REMOTE SENSING UTILITY IN A DISASTER STRUCK URBAN ENVIRONMENT

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A. STATEMENT OF GOALS AND OBJECTIVES

1. Remote Sensing and Public Health. The general purpose of this research is to explore and present ways that a new technology—remote sensing—can contribute to solutions of urban public health problems in time of natural disaster. The objectives of this project are to determine and describe remote sensing standard operating procedures for public health assistance during disaster relief operations which will aid the agencies and organizations involved in disaster intervention. We plan to test the validity of this technology by applying it in a post-disaster situation (if such a disaster occurs in our space and time frame) and comparing it, where possible, to existing methods of gathering information. The important variable here is time since existing methods do eventually accumulate necessary data. This research is analogous to a therapeutic trial in that we are testing one "vaccine"—remote sensing—against other "vaccines"—existing approaches.

2. Disasters and Public Health. Disasters interrupt systems necessary to maintain the public health. It is necessary not only to reestablish all the interrupted systems on which the protection of health of a community relies; but, to manage the potential and real public health problem during the period of reestablishment. The activities involved in doing this may seem from one perspective to have no relation to health, but from another perspective they are the underpinnings on which the health of a community depends. Two
points need to be made clear: (1) Public health activities are broad-spectrum, that is, they are carried out on a societal as well as on an individual level, and (2) the emphasis in public health is on prevention, not cure. Medical care per se or effective treatment of illness, it has been argued, "has little, if any, effect on the health of a community" (Stallones, 1972). In fact, for some diseases successful treatment may even increase the burden of illness in the community. From a community health perspective, medical care or treatment of illness "represents the failures of community health" (Stallones).

When we consider prevention in relation to natural disasters we do not mean to imply prevention of the event since with most types of natural disaster this is not yet possible. This research emphasizes a preventive approach to the effects of disasters and specifically to post-disaster problems that relate to public health concerns during the emergency phase of relief. It is generally agreed upon that there are three phases of relief activities following a disaster. The first is the emergency phase during which persons impacted by the disaster are rescued and first aid and other medical care are administered. This phase is followed by the recovery period during which time residents of the community assess their situation and work toward reestablishing a stable way of life. Public health concerns at this time may revolve around treatment of illness which might have occurred as either a result of the disaster, a result of actions taken during
the emergency phase, or other factors such as the prevalence of certain disease types pre-disaster. The final phase deals with restoration and rehabilitation of the community to pre-disaster conditions and may take from weeks to years depending on the type of disaster and economic resources available to the community.

Concerns of the emergency phase may range from reestablishing transportation routes into an area cut off by a disaster to the identification of environmental factors which foster disease occurrence. In a disaster context, medical care, while remedial, may also come under the umbrella of public health coordination activities. Public health in the context of disaster relief encompasses the total scope of community health, namely, all the community efforts influenced by the medical arts and sciences, applied to the prevention of disease, protection of life, and the promotion of the well-being and efficiency of man, inclusive of the physical, mental, and social aspects.

3. **End Product:** Manuals for disaster managers and remote sensing personnel. At this point, two manuals or suggested operations guides are planned—one a technical guide for data gathering and analysis, and another describing potential applications of the data gathered. One guide will be written for agency personnel and will outline by public health problem the functions and tasks involved in disaster relief. Evidence exists to show that inappropriate actions on the part of disaster relief managers have frequently
contributed to unnecessary mortality, morbidity and inefficient use of resources (Center for Disease Control, 1974). Mismanagement problems are most often caused by a lack of knowledge and/or skill of the work functions required to manage disaster relief. Tasks which can be accomplished or aided by remote sensing will be identified. This guide will be unique in two respects: (1) It will document functions and tasks which are nowhere clearly outlined and so will impart knowledge to those who cannot rely on experience as well as specifying in diagramatic form these same tasks for experienced personnel, and (2) It will suggest a novel application of an improved technology for solving a serious problem.

The second guide will be directed to a remote sensing specialist. It will outline the tasks to be performed by an image analyst and will include both preplanning and post-disaster activities. The procedures used to develop this manual will be similar to those used in developing the manual for disaster managers. Specifically this will involve diagramming the tasks of the remote sensing specialist and the information sources required to perform these tasks.

B. HYPOTHESES

We have formulated the following hypotheses:

1. Remote sensing technology can supply data faster, more completely, and more accurately than current methods.

2. A manual can prepare a remote sensing technician to
carry out the duties and functions demanded of him in applying remote sensing technology to a natural disaster.

3. Using this method of intervention, we can assist to reduce management errors in a disaster caused by information delay.

Testing the difference in quality of data collected at comparable time intervals from current methods and from remote sensing would ideally require that the two collection systems were used simultaneously and then compared. This could be done if an actual disaster were to occur in the time frame of the current project. A second testing procedure would be to make a retrospective study of the time required for collection and its quality by interviewing persons recently involved in a disaster. This information could be compared to the estimate derived from a simulation whereby remote sensing is used to provide the same data.

The effectiveness of the manual as a training guide for a remote sensing technician will be tested either in a pilot test coinciding with an actual disaster or in a simulation without a disaster. This would consist of utilization of the manual by a remote sensing expert to collect the data and provide observational information needed to deal with the problem areas on the flow charts. Duties would involve such things as flight planning, resource gathering, and photo interpretation. Such a test could be done at the time of a
disaster (with or without input to the decision-making system), or a simulation could be performed without a disaster.

Testing the third hypothesis is very difficult and will not be undertaken since it is virtually impossible to conduct a controlled exposure validation. This would entail having the same disaster strike two similar communities with equal intensity at the same time and exposing one to remote sensing while using the other as a control community without the use of remote sensing. Additionally, we have no mechanism whereby decision-makers would be limited to utilize data from remote sensing sources. However, we will demonstrate its usefulness by the manual which presents the problems in flow chart form to encourage such utilization.

C. STEPS

This section details the steps which have been taken and those which are planned to complete the research described above.

1. Literature Review. Approximately the first three months of the investigation were devoted to reviewing the literature. A comprehensive literature search and review of two topic areas, disasters and remote sensing of the environment, was carried out. A list of indices and abstracts which were searched in connection with the project appears in Appendix A. A bibliography containing 167 documents examined and used is included in Appendix B. In addition, a
computer search was made through the National Library of Medicine (NLM/MEDLINE). Diagram 1 portrays the four areas of literature that were cross-referenced in the search. Table 1 shows the number of references retrieved from each area and the approximate number which were relevant to this project.

The types and extent of past disasters were examined in order to determine the public health and medical problems related to various types of disasters. (See Appendix C for examples of these tabulations.) It was found that while
<table>
<thead>
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<th>Topic Area</th>
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<tr>
<td>Administration of Natural Disasters</td>
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<td>Diseases and Natural Disasters</td>
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most publications in the disaster literature emphasized the need to be aware of possible public health problems, few publications enumerated the problems which developed or might develop. In fact only four studies were epidemiological follow-up studies of a disaster (Gilbert et al, 1973; Manos, 1958; Saha, 1972; and Sommer and Wiley, 1972). The literature search then focused on the environmental disruptions most likely to occur in disasters with emphasis on those which had visible physical surrogates. The damage characteristics which might be surrogates for public health problems were identified. (See Appendix D.) The public health implications of these environmental disruptions were then analyzed in terms of the community as a whole and in terms of specific disease outcomes which might result. Diseases were described according to their mode of occurrence, area of endemicity, and control and prevention.

It was also found that the work functions required to effectively manage disaster relief were nowhere clearly outlined. This situation proved to be an unanticipated obstacle since we had assumed that the tasks to be performed in relief operations were already specified. It has already been noted that disaster mismanagement caused by lack of knowledge and/or skill has contributed to unnecessary mortality, morbidity, injury and inefficient use of resources. Before a plan for effective disaster management can be devised, however, the work functions which need to be performed in disaster relief must be delineated.
The staff also searched for literature concerning the application of remote sensing to disasters. Only three studies examined the potential utility of remote sensing in disasters, and only one applied it retrospectively to post-disaster activities (Rapid City Flood, 1973; Garafalo and Wobber, 1974; Wobber, 1971).

2. Interviewing. Disaster-responding agencies in the state of Texas were identified at all levels of government, and contact was established between them and the project staff. Prior to interviewing people in the agencies, a letter and two lists of questions were sent to them. (See Appendix E for the letter, questions, and list of people interviewed.) It was hoped that this procedure would facilitate discussion since most agency personnel had not considered the idea of using remote sensing technology in disaster relief activities. The major difficulty in conducting these interviews was the unexpected one already mentioned, i.e., the absence of an explicit specification of disaster relief work functions. It was possible, then, to talk only in generalities about how relief activities are carried out. These interviews served, however, to acquaint directors and personnel in Texas agencies with this project and to acquire cooperation in testing this application of remote sensing.

Included among the agencies contacted were the Federal Disaster Assistance Administration (FDAA), State of Texas Emergency Operating Center (EOC), Galveston EOC, Houston EOC
and the Regional Red Cross. Appendix F contains organizational diagrams and maps of Federal disaster regions and the Texas state regions and agencies responding to disasters.

3. Flow diagramming. As mentioned, disaster plans have been organized around functions that have not been made explicit. SOP's when available usually detail tasks by agencies rather than by functions to be accomplished. This approach leads to fragmentation and duplication of effort since restoring certain systems following a disaster may cross-cut several agencies. For example, checking and restoring the water system and supplying water may involve the Division of Engineering Services which is responsible for checking and repairing the system, the Health Department which is required to test for contamination and the Red Cross which is charged with distributing water to areas where the supply has been cut off. A more wholistic approach to disaster management would be to diagram work functions across agency boundaries and this was the approach adopted.

Disaster relief activities were divided into six general areas of concern: medical attention, water, waste disposal, transportation, food, and shelter. Flow diagrams of the major disaster relief decisions and inputs were made to facilitate discussions with interviewees. It was observed in early interviews that their lack of experience and knowledge regarding their disaster relief functions led to a defensive stance and hindered information-gathering. The use of the flow diagrams put the burden of presentation on the research
staff while the interviewees took the role of experts to criticize or comment on the diagrams. These diagrams elaborated within functions the decisions and tasks required to manage relief activities. (See Appendix G for the flow diagrams.) Problem-solving contingencies were elaborated within a decision-making framework identifying what has to be done to "solve" a disaster problem. Sixteen interviews were conducted with agency personnel who are responsible for managing relief activities in Houston and in Galveston to verify the accuracy of the diagrams (Appendix H). Revisions were made following suggestions of disaster managers.

These diagrams are linear, that is, various tasks are ordered sequentially according to priorities. However, relief activities for the most part have a web-like structure in which many things go on concurrently. Therefore it must be kept in mind that the starting point for all the diagrams is either pre-disaster planning or immediately post-disaster. In addition, tasks on some of the diagrams may go on simultaneously. For example, repair of the water facilities may go on concurrently with distribution of water. How remote sensing can aid these work functions will be discussed in the following section.

4. Remote Sensing. Based on the literature review a list of environmental disruptions which might serve as surrogates for health problems was developed. This list was checked by an image analyst to identify which items could be
detected from aerial photography at a given scale and film type. Additions were made to the list based on a photographic analysis of two previous disasters—the Celia hurricane and the Managua earthquake.

Using the flow diagrams discussed in the previous section, the specific observations needed to accomplish tasks within the six functions were listed. A remote sensing technician will review these observations to confirm if they can be made using remote sensing. Many of them overlap with the environmental disruptions identified as part of the literature review. Depending on the remote sensing technology employed and on the feasibility of making these observations, a time frame for delivering the information required within the six disaster management functions will be suggested. A checklist will be devised to facilitate the interface of relief activities and remote sensing.

Attention was also given to outlining remote sensing systems which would be adaptable to disaster situations. Camera systems, film and filter combinations, aircraft, scales of photography and other variables were examined. Alternatives to aerial photography which also may be defined as remote sensing are being considered such as videotape systems and a trained observer/recorder in low altitude aircraft. Recording could be directly on maps or on audiotape.
The advantage to both of these alternatives is that there is no time lost for processing film. An additional advantage to the latter is that many communities may already have trained observers available to them in the form of traffic control or news personnel. The advantage to using aerial photography on the other hand is that it provides a permanent record of the disaster area which can be used not only in part of the emergency relief phase but also in the later phases of recovery and of restoration. The disadvantages of aerial photography are (1) the time lag between photographing the disaster and processing the film, (2) the preplanning necessary to execute a flight, e.g. develop a flight plan, acquire appropriate film type, equipment, etc., and (3) the necessity of having access to a trained image analyst. All systems require some preplanning to the extent that maps of the area denoting the location of various important facilities must be available. The selection of a remote sensing system will depend to a large extent on the resources of the community wishing to implement the plan.

5. **Attend disaster (if one occurs).** In order to gain insight into community priorities, reactions, and problem areas, the staff members will take part, as on-site observers, in a disaster relief operation. They will further view the operation of the Texas Defense and Disaster Relief Council to determine the possible additional roles remote sensing might play in disaster assessment. Experience with an
actual disaster will provide the basis for a more complete procedures manual. Procedures for observation and inter-
viewing are being planned.

Remotely sensed data will be gathered. Provisions have
been made whereby the State Coordinator of the State of Texas
Emergency Operating Center, through his official channels,
can request that a disaster relief reconnaissance mission be
flown by personnel at Bergstrom Air Force Base (Austin).
Arrangements have been made so that the gathering of remotely
sensed data will begin within a maximum of two (2) hours
after the call for assistance has been received assuming
weather conditions permit. This will allow us to obtain time
estimates on the acquisition of data. Provisions will be
made for acquisition of a photo interpreter.

6. Procedure Used to Develop Manuals.

A. First draft of manuals

1. Preparation
   a. Literature review
   b. Interviewing

2. Flow diagramming of functions
   a. Decision-making tasks
   b. Remote sensing tasks

3. Verification of diagrams with disaster
   managers

4. Write up of discussions on
   a. Cross-cutting agency functions and
how diagrams may be used to synchronize them

b. Remote sensing expert's duties and functions.

B. Review and Evaluation

1. Agency review
2. Consultant review
3. Test of efficiency for remote sensing

7. Plan Evaluation. An evaluation and analysis of the project will be carried out along two lines: (1) the procedures in the manuals will be assessed by review for clarity and for impressions of feasibility; (2) tests will be carried out to see if the remote sensing manual can effectively prepare a remote sensing technician to supply data needed by disaster managers. To accomplish the first goal of evaluating the utility of the concepts and procedures in the manuals, disaster managers and consultants will critique them. Evaluation of the teaching effectiveness of the manual will be made by a pre-test and post-test administered to an image analyst. Photographs of a disaster will be analyzed both before and after the photo interpreter has studied the manual. The data and its organization and presentation will be compared.

In order to evaluate the usefulness of the remote sensing approach to the alleviation of public health problems following a disaster and to ascertain whether the maximum
information was extracted from the imagery, a detailed retro-
spective analysis of the photography compared with details
gathered through existing means will be performed if possible.
Validation of the usefulness of remote sensing which is out-
side the scope of this project would be to conduct a follow-
up, epidemiological study correlating the public health
problems which actually occurred in the disaster and those
predicted from the photographic surrogates, taking into
account preventive measures. This would involve collecting
health data from the local agencies responsible for health
care in the community such as the Health Department and
various hospitals and from emergency relief organizations
such as the Red Cross. Recommendations will ultimately be
made regarding this application of remote sensing technology
in meeting the public health needs of a disaster-stricken
community. If time and resources permit, a second pilot
study on a different type of disaster will be conducted.
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APPENDICES
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APPENDIX A

INDICES, ABSTRACTS, AND BIBLIOGRAPHIES

An Annotated Bibliography on Disaster and Disaster Planning
(Disaster Research Center)

Applied Science and Technology Index
Biological Abstracts
Congressional Index Service
Disaster Research Center Publications
DCPA Publications
Engineering Index
Excerpta Medica - Environmental Health and Pollution Control
Excerpta Medica - Public Health, Social Medicine and Hygiene
Government Reports Announcements
Governmentwide Index to Federal Research and Development Reports
Monthly Catalogue - United States Government Publications
N.Y. Times Index
Oceanic Index
Reader's Guide to Periodical Literature
Science Citation Index
Selected Water Resources Abstracts
Water Resources Abstracts
Water Resources Research Catalogue

Indices Of:

American Journal of Epidemiology
American Journal of Public Health
American Journal of Sociology
American Sociological Review
British Journal of Sociology
Contemporary Sociology
Human Organization
Journal of World Meteorological Association
Medical Care Review
Monthly Weather Review
Sociology
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APPENDIX B

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"Summary of Federally-funded Resources Available to Victims of Disasters"


Texas Disaster Act of 1973, Chapter 216, S.B. No. 786.

## APPENDIX C

### INDIVIDUAL NATURAL DISASTER REPORT*

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<tr>
<th>Date and Duration</th>
<th>Type (name)</th>
<th>Location (total area involved)</th>
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</thead>
<tbody>
<tr>
<td>Sept. 5-22, 1967</td>
<td>Beulah (most studied &amp; best documented hurricane)</td>
<td>Lesser Antilles, Puerto Rico, Mexico, Texas</td>
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<table>
<thead>
<tr>
<th>Types of Injuries</th>
<th>Types of Property Damage</th>
<th>Incidence of Disease</th>
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<tr>
<td>Injured</td>
<td>542 homes destroyed</td>
<td>Used US Air Force spray planes to control potential mosquito problems.</td>
</tr>
<tr>
<td># killed</td>
<td>23,000 homes damaged</td>
<td></td>
</tr>
<tr>
<td>8,000</td>
<td>513 small businesses destroyed</td>
<td></td>
</tr>
<tr>
<td></td>
<td>public facilities one million $</td>
<td></td>
</tr>
<tr>
<td></td>
<td>other property loss one billion $</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(as tornadoes)</td>
<td></td>
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<tr>
<td></td>
<td>(115 - Texas Water Report and Texas Almanac)</td>
<td></td>
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<tr>
<td></td>
<td>property and crop losses - extreme!</td>
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Worst natural disaster recorded in Texas. 3rd most destructive hurricane in history. Rains up to 30 inches.

*If applicable, place additional information, summary, or comments on back of form.*
# APPENDIX C

## INDIVIDUAL NATURAL DISASTER REPORT*

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<thead>
<tr>
<th>Date and Duration</th>
<th>Type (name)</th>
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<td>June 1953</td>
<td>Tornado</td>
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<td>Time 4-5:30 p.m.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&quot;about 5:10 p.m.&quot;</td>
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<td>Hight (1956)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lasting about 20 minutes</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Types of Injuries

<table>
<thead>
<tr>
<th>Injured</th>
<th># Killed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,500</td>
<td>93</td>
</tr>
</tbody>
</table>

### Types of Property Damage

<table>
<thead>
<tr>
<th>Estimate</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>$53 million</td>
<td></td>
</tr>
</tbody>
</table>

### Incidence of Disease

<table>
<thead>
<tr>
<th>Type and Extent</th>
</tr>
</thead>
</table>

## Sources:

- Dunlop (1954)
- Hight (1956)
- *Maher (1954)

If applicable, place additional information, summary, or comments on back of form.
Utilities

broken water mains
broken sewer lines
downed power/phone lines (oblique only)
contaminated reservoirs/wells
disrupted traffic signals
power plant damage
water supply station damage (pump)
natural gas supplies (plant)

Streets

obstructed by trees/poles
obstructed by structural debris
collapsed bridges
disrupted road surface
collapsed elevated roadways
road washout

Structural Damage

roofs off
trees/poles fallen on structures
structure off foundation
foundation settled
concrete embutments disrupted
mobile homes displaced
fallen towers, steeples, a.c. units, stacks
fallen radio/tv towers
fallen advertising display
damage to oil tanks, industry
garages/out buildings damaged

Vegetation

stripped, branches down
silt covered, trampled
uprooted

Miscellaneous

boats/commercial vessels displaced/beached
small, local landslides
passenger vehicles overturned
railroad tracks blocked or damaged
fallen fences
large animal carcasses
Dear

Thank you for agreeing to meet with us to discuss our project. As I mentioned on the telephone, we are developing potential uses for aerial photography in times of disaster. Specifically we would like to identify ways in which this technology could minimize or alleviate public health problems following a disaster. For example, areas of stagnant or contaminated water which might attract mosquitoes and thus lead to an outbreak of encephalitis could be pinpointed. Preventive steps could be taken against these sources before a problem developed.

The goals of our project are (1) to develop a procedures manual on using aerial photography as an aid to identifying and solving public health problems during a disaster and (2) to recommend skills and roles of a public health/remote sensing team to implement the procedures which would aid disaster-responding agencies.

At present we are focusing on Texas and are attempting to identify agencies and organizations on the various levels of government who respond to disasters. The tasks and functions of these agencies are nowhere extensively discussed in the literature and, more importantly, the experience of the people who deliver disaster relief is not published. Thus, we have found it necessary to meet with people working in this area in order to find applications of aerial photography which are useful.

We thought it might facilitate discussion at our meeting if we first sent you a list of questions we wished to discuss.

Sincerely,

Marjorie Rush
Principal Investigator
HEALTH PROBLEMS: QUESTIONS PROPOSED FOR DISCUSSION

1. What are the major community health problems encountered in disasters you have experienced?

2. Were any of the health problems you experienced due to contaminated or stagnant water?
   If so, give specific examples, i.e., type and extent of disease.

3. Were any of the health problems you experienced due to crowding and thus unsanitary conditions of relief shelters?
   If so, give specific examples, i.e., type and extent of disease.

4. Were any of the health problems you experienced due to contaminated food supplies?
   If so, give specific examples, i.e., type and extent of disease.

5. Were any of the health problems you experienced due to exposure to dead animals and/or humans?
   If so, give specific examples, i.e., type and extent of disease.

6. Were any of the health problems you experienced due to a vector problem (i.e., mosquitoes, flies, rats, etc.) aggravated by the respective disaster?
   If so, give specific examples, i.e., type and extent of disease.

7. Have snakes ever been a problem in any of the disasters you have experienced?

8. Other than trauma cases, (cuts, fractures, etc.) can you point out any other significant areas where health problems could occur?

9. To what extent are trauma cases prevalent in disasters you have experienced?

10. How can a "disaster team" best intervene to minimize death, disability, and/or suffering?
AGENCY FUNCTIONS: QUESTIONS PROPOSED FOR DISCUSSION

1. What functions does your agency or department perform during a disaster?

2. What are the interrelationships between your agency or department and other levels of government? I.e., What is the "chain of command?"

3. What resources are available to your agency or department? E.g., a written disaster plan, maps of the city sewage, water and gas systems, shelters and manpower. How are volunteers incorporated into relief activities?

4. To what extent do disaster victims use your services?

5. How could the services you are prepared to provide be more widely used?

6. What disasters have you been involved in and what were some major problems you encountered?

7. How could you use aerial photos in your job?
APPENDIX E

LIST OF PEOPLE INTERVIEWED

Marion P. Bowden
Deputy State Coordinator, State EOC
Austin, Texas

William Brady
EOC Director
Galveston County, Texas

John Caswell
Executive Assistant Director
City of Houston
Emergency Operating Center
Houston, Texas

Frank Dickerson
Game Warden
Disaster District Committee, Representative
Texas District 2A
Houston, Texas

Col. Dean Ewing
DCPA Medical Officer
Washington, D.C.

Gerald W. Gillespie
Disaster Medical Services
Texas State Department of Health
Austin, Texas

Dr. Joe Goldman
Storm Research Center
University of St. Thomas
Houston, Texas

Lee Gruklkay
State Employment Commission
Disaster District Committee, Representative
Texas District 2A
Houston, Texas

Dr. W.W. Kemmerer
Director
Galveston County Health Department
Galveston, Texas
Richard W. Keyes  
Regional Liaison Officer  
Division of Disaster Emergency Services  
Texas Department of Public Safety  
Houston, Texas

Robert Lansford  
State Representative to DCPA  
State EOC  
Austin, Texas

C.O. Layne  
State Coordinator, State EOC  
Austin, Texas

Jim Lynch  
Emergency Medical Services Division  
Texas State Department of Health  
Austin, Texas

Leonard Marks  
Aeronautics Commission  
Disaster District Committee Representative

Max McIntyre  
Emergency Medical Services Division  
Texas State Department of Health  
Austin, Texas

Al Richmond  
Resources Technology Corporation  
Nassau Bay, Texas

Jesse Root  
Emergency Medical Services Division  
Texas State Department of Health  
Austin, Texas

Tom Ross  
Department of Public Welfare  
Disaster District Committee Representative  
Texas District 2A  
Houston, Texas

C.L. Russell  
Captain, Texas Highway Patrol  
Chairman of Disaster District Committee  
District 2A  
Houston, Texas
APPENDIX E

William Tidball
Deputy Director, Region VI
Federal Disaster Assistance Administration
Dallas, Texas

Mattie E. Treadwell
Chief Field Officer, Texas
Region 5, DCPA
Austin, Texas

Bruce Wolly
Emergency Medical Services Division
Texas State Department of Health
Austin, Texas

Mike Warren
Red Cross
Houston, Texas

Wayne Wentworth
Parks & Wildlife Department
APPENDIX F
STATE DIVISION OF DEFENSE AND DISASTER RELIEF
DISTRICT AND SUBDISTRICT BOUNDARIES

APPENDIX F

Agencies on the Defense & Disaster Relief Council

Agriculture Department
Texas Air Control Board
Attorney General
State Auditor
State Building Commission
Comptroller of Public Accounts
Board of Control
Texas Education Agency
Texas Industrial Commission
Texas Board of Mental Health and Mental Retardation
Veterans' Affairs Commission
Water Quality Board
Water Rights Commission
Texas Forest Service
Texas Civil Air Patrol Commission
Division of Disaster Emergency Services
Texas Department of Community Affairs
American Red Cross
Texas State Technical Institute
FOOD

WATER SUPPLY

IDENTIFY FOOD HANDLING ESTABLISHMENTS

UTILITIES OUT

COLLAPSED STRUCTURES

VISCERAL EFFECTS: CHEMICAL & MICROBIOLOGICAL TESTS

FOOD CONTAMINATED?

YES

DISPOSE OF CONTAMINATED FOOD

SURVIVE INCIDENT

NO

ESTIMATE AMOUNT OF UNCONTAMINATED FOOD

CULTURAL DIFFERENCES

ESTIMATE POPULATION IN NEED OF FOOD

AGG STRUCTURE

FOOD SUPPLY ADEQUATE?

YES

DISTRIBUTE

STOP

NO

FIND SUPPLEMENTARY SUPPLIES

IDENTIFY TRANSPORTATION ROUTES

DISTRIBUTE

STOP

REPRODUCIBILITY OF THE ORIGINAL PAGE IS POOR
TRANSPORTATION

1. ARE MAJOR TRANSPORTATION ROUTES ADEQUATE?
   - YES
   - NO

2. DETERMINE AVAILABILITY OF
equipment FOR CLEARANCE.
   - YES
   - NO

3. DETERMINE LOCAL RESOURCES ADEQUATE?
   - YES
   - NO

4. FIND TRANSPORTATION ROUTES FOR INFORMATION.
APPENDIX H

LIST OF INTERVIEWS TO VERIFY FLOW DIAGRAMS

Eddie Barr, Director
Emergency Operating Center
Galveston, Texas

Parks Bowden, Director
Emergency Operating Center
State of Texas
Austin, Texas

A. D. Catterson, M.D.
Disaster Medical Services Sub-Committee
Harris County Medical Society
Houston, Texas

Mike Crisswell
Department of Public Works
Galveston, Texas

Artis M. Duty
Sanitary Engineer
Water Division
Department of Public Works
Houston, Texas

James Havens
Department of Public Works
Galveston, Texas

Lou Hollar
Pollution Control
City Health Department
Houston, Texas

Joe Johnson
Sewer Division
Department of Public Works
Houston, Texas

Bob Lansford
State Representative to the DCPA
Emergency Operating Center
State of Texas
Austin, Texas

Carol MaCLané
Department of Public Health
Galveston, Texas
Robert MacLean, M.D.
Communicable Disease Division
City Health Department
Houston, Texas

Joe Nadon
Department of Transportation
Galveston, Texas

Charles W. Nash
Pollution Control
City of Houston Health Department
Houston, Texas

Albert Randall, M.D.
Director
City Health Department
Houston, Texas

Make Warren
Red Cross Disaster Services
Houston, Texas

Charlie Williams
Sewer Division
Department of Public Works
Houston, Texas
## Budget

Expenditures 11-1-73 - 10-31-74

<table>
<thead>
<tr>
<th>Category</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personnel</td>
<td>23,548.85</td>
</tr>
<tr>
<td>Fringe</td>
<td>1,144.37</td>
</tr>
<tr>
<td>Consumable supplies</td>
<td>67.01</td>
</tr>
<tr>
<td>Other expenses</td>
<td>10.00</td>
</tr>
<tr>
<td>Indirect</td>
<td>10,596.98</td>
</tr>
<tr>
<td>Consultant</td>
<td>100.00</td>
</tr>
<tr>
<td>Travel</td>
<td>1,429.59</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>36,896.80</strong></td>
</tr>
</tbody>
</table>
Proposed 2nd Year Budget

<table>
<thead>
<tr>
<th>1. Personnel</th>
<th>%</th>
<th>Salary</th>
<th>Fringe</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research Associate/ Coordinator</td>
<td>100</td>
<td>$12,500</td>
<td>925</td>
<td>13,425</td>
</tr>
<tr>
<td>Research Statistical Aide</td>
<td>50</td>
<td>3,228</td>
<td>262</td>
<td>3,490</td>
</tr>
<tr>
<td>Secretary</td>
<td>25</td>
<td>1,614</td>
<td>131</td>
<td>1,745</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>$17,342</strong></td>
<td><strong>1,318</strong></td>
<td><strong>18,660</strong></td>
</tr>
</tbody>
</table>

| 2. Supplies |
|--------------|--------|--------|-------|
| Office supplies, xeroxing | 200 | 200 |

| 3. Special Costs |
|------------------|--------|--------|-------|
| Phone | 100 | |
| Film & processing | 148 | 298 |
| Postage | 388 | |
| **Total** | | 388 |

| 4. Travel |
|-----------|--------|--------|-------|
| Response team to disaster sites | 2,000 | |
| Per diem (5 persons x 12 days x 55/ day) | 1,800 | |
| SPH to NASA ($5.95 x 50 trips) | 298 | |
| Association of Civil Defense Directors Annual Meeting and Regional Meeting | 800 | |
| Per Diem (2 persons/ 6 days) | 420 | 5,318 |
| **Total** | | 5,318 |

| 5. Overhead |
|-------------|--------|--------|-------|
| 45% S + W | 8,397 | 8,397 |

| 6. Consultants |
|----------------|--------|-------|
| 2,000 | |

| 7. Transfer from 1st year |
|---------------------------|--------|-------|
| 2,000 | 2,000 |
| **Total** | **$34,963** |