

"The Recovery of Polarized Apparent Temperature Distributions of Flat Scenes from Antenna Measurements", IEEE Transactions on Antennas and Propagation, Vol. AP-22, No. 3, pp. 433-442, 1974.

"Simultaneous Active and Passive Microwave Response of the Earth-The Skylab Radscat Experiment", Ninth International Symposium on Remote Sensing of Environment, 1974.

"A Simple Formulation for Oxygen Absorption at Centimeter Wavelengths", Journal of Geophysical Research, Vol. 74, No. 6, pp. 861-864, 1974.

"A Technique for Inverting Radiometer Measurements", Joint IEEE/G-AP and URSI Meeting, Williamburg, Virginia, December, 1972

"Radar Sea Return and the Radscat Anemometer", Ocean '72 IEEE International Conference Record, pp. 180-185, 1972.

"Toward Radscat Measurements Over the Sea and Their Interpretation", Proceedings, Advanced Applications Flight Experiments Principal Investigator's Review, pp. 115-140, 1971.

JOHN P. CLAASSEN

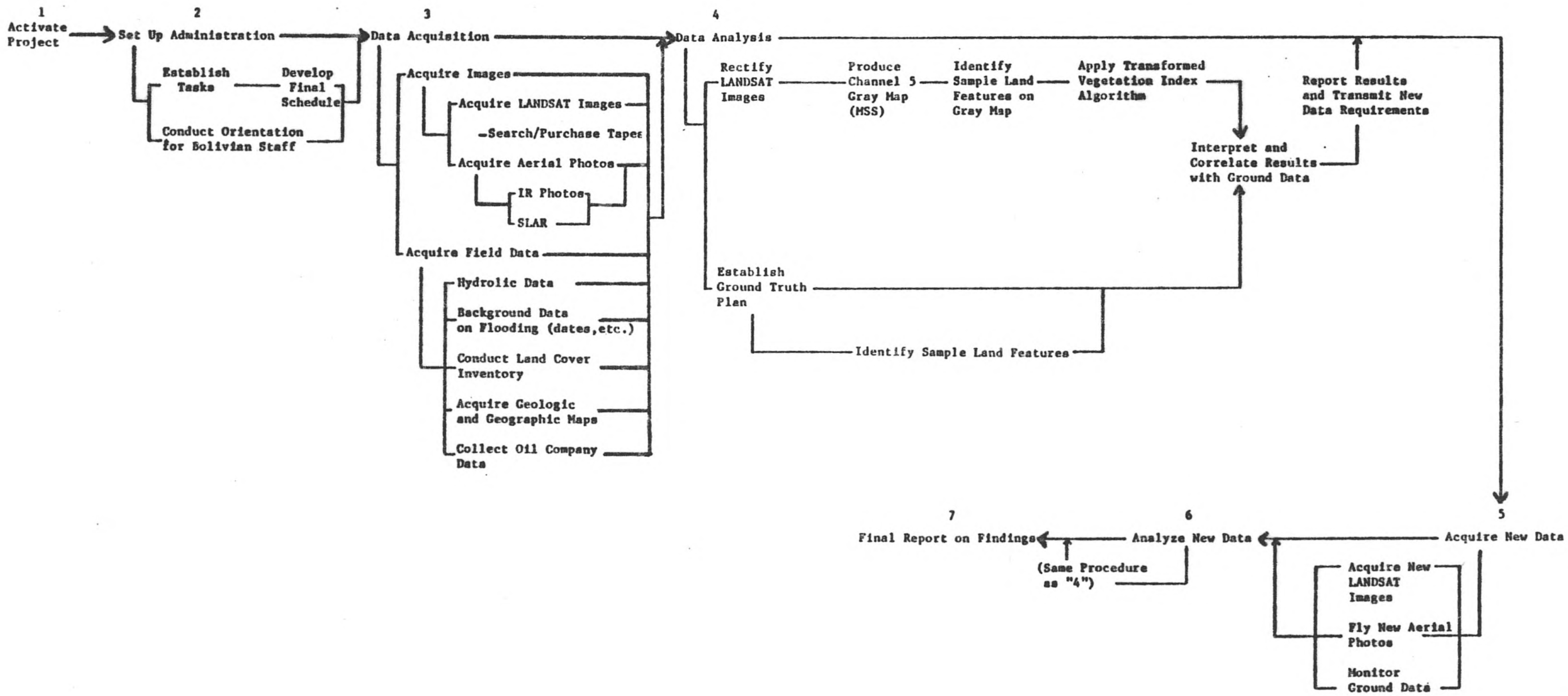
LECTURES:

"Theory and Measurement of Non-Coherent Microwave Scattering Parameters", Naval Research Labs, February, 1975.

"Theory and Measurement of Non-Coherent Microwave Scattering Parameters", NASA Langley Research Center, June, 1975.

APPENDIX B

SCHEDULE OF ACTIVITIES



APPENDIX C

PROPOSED BUDGET:

THE USE OF REMOTE SENSING
FOR FLOOD CONTROL PLANNING

					Subtotal	Total
I.	TRAVEL					
A.	Foreign Travel: Bolivia					
	INTERTECT - 2 @ $700				1,400	
	Texas A&M - 1 @ $700				700	
						2,100
B.	Domestic Travel:	New York	Dallas	Col.Sta.		
	INTERTECT	3 @ $250		3 @ $90	1,020	
	Texas A&M	3 @ $250	3 @ $90		1,020	
						2,040
	TOTAL TRAVEL:					$4,140
II.	OVERSEAS EXPENSES					
A.	Office Expenses:					
	1. Rent	3 months @ $40			120	
	2. Utilities	3 months @ $20			60	
	3. Telephone	3 months @ $10			30	
	4. Postage	N.A.			--	
	5. Equipment Purchase				100	
	6. General Supplies				50	
						360
B.	Material Costs:					
	1. Film & Developing				50	
	2. Drawing Equipment				25	
	3. Reproduction of Slides				100	
	4. Acquisition/Reproduction of Reports and Maps				250	
	5. Translation				250	
	6. Automobile Lease				250	
	7. Fuel for Auto				75	
	8. Maintenance/Repairs for Auto				---	
	9. Automobile Insurance				10	
						1,010

			Subtotal	Total
C.	Salaries & Consultant Expenses (Bolivia):			
1.	Salaries			
a.	INTERTECT	1 month @ $2,500	2,500	
b.	Texas A&M	1/4 month @ $2,400	600	
c.	World Neighbors staff	3 months @ $1,500	4,500	
d.	COMBASE staff	6 months @ $500	3,000	
				10,600
2.	Per Diems			
a.	INTERTECT	30 days @ $42	1,260	
b.	Texas A&M	7 days @ $42	294	
c.	World Neighbors staff	14 days @ $42	588	
d.	COMBASE staff	60 days @ $30	1,800	
				3,942
	TOTAL OVERSEAS EXPENSES:			$15,912

III. U.S. COSTS

A.	Salaries:			
1.	INTERTECT			
a.	Cuny	3 months @ $2,500	7,500	
b.	Parker	1 month @ $1,500	1,500	
c.	Research Assistant	3 months @ $2,000	6,000	
				15,000
2.	Texas A&M			
a.	Harlan	2 months @ $2,500	5,000	
b.	Blanchard	2 months @ $2,400	4,800	
c.	Claassen	2 months @ $2,200	4,400	
d.	Grad. Student	18 months @ $600	10,800	
e.	Grad. Student	18 months @ $600	10,800	
f.	Computer Programmer	3 months @ $1,500	4,500	
g.	Clerk Typist	2 months @ $500	1,000	
				41,300

		Subtotal	Total
B. Material Costs:			
1. LANDSAT Tapes	(6 tapes @ $200)	1,200	
2. Radar Data	(1 tape @ $1,200)	1,200	
3. General Data Acquisition		100	
4. Film and Processing		300	
5. General Supplies		300	
6. Library Acquisitions		250	
7. Data Processing		5,000	
8. Materials for Preparation of Final Report		250	
9. Printing of Final Report		1,000	
10. Translation of Final Report		500	
11. Contingencies		500	
			10,600
C. Overhead:			
1. INTERTECT			
a. Rent	7 months @ $450	3,150	
b. Utilities	7 months @ $145	1,015	
c. Communications		300	
d. Postage		200	
e. Equipment		400	
			5,065
2. Texas A&M (Overhead calculated at the rate of salaries x 52%)			
			21,788
D. Benefits:			
1. INTERTECT (Salaries x 15%)		2,625	
2. Texas A&M (Salaries x 13%)		5,447	
			8,072
TOTAL U.S. COSTS:			$101,825

		Total
IV.	PROJECT CONTINGENCIES (13% of total)	$15,844
V.	INTERTECT CO-OP DEVELOPMENT FEE (12% of total)	$14,625
VI.	TOTAL PROJECT COST	$152,346

BUDGET SUMMARY:

I.	Travel	$ 4,140
II.	Overseas Expenses	15,912
III.	U.S. Costs	101,825
IV.	Project Contingencies	15,844
V.	INTERTECT Co-op Development Fee	14,625
VI.	Total Project Cost	$152,346

Design Criteria

APPENDIX

EXAMPLE OF LEVEE PROTECTION WORKS USED IN JAPAN

(1) **Straw-mat spreading** (Omote-mushiro-bari)

Purpose: To prevent sloughing of embankment and water seepage.

Method: Depending on the size of rupture of the slope face, 9, 12, or 15 sheets of matting are stitched together with rope; ribs of bamboos are coarsely woven through laterally at 90 cm intervals. Sandbags are attached to the lower end of the sheet as weights, the sheet is rolled around the weight and gradually unrolled from the top with rope, adding stitches where necessary. More sandbag weights are then loaded on the sheet to prevent flapping and the sheet is affixed.

Persons	*Materials*			*Tools*	
	Item	*Shape and size*	*No.*	*Item*	*No.*
10	Straw mat	1.8 m × 0.9 m	9	Wooden needles	Adequate number
	Bamboo	Circumference: 9 cm Length: 3.5 m	10	Mallet	1
	Wooden pipe	End diameter: 9 cm Length: 1.2 m	3		
	Two-ply rope	Length: 3 m	15		
		Length: 4.5 m	2		
		Length: 8 m	2		
	Three-ply rope	Length: 20 m	4		

Remarks. – Mats are arranged three in a row and three abreast and bamboo ribs placed at 0.6 m intervals. Sandbag weights are attached to the lower end. Also, to prevent flapping, sandbag weights are loaded on the upstream end to hold down the sheet.

(2) **Tripod stitching** (Gotoku-nui)

Purpose: To prevent enlarging of cracks or ruptures on the land side of an embankment.

Method: Drive three or four bamboo poles deeply into the ground on both sides of the crack at 1 m intervals in the shape of a tripod or quadripod. The tops of the poles are tied together with a rope 1.2-1.5 m above the ground. On top of the knot a sandbag weight is loaded. If there is no turf at the crack, or if the embankment is weak, sandbags may be used to secure the bamboo pole feet. This method is more effective at the foot of a slope than on its face. It is also safer to place supporting piles at the foot of a slope.

Persons	*Materials*		
	Item	*Shape and size*	*No.*
10	Bamboo Plastic bag Two-ply rope	Circumference: 18 cm, tapered Length: 3 m Length: 1.5 m	18 17 51 5

Remarks. – Quadripod: 3 places. Tripod: 2 places. Sandbags are used as foot weights for quadripods. Foot weights are not used for tripods but a sandbag weight is loaded. The distance between feet is about 1 m for both tripods and quadripods.

(3) **Folding** (Orikaeshi)

Purpose: To prevent rupture when cracks occur on the top of an embankment.

Method: Drive bamboo poles into the front and rear surface of the top of the embankment, placing sandbags at the roots as cushions. The poles are bent and the upper ends tied together at the middle of the embankment with rope. As the bent portion of bamboo is liable to break, bags are rolled up and inserted as cushions. To ensure tightness of the bamboos, sandbag weights are loaded on top.

Persons	*Materials*			*Tools*	
	Item	*Shape and size*	*No.*	*Item*	*No.*
10	Bamboo Plastic bag Two-ply rope	Circumference: 15 cm, tapered Length: 3 m Length: 1.5 m	20 40 120 20	Axe	2

Remarks. – Plant 10 bamboos at 1.5 m intervals, placing one cushion sandbag at the base of each and inserting bags at the bent part. Load sandbag weights at the joints.

(4) **Hooping** (Tsuki-no-wa)

Purpose: To store leaking water on the inner side and to reduce the pressure of seeping water.

Method: Stack sandbags around the leak at the foot of the slope in the shape of a hoop (radius 1.2 m-2.0 m). Absorb leaking water within this hoop and prepare channels for water discharge. The height of the stack should be just enough to reduce water pressure and, if the stack is more than three tiers of sandbags, retaining piles or fence piles are used. Mats are laid at the discharge channels and water is discharged through a conduit. Spaces between sandbags are earth-filled and sufficiently compacted to prevent leakage from any gaps.

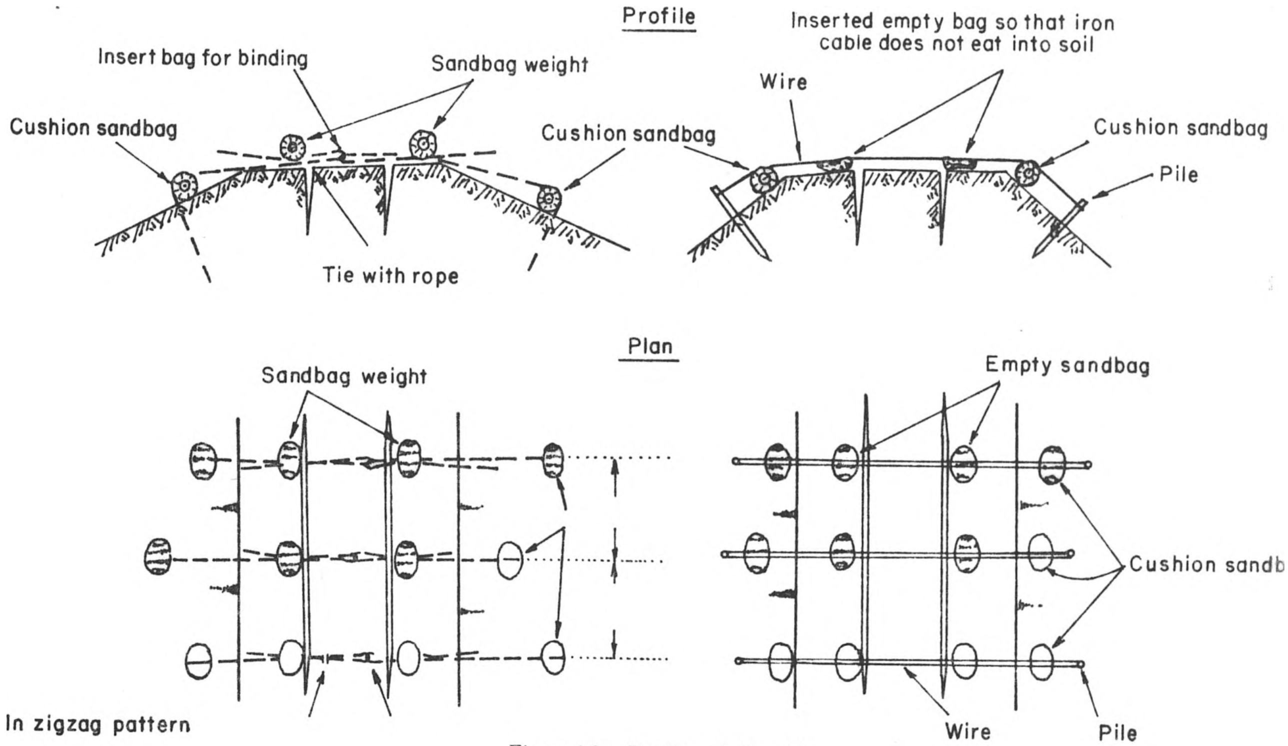


Figure 16 – Folding *(Orikaeshi)*

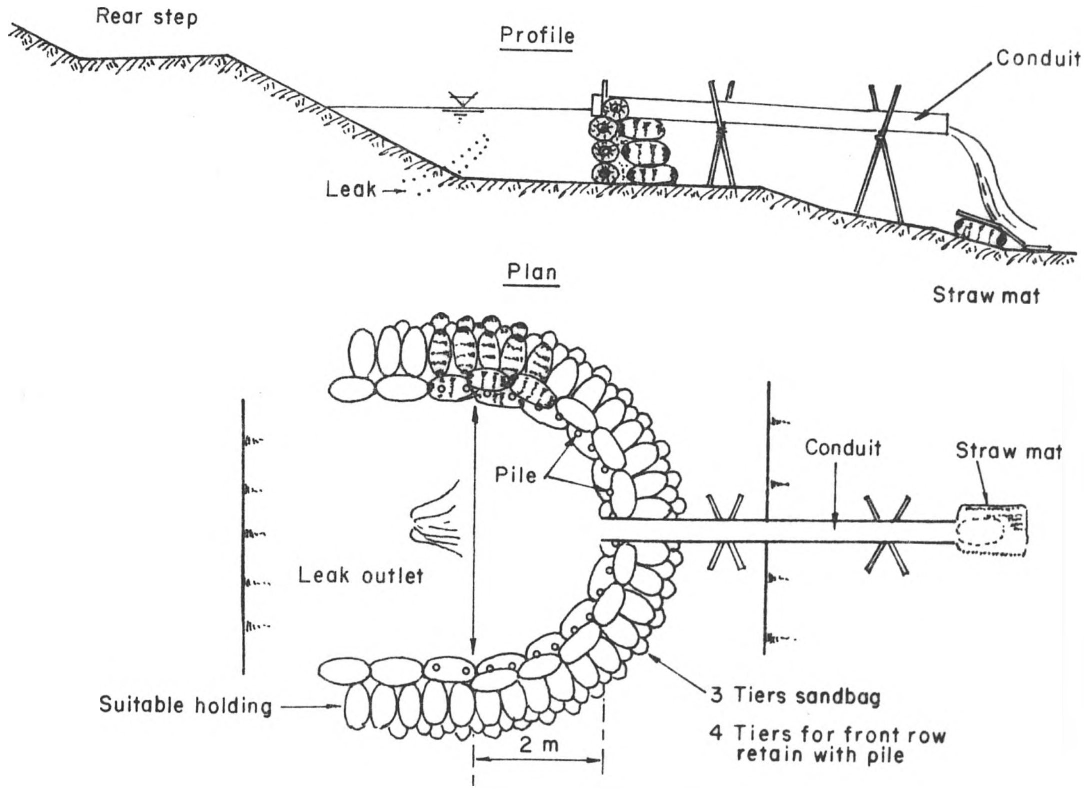


Figure 17 – Hooping *(Tsuki-no-wa)*

Persons	Materials			Tools	
	Item	*Shape and size*	*No.*	*Item*	*No.*
25	Empty straw bag	With lid	140	Mallet	2
	Two-ply rope	Length: 3 m	405		
		Length: 1.5 m	2		
	Pile	Length: 1.5 m Diameter: 6 cm	32		
	Pile	Length: 1.8 m Diameter: 6 cm	4		
	Triangular conduit	20 cm × 30 cm × 200 cm	1		
	Straw mat	0.9 m × 1.8 m	2		

Remarks. – Three tiers of sandbags are stacked in a semi-circle at a radius of 1.8 m, with others added as required. For each bag, a bamboo pile of 1.5 m length and 15 cm circumference is planted as a retaining pile.

(5) **Sandbag stacking** (Tsumi-dohyo)

Purpose: To prevent water overflow.

Method: Stack sandbags to the required height on top of the embankment at about 0.5-1.0 m from the shoulder of the front slope, so that the stack will not be affected by any failure of the shoulder. If the stack is only one tier, the bags may be stacked lengthwise or widthwise. Earth is filled and compacted in between the bags, straw also being inserted to prevent leakage. For three-tier stacking, wooden or bamboo piles are planted for support.

Persons	Materials			Tools	
	Item	*Shape and size*	*No.*	*Item*	*No.*
20	Empty straw bag	With lid	120	Mallet	2
	Sandbag		33		
	Two-ply rope	Length: 3 m	526		
	Bamboo	Circumference: 9 cm, tapered	17		
	Two-ply rope	Length: 1 m	2		

Remarks. – For a length of 20 m with 2 tiers in front and 1 tier at the rear. Each bag is braced with 12 bamboo poles. Parallel stitching is employed for the top.

(6) **Sandbag stacking with piles** (Kuiuchi-tsumi-dohyo)

Purpose: To prevent failure of rear slope of embankment.

Method: Stack sandbag lengthwise along the slope and drive piles of about 2.5 m in length at 0.60 m intervals as support. A lateral beam of 5.0 m in length is affixed to the upper part of piles and props of 4.0 m are planted at 3.6 m intervals. In the middle portion of each prop, two retaining poles are driven, one at each side at an angle. At the root of the holding prop, pegs are driven two in a row as braces.

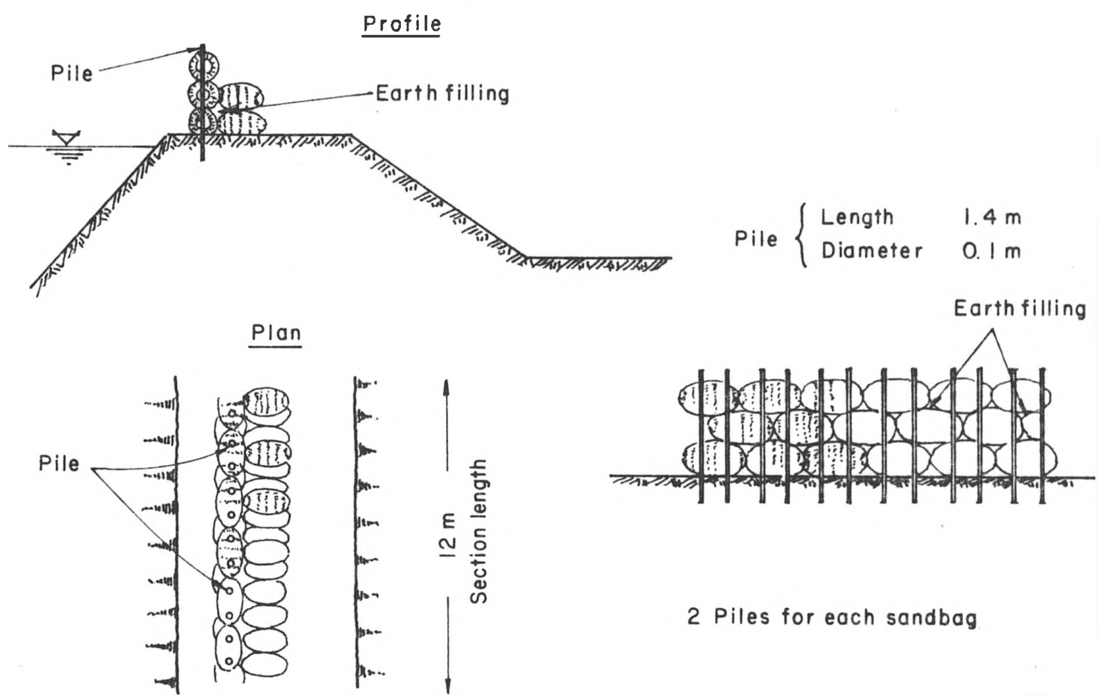


Figure 18 – Sandbag stacking *(Tsumi-dohyo)*

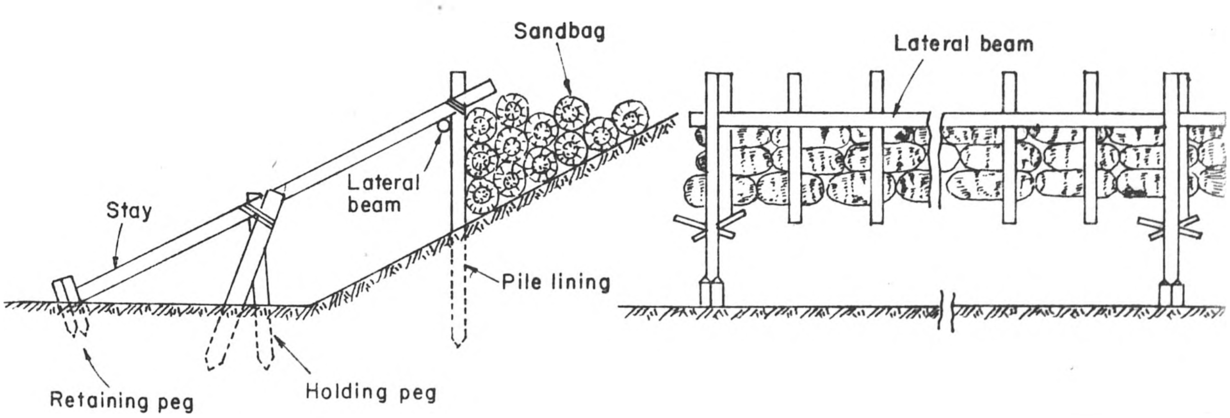


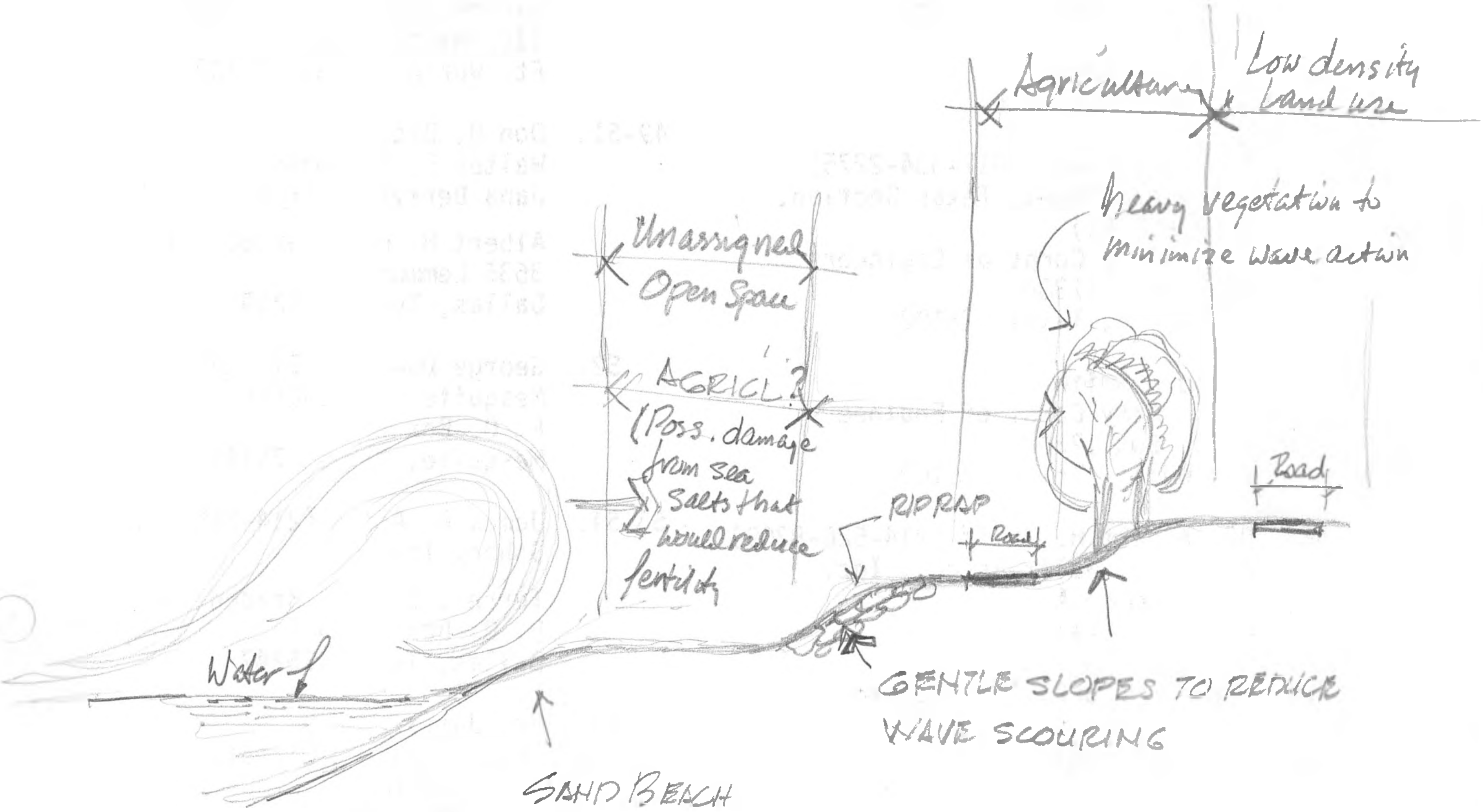
Figure 19 – Sandbag stacking with piles *(Kuiuchi-tsumi-dohyo)*

Persons	Materials			Tools	
	Item	*Shape and size*	*No.*	*Item*	*No.*
76	Empty straw bag	With lid	200	Mallet	
	Sandbags		900		
	Filling earth	Sandy soil (m^3)	30		
	Rope	10 mm (coils)	17		
	Logs*	ϕ 12 cm × 5.0 m	2.8		
		ϕ 12 cm × 4.0 m	3.8		
		ϕ 12 cm × 2.5 m	17.7		
		ϕ 12 cm × 1.5 m	7.6		
		ϕ 12 cm × 0.5 m	7.6		

*For each 10 m section.

10 FEB.

Suggestions from JCE
on T.W. control/protection
Also check Ian MacHarg



Pre-Registration List

41. K. C. Rudy
Trinity River Authority

42. Jonathan Young
Hydroscience, Inc.

43. Troy L. Lovell (817-334-2275)
(Vice-President, Texas Section, A.W.R.A.)
U. S. Army Corps of Engineers
P. O. Box 17300
Ft. Worth, Texas 76102

44. Milburn Smith
U. S. Army Corps of Engineers
P. O. Box 17300
Ft. Worth, Texas 76102

45. Dr. Albert H. Halff (214-526-8309)
Albert H. Halff Assoc., Inc.
3636 Lemmon Ave.
Dallas, Texas 75219

46. Monroe McCorkle, Director
(214-630-1111)
Dept. of Public Works - Dallas
1500 W. Mockingbird Lane
Dallas, Texas 75235

47. Joe Novoa (214-526-8309)
(Secretary - Texas Section, A.W.R.A.)
Albert H. Halff Assoc., Inc.
3636 Lemmon Ave.
Dallas, Texas 75219

48. John H. Mas (817-335-2611)
Carter and gess, Inc.
1100 Macon eet
Ft. Worth, as 76102

49-51. Don O. Brock
Walter E. Sk with
Jana Berryh Loyd

Albert H. H ff Assoc., Inc.
3636 Lemmon ve.
Dallas, Tex 75219

52. George Dowl (214-288-7711)
Mesquite C Engineer
P. O. Box 1
Mesquite, T as 75149

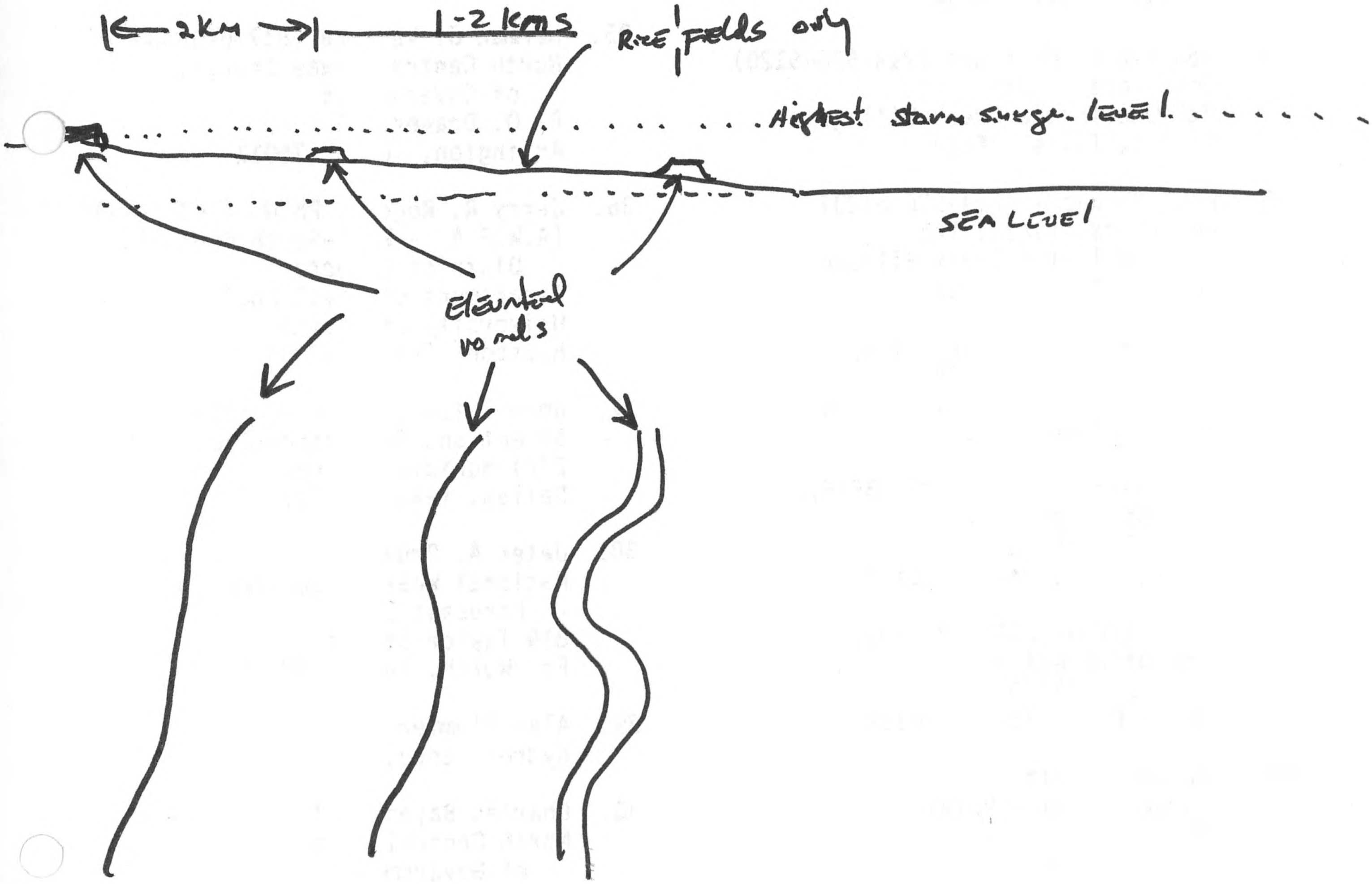
53-54. James R. A s (214-263-5 7)
Johnny Ingr

Turne , Col e, Braden, Inc.
P. O. Box 4 A
Dallas, Tex 75247

55-56. Dr. James C ey
(Past Dist Director - A.W.R.A.
Glen Arnol

Rady and As
400 Contin Life Bldg.
Ft. Worth, as 76102

57. E. E. "Gene Garn
Subdistrict ief, U. S. Geologic urvey
P. O. Box 6
Ft. Worth, xas 76115



2KM
1-2 KMS
RICE FIELDS only
Highest storm surge level
SEA LEVEL
Elevated roads

Pre-Registration List

15. Charles Cryan (817-497-2225)
City of Lake Dallas
P. O. Box 368
Lake Dallas, Texas 75065

16. Travis Roberts (214-369-9171)
Homer Hunter Assoc.
P. O. Box 535
Carrollton, Texas 75006

17. Charles K. Bresett (214-245-1551)
City of Carrollton
P. O. Box 535
Carrollton, Texas 75006

18. G. W. Finley (214-526-6120)
Cook-Consultants, Inc.
222 One Turtle Creek Village
Dallas, Texas 75219

19. Kenneth E. Morrison (214-526-6120)
Cook-Consultants, Inc.
222 One Turtle Creek Village
Dallas, Texas 75219

20. Paul Morawski (214-526-6120)
Cook-Consultants, Inc.
222 One Turtle Creek Village
Dallas, Texas 75219

21. W. P. Wills (214-526-6120)
Cook-Consultants, Inc.
222 One Turtle Creek Village
Dallas, Texas 75219

22. Bob Doverspike (214-293-3695)
City of Forest Hill
P. O. Box 15330
Forest Hill, Texas 76119

23. Leon Barrow (214-293-3695)
City of Forest Hill
P. O. Box 15330
Forest Hill, Texas 76119

24. Glenda Barrett
League of Women Voters
1947 W. Gray
Houston, Texas

25. Modelle Brud[illegible]
League of Wo[illegible] Voters
1947 West Gr[illegible]
Houston, Tex[illegible]

26-34. City of Dall[illegible] - Public Works
(214-630-111[illegible] ext. 351)
1500 W. Mock[illegible]bird Lane
Dallas, Texas 25235
Albro L. [illegible]sons, Jr.
Mrs. Tomm[illegible] McPherson
Michael As[illegible]w
John M. S[illegible]ck
Ronald A. [illegible]ung
Stanley E. [illegible]lystone
Walter Ha[illegible]
Clyde L. S[illegible]ford
Nathan Ma[illegible]

35. Herman J. Ves[illegible]ka (817-640-3300)
North Central [illegible]exas Council
of Govern[illegible]ts
P. O. Drawer [illegible]G
Arlington, Te[illegible]s 76011

36. Jerry R. Rog[illegible], Ph.D. (713-749-4476)
(A.W.R.A. - W[illegible]t-South Central
District D[illegible]ector)
Department of [illegible]ivil Engineering
University of [illegible]ouston
Houston, Texa[illegible] 77004

37. John Teipel, [illegible]ector (214-748-9711)
Street and Sa[illegible]ation Dept.
2721 Municipal Street
Dallas, Texas [illegible]5215

38. Jeter A. Prue[illegible]
National Weath[illegible] Service
Forecast O[illegible]ce
819 Taylor St[illegible]t
Ft. Worth, Te[illegible] 76102

39. Alan Plummer
Hydroscience, [illegible]c.

40. Charles Bayer (817-640-3300)
North Central [illegible]xas Council
of Governm[illegible]s
P. O. Drawer [illegible]
Arlington, Tex[illegible] 76011

BRIEFS

BANANAS COME HOME TO ASIA

Bananas are an important staple for many people in the tropics, and next to citrus fruits are the most important item in the international fruit trade. Bananas will be returning home to Asia as the Philippines becomes the new focus of a global program of genetic improvement for the *Musa* and its popular fruit. Bananas are native to the India-Malaysia region, although today the largest producers and exporters of the fruit are in Central America.

A meeting in Rome last year under the aegis of the International Board for Plant Genetic Resources brought together the world's top banana researchers, who recommended the establishment of a banana and plantain genetic bank in Southeast Asia. Participants at that meeting had expressed concern over the rapid erosion of genetic resources for the crop due to shifting cultivation practices (slash-and-burn agriculture), and the large-scale exploitation and destruction of the natural forest habitat in countries with indigenous wild species of *Musa*. The greatest genetic diversity of banana remains in Southeast Asia.

An experimental station of the Bureau of Plant Industry in Davao, southern Philippines, was selected as the physical base for a global program to identify and improve strains and cultivars of the plant.

NEW SPRAY SPREADS IT VERY THIN

A new family of insecticides, distributed through a novel ultra-low volume sprayer, are the latest developments in the struggle to control the tsetse fly in Africa. The tsetse, because it is a vector of the disease trypanosomiasis affecting humans and animals, effectively prevents any development of the large areas of Africa that are its habitat.

The new insecticides, pyrethroids, are more efficient than conventional chemical controls. Hence, they need be applied in smaller amounts and represent an economic as well as functional improvement. To match the effectiveness of the pyrethroids, British inventor Edward Bals has come up with a sprayer that can distribute the insecticide in droplets about half the thickness of a human hair in diameter. This extremely fine spray is applied by aircraft flying across the wind. Inside the spraying apparatus, 15 lightweight discs spin at about 7000 rpm, throwing off the fine droplets of insecticide by centrifugal force. Blown on the wind, only about a quarter of a teaspoon is required to treat one hectare of forest and bush against tsetse. The sprayer may be used to advantage in control programs for malarial mosquitoes, locusts, and other pests.

THIS DAM MUST BE BLOWN UP

Engineers from Britain's Hydraulic Research Station have designed an inflatable dam for use in controlling water flow in streams and rivers in remote areas and in contrasting terrains. The design seems suited for developing countries, and field tests are now underway on the Khor'Arbat River in Sudan to evaluate the dam's performance.

Made of flexible polyester coated with plastic (PVC), the dam resembles a sheet of paper that has been folded up the middle, with the bent section rolled into a tube. The flat part constitutes an apron that can be spread flat on the upstream side of the dam and anchored with stones. The tube

portion, which forms the actual dam, is filled with water to make it rigid. The British engineers claim as the dam's merits its portability, relatively low cost, flexibility of use under varying terrain conditions, and the fact that it cannot be damaged or destroyed by unusual water loads. This last advantage is one that the inflatable dam holds over conventional solid dams, although solid dams can be constructed "free" using local materials. An experimental program will see the inflatable dams installed in St. Lucia, the Virgin Islands, Dominica, and Botswana, in addition to Sudan.

POPULATION GROWTH DECLINING

News from the recent annual meeting of the American Association for the Advancement of Science (AAAS) adds another measure of confirmation to what population researchers around the world have begun to believe: the global population growth rate is declining. Based on figures compiled and interpreted from UN and national census statistics and the Population Council, research at Harvard University's Center for Population Studies shows that the world's population growth rate peaked at 1.9 percent per year in 1970. Last year, the growth rate dropped to 1.7 percent (representing a decline of about 10 percent). From 1965 to 1975, similar declines of 20 percent or more have occurred in a number of developing countries, including Thailand, South Korea, China, Colombia, North Vietnam, Chile, Cuba, the Dominican Republic, Panama, and Jamaica.

Population growth rates in developing countries overall have dropped since peaking in 1970, from a high of 2.4 percent that year to 2.1 percent, or from 42 births per 1000 to 36 per 1000 in 1977.

However, the world population is still growing rapidly. The declines mean that it will now take 41 years for the world's population to double, rather than the 36 years it would have taken at 1970 rates. World population is currently estimated to be 4.1 billion. Dr. Nick Eberstadt from the Harvard population centre, who chaired a scientific session on fertility at the AAAS meeting, said that the declines could be attributed in large part to the improving socio-economic status of families in developing countries.

REPORT ON CANADA AND THE UN

International leaders in the diplomatic and political world joined more than 200 delegates from across Canada in Winnipeg, in May 1977, to examine the question of "Canada and the United Nations in a Changing World". The topics dealt with during the 3-day conference, organized by the United Nations Association in Canada, ranged from the role of the United Nations, through the management of change and the new international economic order, to disar- [illegible] emphasis was on [illegible] interdependence of the critical issues facing mankind and interpendence between nations.

The report of this conference, containing the addresses made by the 22 speakers, has now been published by the UNA. As Mr J. King Gordon, Conference Chairman, points out: "The publication... will serve not only as a conference record but as a timely resource book for students of international relations and, in particular, of the United Nations...". It is available from the United Nations Association in Canada, 63 Sparks Street, Ottawa, K1P 5A6, Canada.

FOLLOWING COLOMBIA'S EXAMPLE

According to *Hsinhua*, the official Chinese news agency, the country's paramedics have been supplied with a simple portable laboratory. A box of instruments, containing some 300 items, will permit the Chinese "barefoot doctor" to run up to 20 on-the-spot tests for field diagnosis of common diseases. The minilab apparently weighs less than 10 kg, making it light enough to be carried on a bicycle and into the remote and rural areas serviced by the paramedics.

Among its contents are a vacuum flask, used for stool and urine tests, a refrigerant flask for maintaining items at low temperatures, and a battery-operated micro-centrifuge. The portable lab is claimed to be both easy to handle and highly reliable. A similar, though less complex, minilab is among a number of simple health instruments developed to assist rural health workers in a Colombian project supported by the IDRC (see *Reports* Vol. 7 No. 1 p.8).

IT'S NOT WHAT YOU SAY...

When he began working as a village health worker, some 17 years ago, Dr Juan Flavier of the International Institute of Rural Reconstruction, Cavite, Phillipines, found that he lost his audience when he tried to explain family planning. Not only were his lectures, using medical terminology, not understood, but they did not persuade or motivate the villagers to accept the new techniques.

One day, an old woman who had heard his lecture told him that when he tried to explain the uterus she thought of the earth where things grow. The sperm were seeds

Flood Hazards

File
Bolivian
Project

I. Large ~~scale~~ area downstream floods

A. Flood 1000's of km^2

B. Are predictable on the short term (a few days to a week)

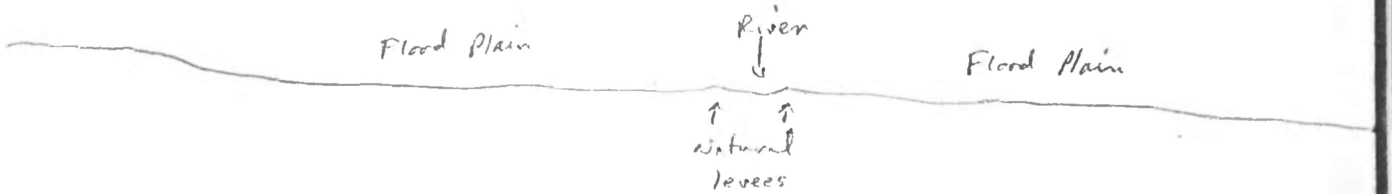
C. Result from prolonged rain over large areas

D. Damage Prevention + lifesaving

1. Possible through costly upstream dam system
2. May be difficult in flat terrane
3. In flat terrane should involve:
    a) building on highest ground available
    b) a warning system upstream to warn of water level changes
    c) in sparsely populated areas, a system of levees
    d) construction appropriate for frequently flooded areas

F. Flood potential recognized where:

1. Rivers in area have large drainage basin
2. Human habitation is on floodplain



3. Upstream areas have potential for heavy rainfall and/or rapid thaw of snowpack over large area

Topo. Data

Geolo. Data

MEMORANDUM TO: Everett

FROM: Loren

DATE: May 16, 1978

RE: Geologic Maps of Bolivia

Enclosed are four copies (one colored) of a part of the geologic map of South America. This is the only map I have that covers the Chaparé area.

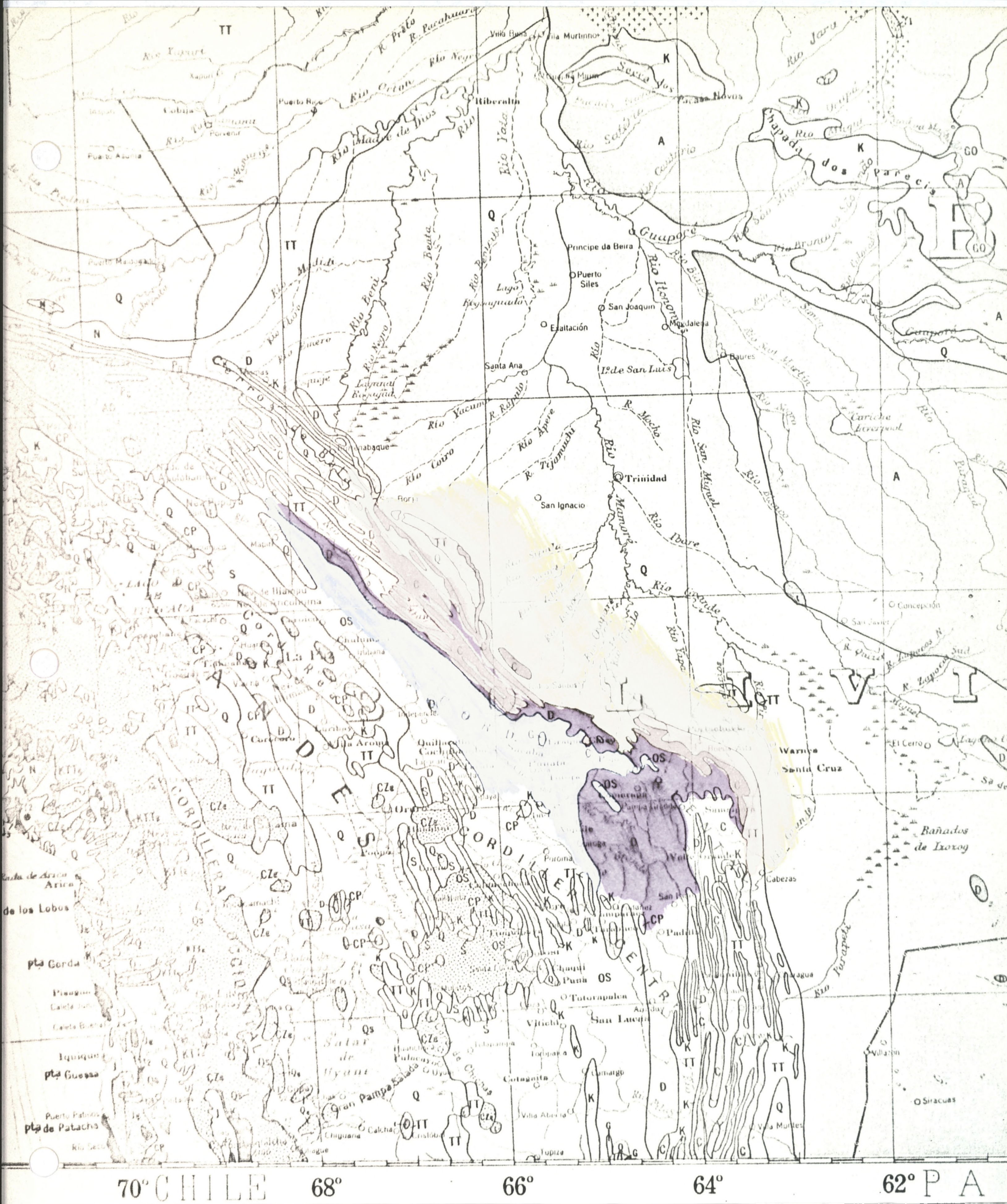
The map units are, in order of age, youngest (top) to oldest (bottom):

- Q - Quaternary (yellow)
- TT - Tertiary (orange)
- C - Carboniferous (red)
- D - Devonian (light purple)
- OS - Ordovician-Silurian (dark purple)
- G - Cambrian (blue).

As best I can learn at present, the rocks are as follows:

- Cambrian - sandstone and shale
- Ordovician - sandstone and shale
- Silurian - sandstone
- Devonian - shale and sandstone
- Carboniferous - conglomerate, sandstone, shale, and limestone with volcanic rocks (basalt)
- Tertiary - sandstone, shale, conglomerate, and volcanic tuff & other igneous rocks
- Quaternary - sand, mud, and gravel

/cm



Riberalta
Puerto Rico
Cobija
Principe da Beira
Puerto Siles
San Joaquin
Exaltación
Magdalena
Santa Ana
Baures
Trinidad
San Ignacio
Rio Guaporé
Rio Mamoré
Rio Beni
Rio Madre de Dios
Rio Grande
Chapada dos Parecis
Lago Rogaguado
Warnes
Santa Cruz
Cabezas
Concepción
San Javier
El Cerro
Bañados de Izozog
Oruro
Potosí
Tupiza
Villa Montes
Siracuas
Villazón
Arica
Iquique
pta Gorda
pta Guessa
pta de Patachs
de los Lobos
Rio Loa
Salar de Uyuni
Gran Pampa Salada
CORDILLERA OCCIDENTAL
CORDILLERA CENTRAL
ANDES
70° CHILE
68°
66°
64°
62° PA

MEMORANDUM TO: Fred

FROM: Loren

DATE: May 18, 1978

RE: Chipare, Bolivia Proposal

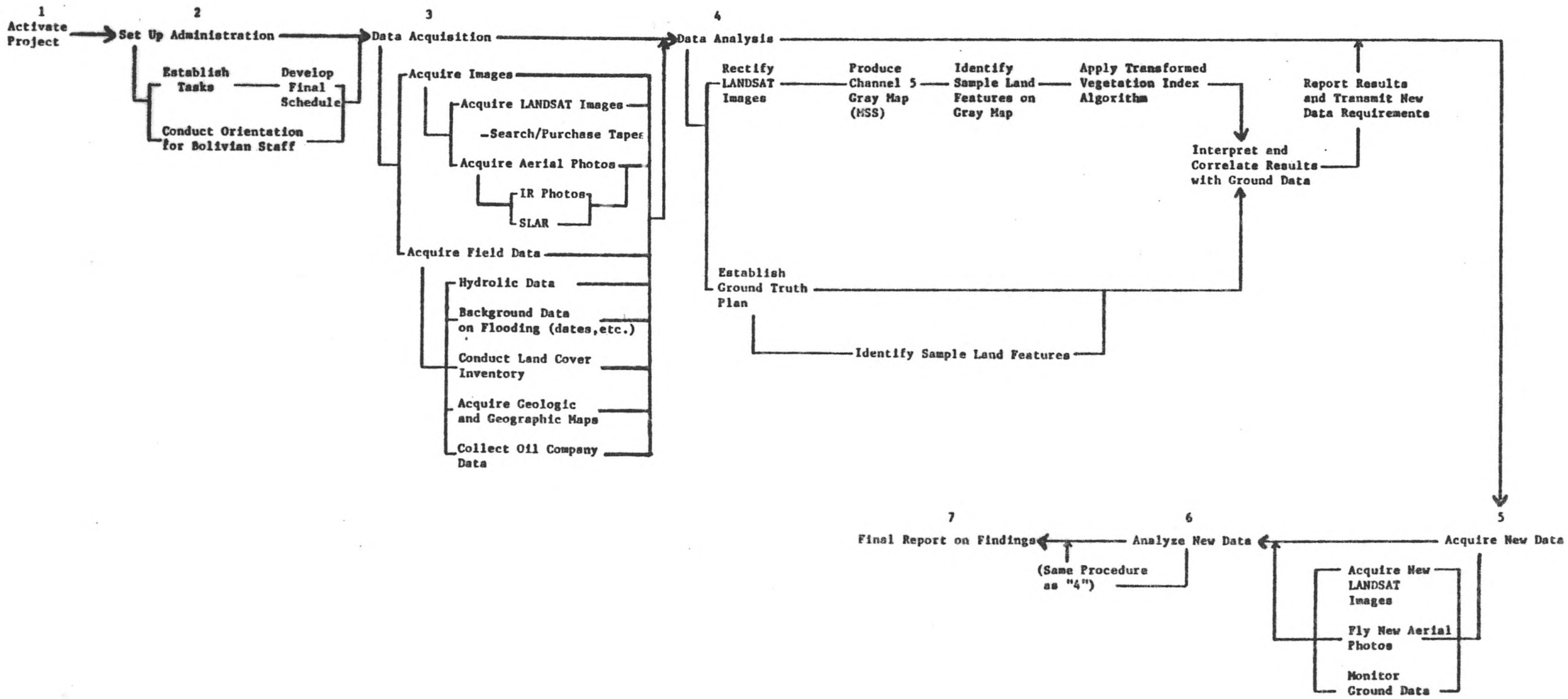
After studying the enclosed Chipare proposal, I have reached the following conclusions.

1. The proposal assumes that flood control on a major river can be "simple and affordable." I doubt this and so will the reviewers. Avoid such language.
2. Five years worth of Landsat data is inadequate for evaluation of flood history (frequency and magnitude). Perhaps the phrase recent history of flooding should be used.
3. The proposal should include a more extensive discussion of factors that control flood damage.
4. The use of Landsat imagery for assisting small rural communities in developing countries to cope with flood problems is an excellent idea. I believe, however, that the proposal needs to demonstrate the involvement of either local people or development agency personel.

/cm

R.S. Data

SCHEDULE OF ACTIVITIES



EROS DATA CENTER
SIOUX FALLS, SOUTH DAKOTA 57198
PHONE 605-594-6511   FEDERAL TELECOMMUNICATIONS SYSTEM PHONES USE 784-7151

REPORT NO. DI029-1
DATE 05/15/78
TIME 21:49
PAGE 1

CONTACT NUMBER [redacted]
LLB   MR. RESSLER

2 ACCESSIONS   CIRCLE RETRIEVAL

LATITUDE	LONGITUDE	RADIUS	AGENCY	QUALITY	CLOUD-COVER	RECORDING-TECH
S16D55M	W65D25M	50	8	5	50%	VERTICAL

DATA TYPE LANDSAT

IMAGERY-TYPE	SCENE ID	FILM-SOURCE	QUALITY	CLOUD	EXPO-DATE	SCENE-CENTER-POINT	SCENE-SCALE	MICROFORM	COL	BIP2 CCT
PATH=249 ROW= 72 LANDSAT										
LANDSAT-2 (MSS)	8252613341500	B&W-02.1"	5555*	20%	07/01/76	S17D13M00S W065D14M00S	1:3,369,000	B22002B0268	P	Y
CORNER POINT COORDINATES=#1:S16D34M51S W064D10M18S, #2:S16D19M02S W065D51M04S, #3:S17D50M50S W066D18M06S, #4:S18D06M50S W064D36M32S										
LANDSAT-2 (MSS)	8214813410500	B&W-02.1"	8558*	40%	06/19/75	S17D19M00S W065D19M00S	1:3,369,000	B2200090771	P	N
CORNER POINT COORDINATES=#1:S16D41M13S W064D15M42S, #2:S16D25M25S W065D55M43S, #3:S17D56M28S W066D22M42S, #4:S18D12M27S W064D41M53S										

** DONE **

EROS DATA CENTER
SIOUX FALLS, SOUTH DAKOTA 57198
PHONE 605-594-6511 FEDERAL TELECOMMUNICATIONS SYSTEM PHONES USE 784-7151

REPORT NO. OL001-1
DATE 06/08/78
TIME 10:07
PAGE 1

CONTACT NUMBER [redacted] TERMINAL T83A32
LLB MR. RESSLER

10 ACCESSIONS

POLYGON RETRIEVAL

LATITUDE	LONGITUDE	LATITUDE	LONGITUDE	AGENCY	QUALITY	CLOUD-COVER	RECORDING-TECH
S16D55M	W65D25M			8	1	90%	VERTICAL

DATA TYPE LANDSAT

PATH=249 ROW= 72 LANDSAT

IMAGERY-TYPE	SCENE ID	FILM-SOURCE	QUALITY	CLOUD	EXPO-DATE	SCENE-CENTER-POINT	SCENE-SCALE	MICROFORM	COL	BIP2 CCT
LANDSAT-2 (MSS)	8252613341500	B&W-02.1"	5555*	20%	07/01/76	S17D13M00S W065D14M00S	1:3,369,000	B2200280268	P	Y
CORNER POINT COORDINATES=#1:S16D34M51S W064D10M18S,#2:S16D19M02S W065D51M04S,#3:S17D50M50S W066D18M06S,#4:S18D06M50S W064D36M32S										
LANDSAT-2 (MSS)	8222013395500	B&W-02.1"	2222*	40%	08/30/75	S17D12M00S W065D08M00S	1:3,369,000	B2200130901	P	N
CORNER POINT COORDINATES=#1:S16D33M41S W064D04M12S,#2:S16D17M58S W065D45M14S,#3:S17D50M00S W066D12M12S,#4:S18D05M54S W064D30M22S										
LANDSAT-2 (MSS)	8214813410500	B&W-02.1"	8558*	40%	06/19/75	S17D19M00S W065D19M00S	1:3,369,000	B2200050771	P	N
CORNER POINT COORDINATES=#1:S16D41M13S W064D15M42S,#2:S16D25M25S W065D55M43S,#3:S17D56M28S W066D22M42S,#4:S18D12M27S W064D41M53S										
LANDSAT-1 (MSS)	8144013505500	B&W-02.1"	2802*	60%	10/06/73	S17D19M22S W065D22M15S	1:3,369,000	*0000000000	P	N
CORNER POINT COORDINATES=#1:S18D07M26S W066D16M21S,#2:S18D23M21S W064D43M53S,#3:S16D31M06S W064D28M54S,#4:S16D14M54S W066D00M24S										
LANDSAT-1 (MSS)	8136813521500	B&W-02.1"	2222*	60%	07/26/73	S17D07M13S W065D27M07S	1:3,369,000	*0000000000	P	N
CORNER POINT COORDINATES=#1:S17D55M08S W066D21M14S,#2:S18D11M18S W064D48M55S,#3:S16D19M04S W064D33M43S,#4:S16D02M39S W066D05M05S										
LANDSAT-1 (MSS)	8122413531500	B&W-02.1"	8888*	90%	03/04/73	S17D11M08S W065D27M53S	1:3,369,000	B1200200060	P	N
CORNER POINT COORDINATES=#1:S16D31M58S W064D24M34S,#2:S16D17M32S W066D05M56S,#3:S17D50M00S W066D31M37S,#4:S18D04M37S W064D49M25S										
LANDSAT-1 (MSS)	8115213525500	B&W-02.1"	8888*	60%	12/22/72	S17D23M37S W065D22M31S	1:3,369,000	B1200110487	P	N
CORNER POINT COORDINATES=#1:S16D45M14S W064D19M54S,#2:S16D30M42S W065D59M49S,#3:S18D01M42S W066D25M31S,#4:S18D16M25S W064D44M48S										
LANDSAT-1 (MSS)	8113413525500	B&W-02.1"	8888*	60%	12/04/72	S17D19M09S W065D24M17S	1:3,369,000	B1200081881	P	N
CORNER POINT COORDINATES=#1:S16D40M35S W064D21M29S,#2:S16D26M02S W066D01M46S,#3:S17D57M26S W066D27M29S,#4:S18D12M08S W064D46M24S										
LANDSAT-1 (MSS)	8100813515500	B&W-02.1"	8858*	60%	07/31/72	S17D10M28S W065D14M48S	1:3,369,000	B1200010801	P	N
CORNER POINT COORDINATES=#1:S17D57M19S W066D09M06S,#2:S18D15M26S W064D37M51S,#3:S16D23M16S W064D20M59S,#4:S16D05M17S W065D51M15S										
LANDSAT-1 (RBV)	8100813515200	B&W-02.2"	885**	70%	07/31/72	S17D10M28S W065D14M47S	1:3,369,000	B1200010800	P	N
CORNER POINT COORDINATES=#1:S16D32M11S W064D16M51S,#2:S16D16M18S W065D56M38S,#3:S17D48M28S W066D13M08S,#4:S18D04M30S W064D32M32S										

** DONE **

Ressler Notes on Remote Sensing Pertaining to Bolivia:

1. Availability of LANDSAT Imagery: As noted earlier, only 2 images exist with cloud cover less than 50%. (Enclosed is complete EROS listing of available imagery). There may be more images available from other centers (see enclosed sheet) and I have written Brazil requesting a computer print-out for dates of available imagery. Foreign stations independently process their imagery and market the data directly to users.

2. Scale: The computer print-out lists the scale as 1:3,369,000, but this may be enlarged in processing to a scale of 1:1,000,000 (?). The smallest unit measured (a pixel) is the averaged value over an area of 79 meters by 56 meters. This is to say that even if we were able to enlarge the pictures, we could not get detailed information. Enclosed is a copy of a chart from Marjorie Rush's paper (which is not very definitive) that outlines scales she considers useful.

3. Color Infrared Aerial Photography (CIR) appears to be quite useful in determining area of inundation. This, of course, can be used in any camera from 35mm. up. Dr. Harlan recommended that we first acquire black-and-white LANDSAT bands 5 and 7, but we may need to go to aerial photographs.

4. Peru Study of Underwater Faults: Dr. Harlan says that LANDSAT is almost of no value, unless the water over the fault is 50 meters or less and the water is very clear. Microwave radar would be of no value. This seems to take us to either examination of land for extrapolation of what is happening at the fault, or Loren suggests seismic reflection.

I think we should procede with the proposal on the assumption that a) any imagery indicating drainage area would be helpful, and b) at a minimum the project would indicate limits in the use of the LANDSAT materials. (Limits is not something that is in the literature!)

I suspect that we may need to acquire further imagery from aerial photographs, and suggest that we expand the proposal to include such.

Loren has recommended two sources of low-level photography: Aeroservices Corporation and IGM (Instituto Geographico Militar) which is in La Paz, Bolivia. I am not sure what these sources may provide. I have contacted Aeroservices.

Just received a letter from Lincoln Young who was very supportive of our remote sensing study in India. A big encouragement! We are awaiting Texas A&M's response and information on some R.S. research projects in India which might have to do with the A.P. area.

EMR:jwp

- Allen thinks he may have found a source of funding for the India study - Christian Aid ($10,000) and Oxfam ($1,000). We are still waiting for final confirmation. No new date has been set for the seminar.
- We look forward to you getting back! Have a good time.

Ed

CONSELHO NACIONAL DE DESENVOLVIMENTO CIENTÍFICO E TECNOLOGICO
INSTITUTO DE PESQUISAS ESPACIAIS

avenida dos astronautas 1758
caixa postal 515
tel (0123) 21 8900 telex (011) 21534
12 200 S. J. CAMPOS S. PAULO
BRASIL

LANDSAT PRODUCTS / PRICE LIST

IMAGE SIZE	SCALE	FORMAT	BLACK & WHITE UNIT PRICE	COLOR COMPOSITE UNIT PRICE
59 x 73 mm	1:3.704.000	Film Positive	US$ 6.00	US$ N.A.
59 x 73 mm	1:3.704.000	Film Negative	8.00	N.A.
220 x 270 mm	1:1.000.000	Film Positive	10.00	15.00
220 x 270 mm	1:1.000.000	Paper	6.00	12.00
0.44 x 0.54 m	1:500.000	Paper	12.00	25.00
0.88 x 1.08 m	1:250.000	Paper	25.00	N.A.

COMPUTER COMPATIBLE TAPES (CCT)

TRACKS	bpi	FORMAT	SET PRICE
9	800	2 tapes (set)	US$ 200.00

February, 1978

Parada
Nelson de Jesus Parada
Director

```
                INSTITUTO DE PESQUISAS ESPACIAIS (INPE)
   DEPARTAMENTO DE PRODUCAO DE IMAGENS - BANCO DE IMAGENS TERRESTRES
  4/05/78 (1)   ORBITA BASE  360 (2)   WRS(PATH)  249 (3)     PAG  1
                    DATA DE PASSAGEM  24/09/77 (5)                (4)
                  LANDSAT  2 (6)    ORBITA-REAL  13607 (7)
                                                        RBV-QUALIDADE-MSS
IDENTIFICACAO LATITUDE    LONGITUDE    PT (ROW) CN   1 2 3     4 5 6 7 8

77267/130835  N 04/21/00  W 060/14/0(  09   57  80             8 8 8 8
77267/130900  N 02/54/00  W 060/33/0(  10   58  80             8 8 8 8
77267/130925  N 01/27/00  W 060/51/0(  11   59  80             8 8 8 8
     (8)                 (9)          (10) (11) (12)      (13)
```

1. Catalog release data.

2. Path number of this pass of the satellite in the Brazilian Reference System*.

3. Path number in the Worldwide Reference System*.

4. Page number within this pass of the satellite.

5. Date of this pass.

6. Serial number of the satellite.

7. Revolution number corresponding to this pass.

* See attached map.

8. Identification number. Example:

   77 - year of the pass
   267 - day of the year
   13 - UCT time of acquisition of this scene
   09 - minutes
   25 - seconds.

9. Scene center coordinates.

10. Row number for this scene, in the Brazilian Reference System*.

11. Row number in the Worldwide Reference System*.

12. Cloud cover percentage estimate for this scene.

13. Scene quality per band; 2 = poor, 5 = fair, 8 = good. A blank indicates an unprocessed band.

INSTITUTO DE PESQUISAS ESPACIAIS (INPE)

DEPARTAMENTO DE PRODUCAO DE IMAGENS - BANCO DE IMAGENS TERRESTRES

ATUALIZACAO DE CATALOGO EMITIDA EM 25/07/78

ITEM	ORBITA BASE	SAT	ORBITA REAL	NUM.PAG	OBSERVACOES
00001	360	L1	06133	01	
00002	360	L1	06133	01	
00003	360	L1	19687	01	
00004	360	L1	19938	01	
00005	360	L1	20440	01	
00006	360	L1	20942	01	
00007	360	L1	21193	01	
00008	360	L2	09089	01	
00009	360	L2	09340	01	
00010	360	L2	10595	01	
00011	360	L2	12101	01	
00012	360	L2	12352	01	
00013	360	L2	12603	01	
00014	360	L2	13105	01	
00015	360	L2	13607	01	
00016	360	L2	14109	01	

NCRED/PED 00001

* FIM *

INSTITUTO DE PESQUISAS ESPACIAIS (INPE)

DEPARTAMENTO DE PRODUCAO DE IMAGENS - BANCO DE IMAGENS TERRESTRES

25/07/78 ORBITA BASE 360 WRS(PATH) 249 PAG 1

DATA DE PASSAGEM 6/10/73

LANDSAT 1 ORBITA-REAL 06133

IDENTIFICACAO	LATITUDE	LONGITUDE	PT	(ROW)	CN	RBV-QUALIDADE 1	2	3	MSS 4	5	6	7	8
73279/135050	S 17/22/00	W 065/20/00	24	72	50				8	8	8	8	

* FIM *

OBS: ORDENE O CATALOGO POR ORBITA BASE E DATA DE PASSAGEM

INSTITUTO DE PESQUISAS ESPACIAIS (INPE)

DEPARTAMENTO DE PRODUCAO DE IMAGENS - BANCO DE IMAGENS TERRESTRES

25/07/78 ORBITA BASE 360 WRS(PATH) 249 PAG 1

DATA DE PASSAGEM 6/10/73

LANDSAT 1 ORBITA-REAL 06133

IDENTIFICACAO	LATITUDE	LONGITUDE	PT	(ROW)	CN	RBV-QUALIDADE-MSS 1 2 3	4 5 6 7 8
00440/135050	S 17/19/00	W 065/22/00	24	72	50		8 8 8 8

* FIM *

OBS: ORDENE O CATALOGO POR ORBITA BASE E DATA DE PASSAGEM

INSTITUTO DE PESQUISAS ESPACIAIS (INPE)

DEPARTAMENTO DE PRODUCAO DE IMAGENS - BANCO DE IMAGENS TERRESTRES

25/07/78 ORBITA BASE 360 WRS(PATH) 249 PAG 1

DATA DE PASSAGEM 4/06/76

LANDSAT 1 ORBITA-REAL 19687

IDENTIFICACAO	LATITUDE	LONGITUDE	PT	(ROW)	CN	RBV-QUALIDADE-MSS 1 2 3	4 5 6 7 8
76156/130800	S 17/17/00	W 065/24/00	24	72	30		8 8 8 8

* FIM *

OBS: ORDENE O CATALOGO POR ORBITA BASE E DATA DE PASSAGEM

INSTITUTO DE PESQUISAS ESPACIAIS (INPE)

DEPARTAMENTO DE PRODUCAO DE IMAGENS - BANCO DE IMAGENS TERRESTRES

25/07/78 ORBITA BASE 360 WRS(PATH) 249 PAG 1

DATA DE PASSAGEM 22/06/76

LANDSAT 1 ORBITA-REAL 19938

IDENTIFICACAO	LATITUDE	LONGITUDE	PT (ROW)	CN	RBV-QUALIDADE-MSS 1 2 3	4 5 6 7 8
76174/130641	S 17/18/00	W 065/26/00	24 72	40		8 8 8 8

* FIM *

OBS: ORDENE O CATALOGO POR ORBITA BASE E DATA DE PASSAGEM

INSTITUTO DE PESQUISAS ESPACIAIS (INPE)

DEPARTAMENTO DE PRODUCAO DE IMAGENS - BANCO DE IMAGENS TERRESTRES

25/07/78 ORBITA BASE 360 WRS(PATH) 249 PAG 1

DATA DE PASSAGEM 28/07/76

LANDSAT 1 ORBITA-REAL 20440

IDENTIFICACAO	LATITUDE	LONGITUDE	PT	(ROW)	CN	RBV-QUALIDADE-MSS 1 2 3	4 5 6 7 8
76210/130345	S 17/20/00	W 065/22/00	24	72	40		8 5 8 8

* FIM *

OBS: ORDENE O CATALOGO POR ORBITA BASE E DATA DE PASSAGEM

INSTITUTO DE PESQUISAS ESPACIAIS (INPE)

DEPARTAMENTO DE PRODUCAO DE IMAGENS - BANCO DE IMAGENS TERRESTRES

25/07/78 ORBITA BASE 360 WRS(PATH) 249 PAG 1

DATA DE PASSAGEM 2/09/76

LANDSAT 1 ORBITA-REAL 20942

IDENTIFICACAO	LATITUDE	LONGITUDE	PT	(ROW)	CN	RBV-QUALIDADE-MSS 1 2 3	4 5 6 7 8
76246/130046	S 17/21/00	W 065/22/00	24	72	30		5 5 8 5

* FIM *

OBS: ORDENE O CATALOGO POR ORBITA BASE E DATA DE PASSAGEM

INSTITUTO DE PESQUISAS ESPACIAIS (INPE)

DEPARTAMENTO DE PRODUCAO DE IMAGENS - BANCO DE IMAGENS TERRESTRES

25/07/78 ORBITA BASE 360 WRS(PATH) 249 PAG 1

DATA DE PASSAGEM 20/09/76

LANDSAT 1 ORBITA-REAL 21193

IDENTIFICACAO	LATITUDE	LONGITUDE	PT (ROW)	CN	RBV-QUALIDADE-MSS 1	2	3	4	5	6	7	8
76264/125916	S 17/16/00	W 065/19/00	24 72	40				8	8	8	8	

* FIM *

OBS: ORDENE O CATALOGO POR ORBITA BASE E DATA DE PASSAGEM

INSTITUTO DE PESQUISAS ESPACIAIS (INPE)

DEPARTAMENTO DE PRODUCAO DE IMAGENS - BANCO DE IMAGENS TERRESTRES

25/07/78 ORBITA BASE 360 WRS(PATH) 249 PAG 1

DATA DE PASSAGEM 4/11/76

LANDSAT 2 ORBITA-REAL 09089

IDENTIFICACAO	LATITUDE	LONGITUDE	PT	(ROW)	CN	RBV-QUALIDADE-MSS 1	2	3	4	5	6	7	8
76309/133022	S 17/16/00	W 065/19/00	24	72	50				8	8	8	8	

* FIM *

OBS: ORDENE O CATALOGO POR ORBITA BASE E DATA DE PASSAGEM

INSTITUTO DE PESQUISAS ESPACIAIS (INPE)

DEPARTAMENTO DE PRODUCAO DE IMAGENS - BANCO DE IMAGENS TERRESTRES

25/07/78 ORBITA BASE 360 WRS(PATH) 249 PAG 1

DATA DE PASSAGEM 22/11/76

LANDSAT 2 ORBITA-REAL 09340

IDENTIFICACAO	LATITUDE	LONGITUDE	PT	(ROW)	CN	RBV-QUALIDADE 1	2	3	MSS 4	5	6	7	8
76327/132938	S 17/20/00	W 065/19/00	24	72	30				8	8	8	8	

* FIM *

OBS: ORDENE O CATALOGO POR ORBITA BASE E DATA DE PASSAGEM

INSTITUTO DE PESQUISAS ESPACIAIS (INPE)

DEPARTAMENTO DE PRODUCAO DE IMAGENS - BANCO DE IMAGENS TERRESTRES

25/07/78 ORBITA BASE 360 WRS(PATH) 249 PAG 1

DATA DE PASSAGEM 20/02/77

LANDSAT 2 ORBITA-REAL 10595

IDENTIFICACAO	LATITUDE	LONGITUDE	PT	(ROW)	CN	RBV-QUALIDADE 1	2	3	MSS 4	5	6	7	8
77051/132604	S 17/14/00	W 065/20/00	24	72	50				8	8	8	8	

* FIM *

OBS: ORDENE O CATALOGO POR ORBITA BASE E DATA DE PASSAGEM

INSTITUTO DE PESQUISAS ESPACIAIS (INPE)

DEPARTAMENTO DE PRODUCAO DE IMAGENS - BANCO DE IMAGENS TERRESTRES

25/07/78   ORBITA BASE 360   WRS(PATH) 249   PAG 1

DATA DE PASSAGEM 8/06/77

LANDSAT 2   ORBITA-REAL 12101

IDENTIFICACAO	LATITUDE	LONGITUDE	PT	(ROW)	CN	RBV-QUALIDADE-MSS 1 2 3	4 5 6 7 8
77159/132039	S 17/17/00	W 065/12/00	24	72	40		8 8 8 8

* FIM *

OBS: ORDENE O CATALOGO POR ORBITA BASE E DATA DE PASSAGEM

INSTITUTO DE PESQUISAS ESPACIAIS (INPE)

DEPARTAMENTO DE PRODUCAO DE IMAGENS - BANCO DE IMAGENS TERRESTRES

25/07/78 ORBITA BASE 360 WRS(PATH) 249 PAG 1

DATA DE PASSAGEM 26/06/77

LANDSAT 2 ORBITA-REAL 12352

IDENTIFICACAO	LATITUDE	LONGITUDE	PT	(ROW)	CN	RBV-QUALIDADE-MSS 1	2	3	4	5	6	7	8
77177/131946	S 17/16/00	W 065/09/00	24	72	30					8	8	8	8

* FIM *

OBS: ORDENE O CATALOGO POR ORBITA BASE E DATA DE PASSAGEM

INSTITUTO DE PESQUISAS ESPACIAIS (INPE)

DEPARTAMENTO DE PRODUCAO DE IMAGENS - BANCO DE IMAGENS TERRESTRES

25/07/78 ORBITA BASE 360 WRS(PATH) 249 PAG 1

DATA DE PASSAGEM 14/07/77

LANDSAT 2 ORBITA-REAL 12603

IDENTIFICACAO	LATITUDE	LONGITUDE	PT	(ROW)	CN	RBV-QUALIDADE 1 2 3	MSS 4 5 6 7 8
77195/131853	S 17/17/00	W 065/10/00	24	72	30		8 8 8 8

* FIM *

OBS: ORDENE O CATALOGO POR ORBITA BASE E DATA DE PASSAGEM

INSTITUTO DE PESQUISAS ESPACIAIS (INPE)

DEPARTAMENTO DE PRODUCAO DE IMAGENS - BANCO DE IMAGENS TERRESTRES

25/07/78 ORBITA BASE 360 WRS(PATH) 249 PAG 1

DATA DE PASSAGEM 19/08/77

LANDSAT 2 ORBITA-REAL 13105

IDENTIFICACAO	LATITUDE	LONGITUDE	PT	(ROW)	CN	RBV-QUALIDADE 1	2	3	MSS 4	5	6	7	8
77231/131655	S 17/20/00	W 065/09/00	24	72	40				8	8	8	8	

* FIM *

OBS: ORDENE O CATALOGO POR ORBITA BASE E DATA DE PASSAGEM

INSTITUTO DE PESQUISAS ESPACIAIS (INPE)

DEPARTAMENTO DE PRODUCAO DE IMAGENS - BANCO DE IMAGENS TERRESTRES

25/07/78 ORBITA BASE 360 WRS(PATH) 249 PAG 1

DATA DE PASSAGEM 24/09/77

LANDSAT 2 ORBITA-REAL 13607

IDENTIFICACAO	LATITUDE	LONGITUDE	PT	(ROW)	CN	RBV-QUALIDADE 1 2 3	MSS 4 5 6 7 8
77267/131450	S 17/20/00	W 065/12/00	24	72	50		8 8 8 8

* FIM *

OBS: ORDENE O CATALOGO POR ORBITA BASE E DATA DE PASSAGEM

INSTITUTO DE PESQUISAS ESPACIAIS (INPE)

DEPARTAMENTO DE PRODUCAO DE IMAGENS - BANCO DE IMAGENS TERRESTRES

25/07/78 ORBITA BASE 360 WRS(PATH) 249 PAG 1

DATA DE PASSAGEM 30/10/77

LANDSAT 2 ORBITA-REAL 14109

IDENTIFICACAO	LATITUDE	LONGITUDE	PT	(ROW)	CN	RBV-QUALIDADE 1	2	3	MSS 4	5	6	7	8
77303/131251	S 17/19/00	W 065/14/00	24	72	20				8	8	8	8	

* FIM *

OBS: ORDENE O CATALOGO POR ORBITA BASE E DATA DE PASSAGEM

Hydro. Data

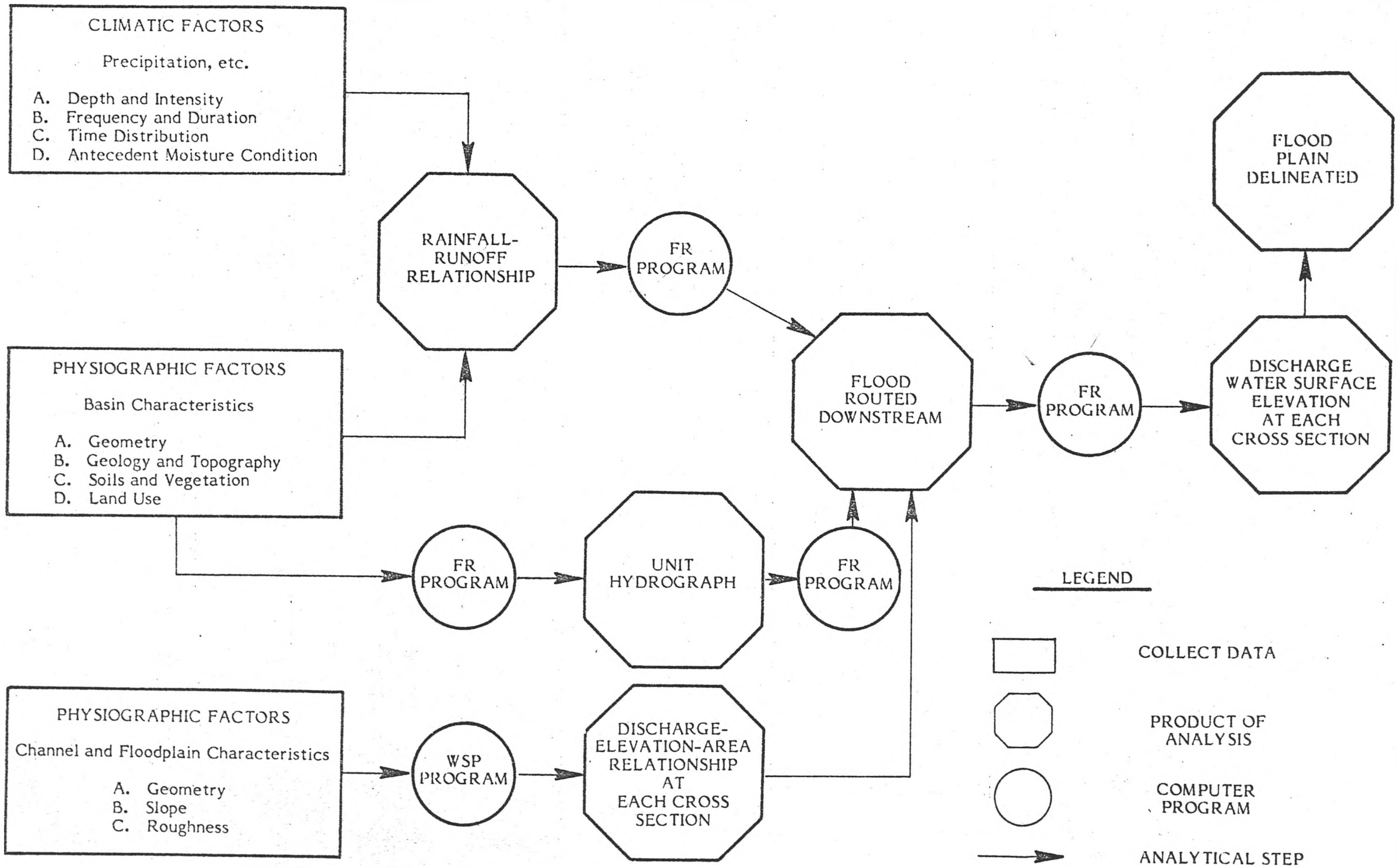


FIGURE I-1

PROCESS OF FLOOD-PLAIN DELINEATION

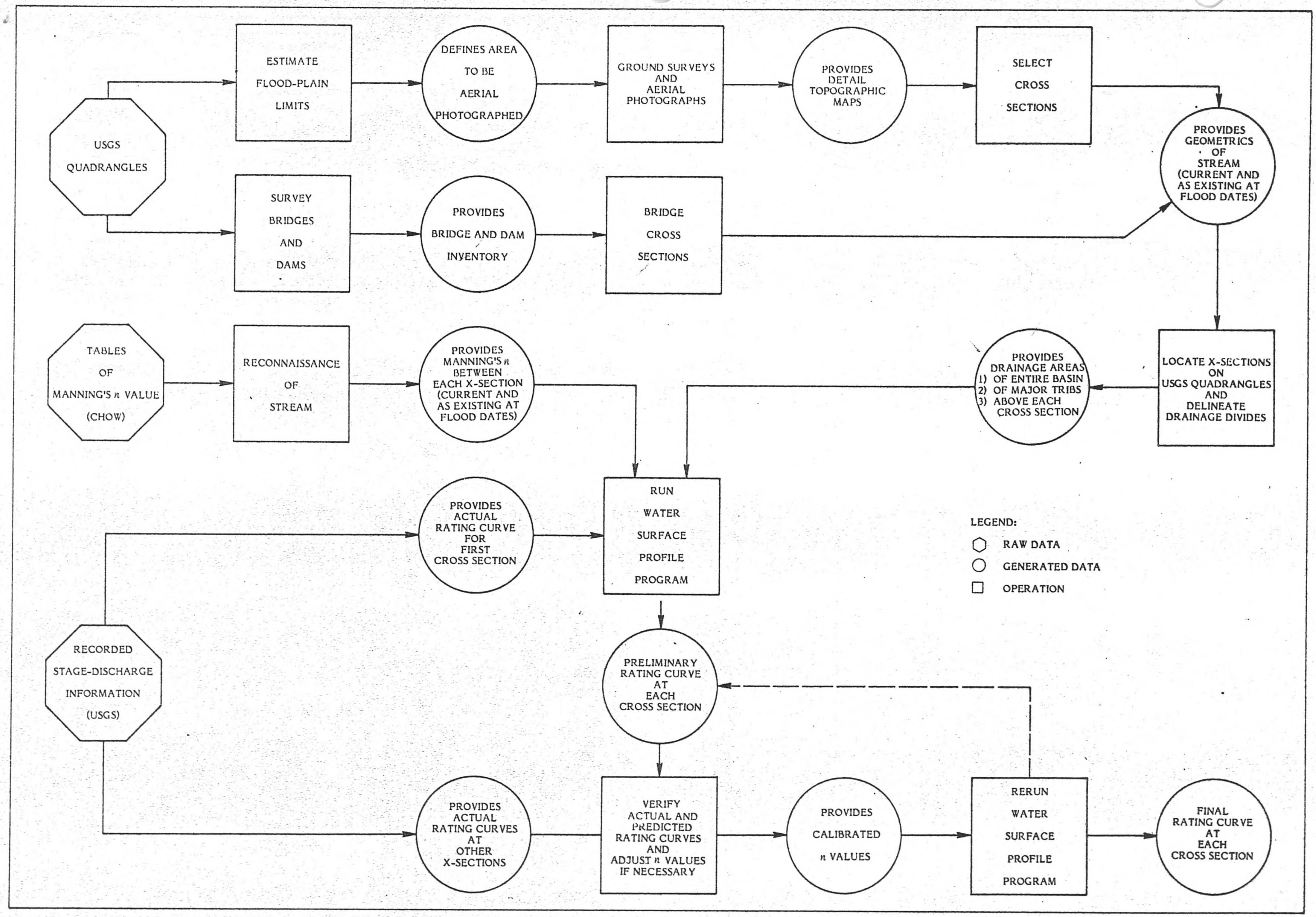


FIGURE V-1
Use of the Water Surface Profile Program

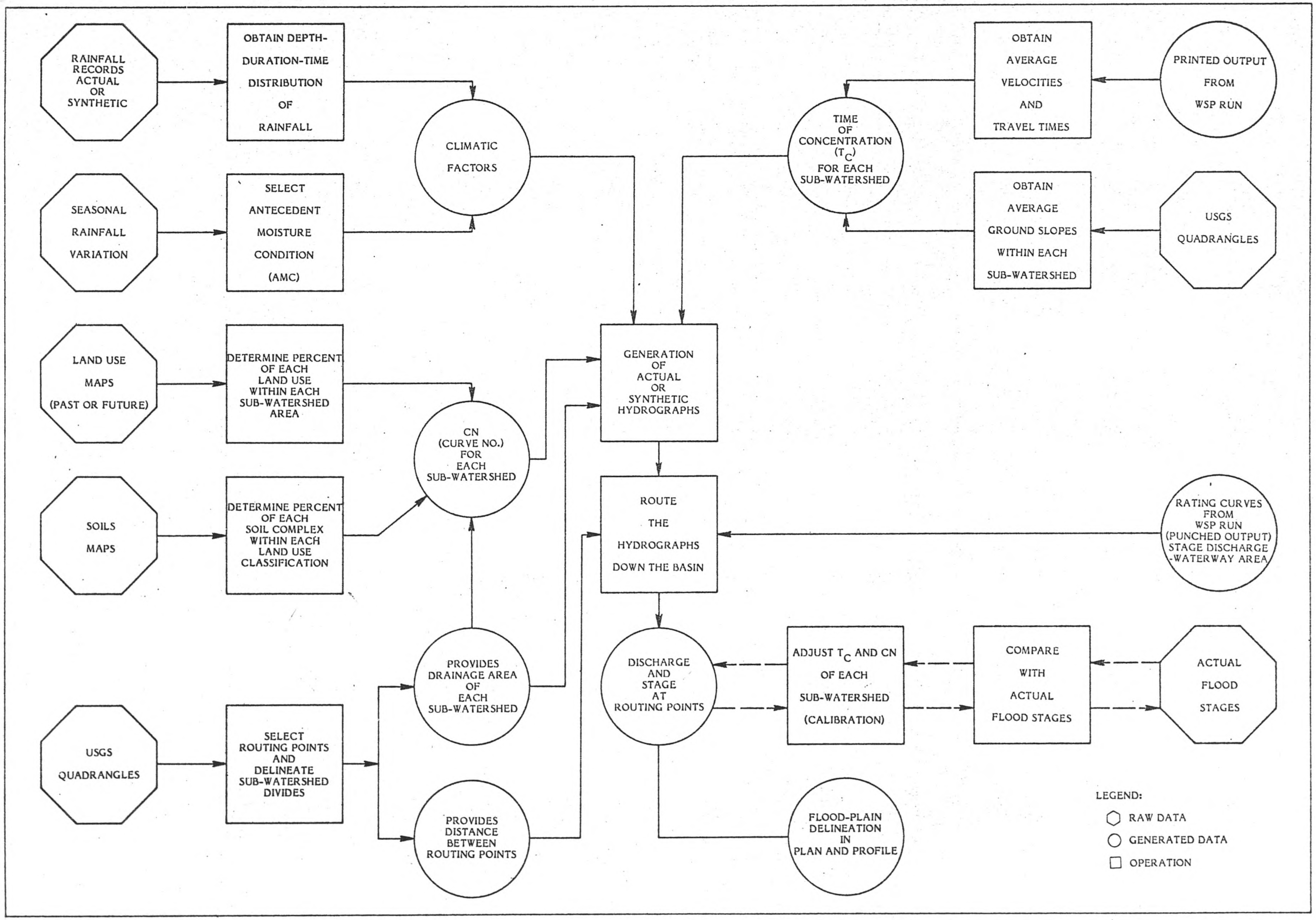


FIGURE V-2
Use of the Flood Routing Program

CHAPTER 8

FLOOD CONTROL

The purpose of the present chapter is to explain how various devices may be employed in order to control an excess flow of water so that a flood may be prevented or, at least, its worst effects reduced. These devices include engineering works, embankments, detention reservoirs, the adaptation of river channels and facilities for flood diversion. The possibility of storm surges further complicates the problem of flood control.

Engineering works

Over the years, in many parts of the world, different types of engineering work have been developed to protect man and his property from floods. These works can be placed in two categories – those controlling water in the river-channel phase and those controlling it in the land phase.

There are various ways of effecting control in the river-channel phase. Land can be protected from inundation by embankments and river channels can be straightened, widened or deepened to lower flood levels by creating more efficient flow conditions. Excess water in the main river channels can be diverted into by-passes and diversion channels. Natural or man-made reservoirs can be used to hold back excess water temporarily from the river, the stored water being released later at such rates and times that it can be carried safely by the river. Pumping stations can be installed to dispose of water from the protected areas behind an embankment.

In the land phase, control can to some extent be exerted by proper management of the upstream areas of the watershed and by reafforestation and soil conservation to reduce the rate of runoff and sedimentation.

Usually the construction of embankments and the associated works results in a general increase in flood stages along a river unless reservoirs are constructed or extensive channel improvement takes place. Upstream local protective measures, such as levee construction and channel improvement, may increase the magnitude of floods at points downstream. These measures, as well as reservoir construction, should therefore be looked upon as part of the flood-control works within an overall water-resources development programme for the whole river basin. They must be planned and executed with care so that the benefits at one place are not offset by increased damage elsewhere. The type of structure used should be carefully selected to offer the maximum protection at the minimum cost. Funds for maintenance and repair must also be provided to ensure that the structures function efficiently when brought into use.

It should also be recognized that failure or collapse of flood protection structures can frequently be caused by major floods or through rubbish being jammed against a bridge and causing an unexpectedly high stage or, sometimes, because of the occurrence of floods greater than the design flood. Another risk of a different kind is that the construction of engineering works tends to give a false sense of security to people living in the protected area. It is therefore essential that these flood-control measures should be accompanied by the other measures necessary, such as land-use control, building codes, etc., in a comprehensive approach to the effective protection of life and property.

Embankments

Embankments (also called dikes, levees or bunds) on alluvial plains and in river deltas were originally constructed by groups of villagers and farmers seeking to defend their small holdings. They could be built at low cost with labour and materials available along the river. Earthen embankments are one of the oldest and most widely used measures to protect land from flood waters. In the lower reaches of large rivers, embankments are the only feasible method of preventing inundation and are, perhaps, the cheapest structural protection against floods. Old dikes have been raised and strengthened and new dikes have been constructed over the years. It is reported that, in India,* the total length of embankment constructed before 1947 was 5300 km and that about 7000 km was constructed between 1954 and 1969. A major portion of this length, about 3000 km, was constructed on the Brahmaputra River. Along the Kosi River, a total length of 240 km was completely embanked during the period 1953-1959.

Water that would normally drain freely across the flood plain into the river will accumulate behind the embankments. It is accordingly necessary to have an adequate system to drain this water into the river through sluice gates and pumping stations. Drainage and sewerage from urban areas may require pumping during high flood stages. Tributaries joining the main river in an embanked reach must be given special attention as floods in the main river will back up the tributaries and, to offset this effect, backwater embankments may be necessary.

Normally no flood-control structures or embankments are designed and constructed to afford complete protection against infrequent and extraordinary floods, as the cost of such works would exceed the economically justified benefits. Projects for the control of floods in urban or built-up areas should, however, provide a higher degree of protection than for rural or agricultural areas.

In India, for example, embankments in agricultural areas are designed in general to protect against a 25-year flood frequency, whereas those protecting important urban areas are against 50-year floods. In Japan, the long-term flood-control programme specifies that projects for the major 108 rivers should be undertaken to give protection against floods which have a probability of occurrence of once in 100 years, in certain cases once in 200 years; projects for urban and other rivers give protection against once-in-50-year floods but, in special cases, against floods having a frequency of once in a hundred years.

In most cases the criteria for the design of embankments are based on the maximum recorded flood. As more hydrological data become available for longer periods, and as past maximum floods are replaced by new and larger floods, the planning and design criteria are changed accordingly. In the initial stage in India, the crest width of embankments was generally 3 m but it has now been increased to 5 m. Free-board was 1-1.5 m above the observed high flood level. Side slopes were 2:1 on the river side and 3:1 on the country side. In Japan, a crest width of 5-7.5 m is employed and free-board is 1.5-2 m in general.

Erosion along the embankment and natural banks is one of the serious problems that must be resolved in flood-control and river-improvement works. Over the years, numerous methods have been tried in many countries to prevent bank erosion along river courses, for example, in the Brahmaputra River and the Yellow River. Revetments, spurdikes and groins vary considerably and it is clear that each river should to some extent be regarded as a separate problem.

Channel cross-sections and longitudinal bed profiles can be determined by making assumptions based upon measurements of the flow discharge and sediment transportation. The long-term variation of the river behaviour should be taken into account when planning anti-erosion and flood-control works. Thereafter river behaviour should be monitored so that if any need for additional works arises, it will be recognized in good time.

Storm-surge protection

Coastal embankments susceptible to storm surges should be designed specifically to withstand the expected storm-surge water heights and forces, the combined action of wind and waves, and overtopping from the storm-surge water. Furthermore, coastal embankment projects in deltaic areas should be planned in conjunction with other development projects such as highways, harbour and reclamation projects in order to avoid duplication of investment costs.

---

*J. P. Maegamvala and R. B. Shah, "Review of river training measures in India". *Report of Eighth Congress on Irrigation and Drainage, 1972.*

Many reservoirs, even if properly maintained through watershed management and erosion control work, gradually fill with sediment which reduces the storage capacity and affects the behaviour of the lower part of the river. Despite their physical, economic and social limitations, many dams and flood-control reservoirs have been constructed and will be constructed in the future because water stored during the rainy season can be used effectively in the dry season to meet many water-use purposes.

The swamps and lakes often found in alluvial areas can be used as flood-retarding basins and can thus serve a purpose similar to that of flood-control reservoirs. As the depth available for water storage is normally no more than a few feet, the area of the basin needs to be large if this method is to contribute greatly to flood prevention. Out of the flood season the land can be used for cultivation and recreational purposes or, sometimes, to store water that can later be fed into the normal water supply system.

River-channel improvement and flood diversion

River-channel improvement by clearing, straightening, widening and deepening can be undertaken to decrease the length of the river and to improve its conveyance ability. Work to increase the effective slope of the channel or to reduce bed and bank friction by the elimination of bars, smoothing bank contours, the enlargement of the natural channel by dredging, and the removal of obstructions or bends are all beneficial in increasing the velocity of the river flow and, consequently, in lowering the flood stage.

Diversion floodways provide a means for the escape of flood water in excess of the carrying capacity of the main channels into emergency or auxiliary channels. They can be used to control unusual floods around cities in the lower reaches of a river near the sea. Diversion of excess water from one river to another is practicable only if the flood flow can be safely conveyed into the second river. In deltaic areas it may also be possible to divert flood waters directly into the sea.

As with embankments, proposals for channel improvement and flood diversion should be considered as part of a flood-control programme for the whole river and so planned and effected that the benefits at one point are not offset by increased damage elsewhere.

Watershed management

Proper watershed management reduces flood damage on small streams during minor floods by affording some degree of control over water in the land phase of the runoff cycle. Watershed management measures can be grouped broadly under two headings. The first is concerned with improvement of the vegetation mantle in crops, grasslands and forests and includes such measures as suitable rotation of crops, grass cultivation, tree planting and reafforestation. The effect of these measures is to increase the water infiltration capacity of the soil.

The second heading includes engineering works such as terracing, contour bunding, contour cultivation and cropping, gully plugging, sediment check dams, outlet structures, spurs, groynes and similar works to prevent hillside erosion and landslides, and to reduce the sediment load in streams.

Landslides in mountainous areas, or landslips on steep hillsides, can be the cause of heavy loss of life and tremendous damage to property during periods of heavy rainfall. A recent example was the loss of more than 80 lives in the Hong Kong landslips of June 1972.

The threat of landslides can be controlled by soil removal, surface and underground drainage, the interception of groundwater, the use of piles, and retaining walls. These counter-measures call not only for direct expenditure in civil engineering works but may also, in some cases, require the purchase of land or the denial of its use for other purposes.

CHAPTER 12

FLOOD FIGHTING

From ancient times, villagers and farmers living in river deltas have acquired considerable experience developing voluntary efforts to defend their lives, crops and property against frequent flooding. Whenever flood or storm surge threatened, groups of flood fighters have sprung to the defence of their villages and have done what they could to minimize loss and damage. Although flood fighting has traditionally been thought of as a local, self-help responsibility, it has long been realized that when a flood constitutes a threat to a number of neighbouring communities, co-ordinated action under unified control is much more effective than independent action by each community.

Flood fighting can be defined as the taking of precautionary measures against disaster at times of flood and storm surge. These measures should aim to prevent damage or to minimize its extent, to protect life, limb and property and, in general, to ensure the safety of the population. Successful flood fighting and the attainment of the above goals depend upon good organization, thorough advance planning, well-trained personnel and the effective co-ordination of operations at local, provincial and national levels.

Flood-fighting corps

Legislation for disaster preparedness should provide for a flood-fighting corps in each vulnerable town or village with responsibility for the planning and conduct of flood-fighting operations. Each corps should consist of a small full-time cadre and a much larger part-time staff. In Japan, where flood fighting is highly developed, there were in 1973 some 3000 flood-fighting organizations with a total of 20000 full-time personnel and more than one million part-time staff.

Before the flood season, each flood-fighting corps should conduct field exercises and practical demonstrations of flood-fighting methods, including trials of evacuation and rescue operations. Arrangements should be made for additional manpower to be made available when necessary, both from within the local area of the flood-fighting corps and from neighbouring towns and villages. This additional help may be required when, for example, there is a risk of a dike being breached by flood or storm-surge waters. At such a time the local flood-fighting corps may be unable to ensure the protection of the area with its own resources. Furthermore, the public should be trained and educated to co-operate actively with the flood-fighting corps during emergency operations because under such conditions it may be necessary to mobilize the services of all available inhabitants.

Those participating in flood-fighting operations should be adequately insured because of the significant risk of death or serious injury.

Advance planning of flood-fighting operations

For flood fighting to be successful, careful advance planning of all aspects of the operations is necessary. The planning should cover all those who will be involved from the flood-fighting corps, municipality, town or village officers and general public to the regional and central government.

As a first step, responsibilities should be defined. Usually, the central government will give advice and provide financial assistance to regional governments and to local flood-fighting organizations. At the regional level, the authorities may co-ordinate and assist emergency operations carried out by the local flood-fighting corps. When necessary the public works department of the central and regional governments should furnish the heavy equipment required for the construction of emergency dikes. At the community level, the city, town or village authorities which control the flood-fighting corps will be responsible for carrying out the actual emergency operation. If it is considered to be more suitable, several towns or villages may group themselves together in establishing a jointly managed flood-fighting organization for the total area covered by those towns or villages.

Advance planning for flood-fighting operations should cover the following points:

(*a*) Areas of responsibility, organizational system and duties;

(*b*) Patrols and watches along dikes and embankments;

(*c*) Communication and transportation facilities;

(*d*) Procedures for the operation of dams, sluices and lockgates;

(*e*) Warnings for flood-fighting operations;

(*f*) Mobilization of flood-fighting corps;

(*g*) Co-operation with other flood-fighting organizations and arrangements for mutual assistance;

(*h*) Supplies and the stocking of depots with tools, equipment and other material needed for flood-fighting operations.

The Imba-Tone River Flood Defence Association in Chiba Prefecture, Japan, provides a good illustration of how flood fighting can be organized at the local level. As shown in Figure 13, it consists of three cities and seven towns along the right bank of the lower Tone River which have joined together for the purposes of flood-fighting operations. When serious flooding is expected, more than four thousand members of the flood-fighting corps are mobilized. A headquarters, four branches and ten depots for flood-fighting operations are established under the operational plan which has been drawn up to protect some 11 km of embankment.

Equipment and material for flood-fighting operations

A combination of sufficient trained manpower, adequate stocks of well laid-out material, telecommunication equipment, construction machinery and vehicles for transport are necessary for effective flood-fighting operations. All the above equipment and material should be carefully inspected each year before the rainy season begins. It is also desirable that the flood-fighting corps should be equipped with walkie-talkies for ease of communication. Vehicles should be equipped with sirens to be used for warning and other specified purposes. Warehouses or depots should be set up in protected areas along the river embankment so that tools such as pickaxes and shovels, sandbags, lumber, ropes and wire are readily available for emergency use.

In providing these supplies it is desirable to prescribe the quantities of each item that will be required in a given area. In making this decision the particular river conditions, extent of embankment, experience gained through past disasters in the area, and the number of people in the flood-defence force should all be taken into account. Table IV shows the quantities recommended by the Ministry of Construction in Japan for a depot in an important levee protection area.

Flood-fighting warnings

On the issue of a tropical cyclone warning, each town and village in areas concerned should place its flood-fighting corps on stand-by alert. If and when a flood warning is issued, the flood-fighting corps should be mobilized at a state of full alert. Table V on page 71 illustrates how various stages of alert can be applied to the monitored water-level at a designated point along the river.

TABLE IV

Standard of supplies to be stored in a levee protection depot in an important levee protection area

Item	*Quantity*	*Item*	*Quantity*	*Item*	*Quantity*
Straw bags or empty rice bags	600	Shovels	30	Bonfire stands	8
Rope	550 kg	Mauls	10	Large lights	3
Straw mats	100	Saws	4	Large paper lanterns	2
Cedar logs of end diameter 9 cm, length 5.1 m	10	Sickles	10	Candles	1 kg
Cedar logs of end diameter 9 cm, length 3.6 m	30	Axes	5	Carbide	50 kg
Cedar logs of end diameter 9 cm, length 1.8 m	200	Cutting pliers	3	Firewood	400 kg
Bamboo	15	Hand rammors	8	Torchwood (pine)	200 kg
Bamboo baskets	20	Steel wire No. 8	100 kg	Straw baskets	50
		Steel wire No. 10	100 kg	Poles for shouldering	50
		Clamps	50	Scaffolding planks	2
		Ladder	1	Cobble	Some
		Bucket	1	Reserve soil	Some

Note. – Ten depots of this type are provided along 11 km of levee of the Imba-Tone River Flood Defence Association (as shown in Figure 13).

TABLE V

Nature and stages of flood-fighting warnings

Stage	*Nature of alert*	*Action involved*	*Time of announcement*
1	Stand-by	Placing of members of the flood-fighting corps on stand-by	Coincides with issue of tropical cyclone warning
2	Preparation	Inspection of major material and equipment for flood fighting, preparations for opening and closing of weirs and gates, mobilization of senior members	When the specified water-level is reached
3	Mobilization	Mobilization of members of the flood-fighting corps	On issue of flood warning and/or when the warning water-level is reached
4	Dismissal	Termination of flood-fighting activities	When the water-level is observed to decrease from the warning level and there is no necessity for further flood-fighting activities
From time to time	Water-level	To announce water-level conditions such as rise and fall of water-level, period of time at given level, magnitude and time of occurrence of maximum water-level, etc., which are deemed necessary for flood-fighting activities	From time to time, the observed and predicted water-levels on both rise and fall are announced

Threshold and warning levels for each gauging station should be specified in the flood-fighting plan and advance notice sent to the local flood-fighting organizations. In order that the water-resources agency may decide when a flood-fighting warning shall be issued, the water-levels at gauging stations along rivers and sea coasts should be reported (*g*) *Flood-fighting signals*

A system of flood-fighting signals should be devised and set up to alert members of the flood-fighting corps to mobilize and to warn the general public of the need to evacuate danger areas. The system used in Japan and the meaning of the signals is shown in Figure 23. When flooding becomes so severe that neither the flood-control structures nor the flood-fighting operations can stem the threat of disaster, the only course of action is the immediate evacuation of the population to safety. Signal No. 4 provides for this contingency but the inhabitants must be alerted when Signal No. 1 is issued so that they are standing by to assist the flood-fighting corps and are prepared to evacuate if circumstances demand it.

In each country careful thought should be given to those additional dispositions of an emergency nature which may be needed in order to meet specific local conditions.

Division	Alarm bell signal	Siren signal	Significance of signal
Signal 1	○ stop ○ stop ○	o——— stop o——— = 5 sec. = 15 sec. = 5 sec.	The water level has reached the warning level.
Signal 2	○-○-○ ○-○-○	o——— stop o——— = 5 sec. = 6 sec. = 5 sec.	All members of the flood fighting corps to mobilize.
Signal 3	○-○-○-○ ○-○-○-○	o——— stop o——— = 10 sec. = 5 sec. = 10 sec.	The general population of the area to be mobilized.
Signal 4	Continuous	o——— stop o——— = 1 min. = 5 sec. = 1 min.	All inhabitants in the area to leave in accordance with the evacuation arrangements

Figure 23 – Flood-fighting signals used in Japan

(*h*) *Emergency operation of reservoirs*

In addition to emergency flood fighting along river levees and coastal dikes in the downstream area, the emergency operation of reservoirs upstream must be effectively co-ordinated so that release of water from reservoirs and ponds does not cause any unexpected flooding downstream. The rules for operating reservoirs during floods should specify that outflow from the reservoir should not exceed the inflow from upstream and that there should not be

APPENDIX

PROPOSED LIST OF ITEMS OF INFORMATION TO BE SOUGHT IN A DISASTER SURVEY AND ASSESSMENT

Kind of disaster .... Highest wind velocity ....

Date .... and hour .... of occurrence

*Localities affected .... Names of cities, towns, villages ....

For floods: depth of water in homes and buildings ....

Number of persons affected ....

Number of persons killed ....

Number of persons injured ....

Number of persons homeless ....

Number of persons evacuated and where to ....

Number of dwellings destroyed ....

Number of dwellings damaged and needing repair ....

Number of commercial buildings destroyed ....

Number of commercial buildings damaged and needing repair ....

Institutions destroyed or damaged ....
(indicate whether schools, hospitals, places of worship, etc.)

Livestock losses: number and kind ....

Agriculture losses: kind and number of hectares ....

Conditions of streets and highways and airports ....

Conditions of utilities ....

Conditions of water supply ....

Conditions of communications ....

*A separate survey should be made for each locality and consolidated for the national survey.

Number of persons (families) needing shelter ....

Number of persons needing food ....

Number of persons needing medical care ....

Kind and quantity of supplies, personnel and/or equipment in the disaster area(s)...

....

(It is necessary to be very specific. For example, if food is needed the kind of food and quantity must be specified. Medical supplies must be requested by a responsible physician or public health officer, keeping in mind that disasters do *not* cause epidemics, etc.)

Availability of manpower in disaster area ....

Availability of storage space in disaster area ....

Weather conditions in disaster area ....

Names of responsible local officials ....

Names of organizations working in disaster area ....

Location of local disaster-control centre ....

Name of person(s) making survey ....

Sources of information ....

Bolivia File 8/28/78

Transcription of tape from Ed Ruddell

I apologize for the fact that it has been two weeks since I talked to you on the phone, and I still haven't gotten this information transcribed about the costs of building roads in the Chapare area of Bolivia. In order to avoid any further delay, I will proceed to translate this immediately.

________________ Hinajosa reports in his letter of June 15, 1978, that the previous floods occurred on February 3, 1973; March 14, 1976; and January 2, 1977.

The cost of road building equipment for that area is as follows: A D-6 costs $31.00/hour to rent. They estimate that it will move 12 cubic meters per hour. A loader costs $23/hour, and they estimate that it will move ~~8~~ 90 cubic meters per hour, depending upon the number of trucks ready to receive and move the dirt. It costs $1.05 per cubic meter to transport dirt the first five kilometers. After that, you must increase the cost $.25 for each kilometer the dirt is moved. A 12-ton compactor costs $15/hour. A tanker with a 6,000 liter capacity costs $22/hour. They estimate 140 meters of water are required for each cubic meter.

I believe that is all, Fred. I wanted to mention that last night Pilar showed me an article in Newsweek which discussed the cost of disasters. At the conclusion, INTERTECT was mentioned. We were glad to see you are getting favorable publicity and to know that there is a new international agency ~~wich~~ which is attempting to evaluate relief efforts around the world.

Let us hear from you soon. So far, no news of the next child. Best wishes.

Ed Ruddell