

a/o 20 February, 1992

BISSON EXPLORATION, CO.

1. Botswana/Ethiopia combined proposal materials
2. Prefeas. & Ph. I Team description



Robert A. Bisson, Exploration Consultant  
P.O. Box 440  
Melvin Village, NH 03850  
(603) 544-9058

February 19, 1992 (By FAX - 3:15pm)  
(phoned in advance)

Ms. Lois McDuffy  
FA/OP/A/AOT  
Room 1516, SA-14  
Washington, D.C. 20523

Dear Ms. McDuffy:

I understand that one of your concerns regarding my unsolicited proposal was that some other entity had challenged my proprietary and target region-specific experience claims, per your CBD announcement. I have since learned from Earthsat's President, Bob Porter, whose firm was part of my project plan (image processing and GIS work), that his middle management had responded to your notice and also included my colleague, Dr. El-Baz, as a "megawatershed" expert.

I would like to point out the fact that first, the "megawatershed" model is only part of the unique and proprietary capabilities listed in the CBD as necessary to carry out these projects in a timely fashion. Second, as you can see from the enclosed correspondence, while Dr. El-Baz is included in Earthsat's list of generally available outside consultants, Dr. El-Baz is not, in fact available to work on these projects, and Earthsat is planning to perform its qualified services, as a subcontractor, as originally planned.

I have worked with Earthsat for years and had briefed their President, Bob Porter on my proposed new Africa projects some months ago. I fully intended to employ his firm's services, as we have teamed before in proposing similar regional exploration programs, using my water exploration expertise and Earthsat's Image Processing/interpretation and map production facilities. Please see the attached letter, dated February 19, which confirms this arrangement.

Per my conversation last week with Ms. Hacken, the projects' basic goals have time constraints (also listed in the CBD announcement) which require immediate commencement of project

activities. A.I.D.'s technical review committee fully understands the need to begin the work right away. Therefore, please advise me of what additional information or steps are germane to beginning work under contract with USAID.

Thank you for your assistance in this matter.

Sincerely,

A handwritten signature in black ink, appearing to read "Robert A. Bisson". The signature is written in a cursive style with a long horizontal flourish at the end.

Robert A. Bisson

Enclosures



February 18, 1992

Agency for International Development  
FA/OP/A/AOT  
Room 1516, SA 14  
Washington, D.C. 20523

Attention: Ms. Lois McDuffey:

Dear Ms. McDuffey:

In confirmation of our conversation this date, EarthSat hereby withdraws its expression of interest in participating as a prime contractor on the East Africa Water Access and Technology project. It is our understanding that Mr. Bisson has included our services in his unsolicited proposal. Accordingly, we will support him in any sole source contract resulting from his proposal or we will team with him in any competitive proposal effort that may result from other responses to your CBD announcement.

Sincerely,

A handwritten signature in black ink that reads "Max E. Miller".

Max E. Miller  
Manager, Program Development



February 19, 1992

Mr. Robert A. Bisson  
The Representative  
1101 S. Arlington Ridge Road  
Arlington, VA 22202

Dear Mr. Bisson:

In confirmation of your discussion with Bob Porter, EarthSat has withdrawn its expression of interest and qualification statement for prime contractor consideration for the USAID East Africa Water Access and Technology programs.

It is my understanding that we will provide exclusive support with image processing and GIS work under this contract as follow-on in this region. If you are in agreement with this, please sign below and fax your response.

Should the project be competed as a result of other submissions of expressions of interest, we are prepared to formally team with you in a proposal submission.

Sincerely,

A handwritten signature in cursive script that reads "Max E. Miller".

Max E. Miller  
Manager, Program Development

AGREED:

A handwritten signature in cursive script that reads "Robert A. Bisson".

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February 14, 1992

## Best Available Copy

Mr. Howard Fry  
Director of Operations  
U.S. Agency for International Development  
Washington, D.C.  
fax: (202) 647-0432

Dear Mr. Fry:

I have been listed as a contributor to proposals, which were recently submitted to the United States Agency for International Development, for a study of the groundwater potential in Ethiopia and Botswana.

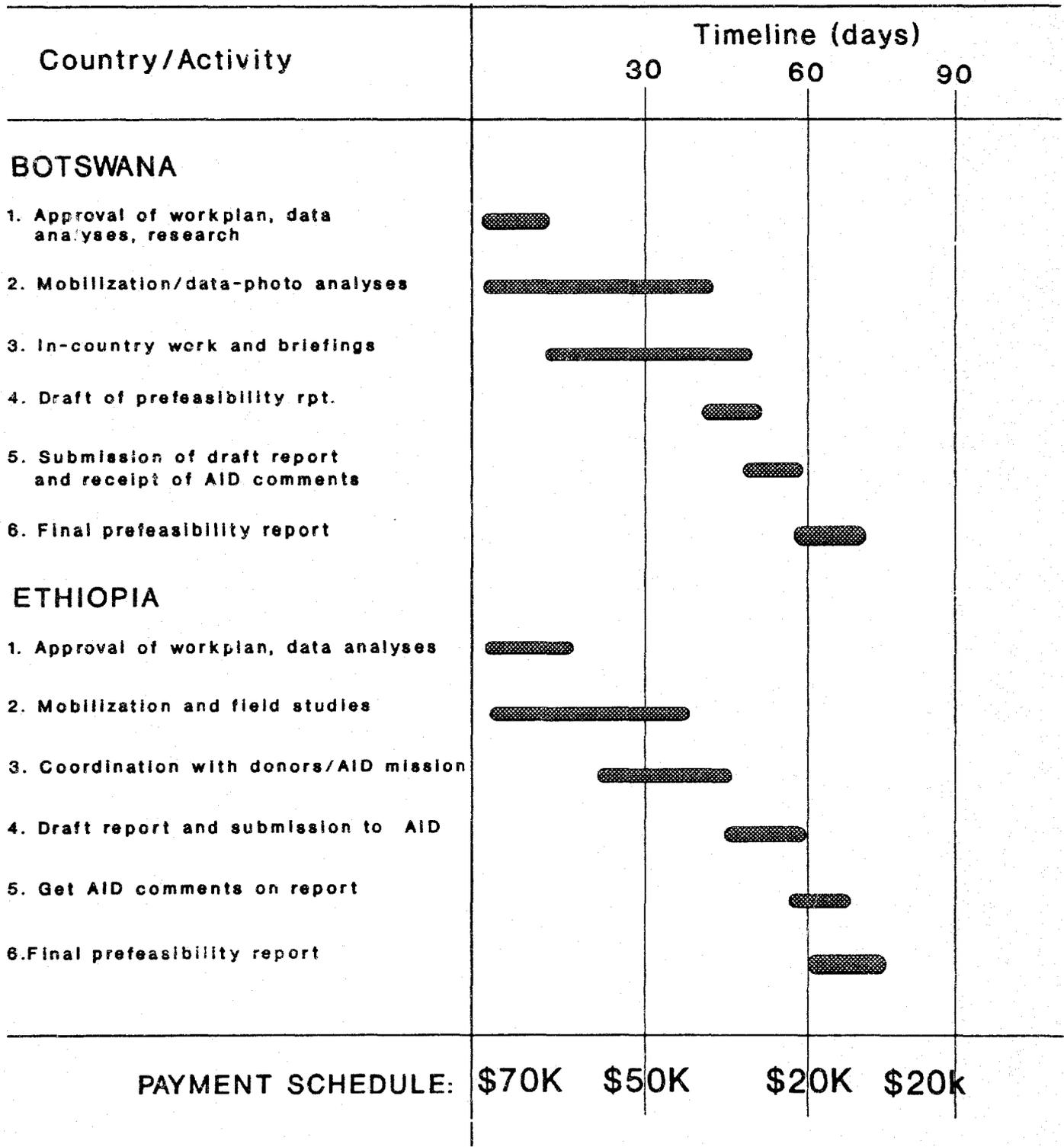
Because of recent commitments, I hereby withdraw my name from said proposals. Urgent demands on my time would not allow me to contribute to this particular study.

Thank you for taking my request into account while considering action in this regard.

Sincerely,

Dr. Farouk El-Baz  
Center for Remote Sensing

# BOTSWANA/ETHIOPIA WATER RESOURCES STUDY ACTIVITIES AND PAYMENT SCHEDULE



**Total Cost: \$160K**

# Water Wars Come to Botswana

## Rapid expansion of economy creates demand for Bushmen's resources

By Bruce Finley

Chronicle Foreign Service

### Maun, Botswana

Chief Kwere Seriri, taking shelter from the sun beneath a tree, said he had not heard of the Botswana government's plans to divert water from his swampy northern homeland to a booming economy based on diamonds and cattle farther to the south.

But the Bushman leader knows that in the vast Okavango Delta, where he once "chased animals without getting tired," there are fewer and fewer places left for his tribe to continue its traditional way of life.

Botswana's indigenous peoples find themselves politically outgunned in a society that is rushing headlong toward development.

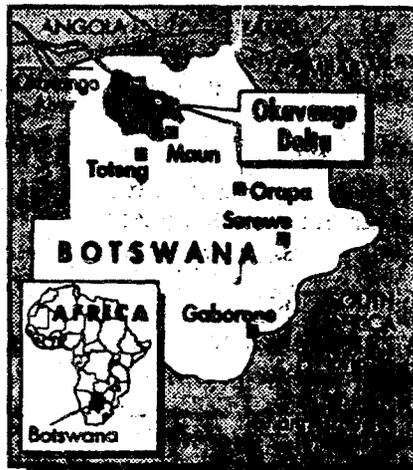
No nation in the world has outpaced Botswana for growth over the past quarter-century, with its gross national product increasing at a rate of 10 to 15 percent a year. The government has \$3.3 billion in cash reserves, and the average per-capita income is \$1,600, one of the highest figures in Africa.

The nation of 1.3 million people, which was known as Bechuanaland until it was granted independence by Britain in 1966, has become a beacon of affluence on an otherwise troubled continent.

Botswana's supermarkets are stocked; its telephones work on optical fiber; its roads are being paved, and foreign-made computers and other machines are available. Even its politics are stable, democratic and increasingly open under President Quett Masire.

### Project Forces Reassessment

But the Okavango Integrated Water Project, which would drain water from one of the world's last



the extra water to quench the thirst of its swelling cities. Demand is expected to double by the end of the century, with the population growing at a 3.4 percent annual rate.

Just as the bulldozers began dredging, however, delta residents and other Botswanans objected strongly, saying that edible river lilies and reeds and animals that depend on wetlands would be lost.

Greenpeace International backed up the objectors with threats of a global boycott of Botswanan diamonds and beef. The country supplies 19,000 tons of beef a year to Western Europe as part of a trade concession arrangement.

### Project on Hold

The government ordered the bulldozers to stop, and the Okavango project has been suspended while an environmental impact assessment is made by the International Union for the Conservation of Nature.

If the foreign experts decide that damage to the delta would outweigh the project's human benefits, the government will probably halt it, said Okavango Delta

But the development talk is being drowned out by local opponents like Roy Ridges, 24, a member of the Batawana tribe and manager of the local Avis car rental concession.

He has urged the indigenous people of northern Botswana to fight to halt the water project on the grounds that it would pave the way for more tourist roads, possible oil drilling and the erection of cattle fences that would restrict wildlife migration.

Local citizens are becoming increasingly militant, Ridges said. "Threats are being made. We could break off and form a separate country. We have people with the power to do that."

### Nature 'Driven Away'

He remembers when a four-wheel-drive vehicle was needed to negotiate the rutted and sandy roads around Maun — which was named after the honking cry of a goose, when it still had geese. "Slowly, slowly, nature is being driven away," he lamented.

Western diplomats in Botswana see in the Okavango controversy a classic challenge to reconcile the claims of nature with those of man's desire to create wealth.

"Both sides can be assuaged, provided that everybody goes about it with appropriate caution, skepticism and care," said a U.S. Embassy official in Gaborone, the capital.

The diplomats downplay the project's damage to wetlands. The U.S. official said the Okavango plan differs from such American cases as the poisoning of the Everglades and the filling of parts of San Francisco Bay because it would use water only after it passes through much of the delta.

Agency for International Development  
Washington, D.C. 20523



Assistant Administrator  
for Africa

JAN 16 1991

MEMORANDUM

TO: A-AA/OPS, Howard M. Fry ✓  
FROM: AA/AFR, Scott M. Spangler *SM* ✓  
SUBJECT: Technical Assistance Proposal for Addressing Water Resources in Botswana

Thank you for forwarding Robert Bisson's unsolicited proposal concerning groundwater mapping in Botswana and Ethiopia. Africa Bureau staff have been in contact with Mr. Bisson over recent months and have participated in discussions in which he presented his unique water exploration technology.

On December 18, 1991, a technical review of the proposal was conducted. While the proposal seems technically viable, several Africa Bureau staff were concerned that a truly detailed and technical review should be undertaken by the R&D Bureau where the proposal can be looked at in greater detail by experts in this field. My staff will forward Mr. Bisson's proposal to R&D for their review and appropriate action. I understand Len Rogers has been discussing the proposal with my staff.

I have sent a letter to Mr. Bisson which outlined some of the Africa Bureau's concerns regarding his proposal and informed him that action on the proposal has been transferred to R&D/R, Mr. Howard Miners, for action. Other issues raised by the Africa Bureau are mentioned in the letter to Mr. Bisson, a copy of that letter is attached.



United States Department of the Interior

GEOLOGICAL SURVEY  
RESTON, VA 22092

In Reply Refer To:  
Mail Stop 411

February 11, 1992

Dr. Anthony P. Tummarello  
U.S. AID-RD-R  
Room 320  
1601 No. Kent Street  
Rosslyn, Virginia 20523-1818

Dear Dr. Tummarello:

Reference is made to your request for my opinion on the Technical basis for the unsolicited proposal by Robert A. Bisson concerning ground-water exploration in Botswana.

Following Mr. Bisson's presentation, review of the material provided by you and Mr. Bisson, and discussions with various colleagues, I conclude that the "mega watershed" conceptual model can be used to guide ground-water exploration in the Okavanga delta and adjacent areas in Botswana. I suggest that initiation of the phase one proposal should be made contingent on the identification of a qualified contractor ready to implement phases two through four of the project on a timely basis.

If you have any questions, please contact me at FTS 959-5721.

Sincerely,

Peter R. Stevens

Unsolicited Proposal  
for Prefeasibility Study regarding  
the application of the Megawatershed conceptual Model  
to Groundwater resource assessment in Botswana

Submitted by

Robert A. Bisson,  
Exploration Consultants  
P.O. Box 440  
Melvine Village, N.H. 03850  
(603) 544-9058

## TABLE OF CONTENTS

pg	1	Unsolicited letter proposal
pg	4	The water problem
pg	5	The groundwater Solution
pg	7	Design Phase-Scope of Services
pg	8	Prefeasibility Study scheduling
pg	11	Study area - regional map
pg	12	Study area - Botswana map
pg	13	The Okavango River/delta system - map
pg	14	The Okavango River/delta system - statistics
pg	15	The IUCN World Conservatio Union, Project Review on the proposed "Southern Okavango Integrated Water Development Project"
pg	30	Prefeasibility Study Budget
pg	31	Consultant's Biography

December 6, 1991

Mr. Howard M. Fry  
Acting Associate Administrator for  
Operations  
Room 3942 NS  
Washington, D.C. 20523-0072

Dear Mr. Fry,

I am writing to propose a U.S. A.I.D. groundwater mapping initiative in Botswana which will have significant near-term environmental benefits as well as provide for very substantial mid and long term economic growth for the entire SADCC region. Under USAID auspices, the proposed project would create fertile ground for the development of a coalition of environmentalist groups and private-sector participants from the entire region, brought together by the opportunity to save a natural treasure - the Okavango Swamp and at the same time provide all the water necessary to realize the economic potential of the area.

Currently, USAID has regional priorities in the SADCC states which include environmental issues, ranging from sustained agricultural and economic growth to the conservation of biological diversity in wilderness areas, such as the Okavango Delta. With population growth in the region approaching 3.5% and deteriorating income levels and nutritional status, there is substantial pressure to trade off a rich wilderness and wildlife heritage for the short-term comforts brought by the explorations of irreplaceable natural resources. In his 1991 report to the Global Coalition for Africa, Robert S. McNamara summarizes this perspective quite well when he writes "... natural resource management must be seen from both a 'production' and a 'protection' perspective. It is not enough to argue that land, water, and other natural resources should be conserved for their intrinsic value or beauty. As they are being protected, ways must be found to make them productive. The essence of sustainability is this combination of productivity and protection..."

In the continental rift areas of Southern Africa, there exists an untapped water resource of major use to all people of the region. In similar geologic terrains in Africa USAID has already proven that major undiscovered fractured rock resources can be mapped and tapped. By creating the opportunity in Botswana to develop major new water supplies while conserving a very high profile natural ecosystem, the Agency will clearly demonstrate the

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'Africa's Development Crisis: Agricultural Stagnation, Population Explosion and Environmental Degradation, April 1991.

Best Available Copy

relevance and viability of a new type of water strategy, based on proven U.S. space-age technology and know-how and pioneered by USAID in East Africa.

Last week, at a preliminary briefing session, I presented a proposed action plan, in concept, as described in the attached material. The people present who were familiar with the Okavango Delta and Botswana's socioeconomic realities responded with resounding encouragement, while others less experienced in the region asked excellent questions and appeared intrigued with the prospects.

In government, as elsewhere, timing is everything and there are two points of timing I would like to underscore here. First, according to Doug Lee, (the National Geographic writer who spent nearly a year in Botswana comprehensively researching his Dec, 1990 cover story on Botswana and the Okavango) the only water option currently being explored by the Botswanan government and its consultants is to perform major "surface surgery" on the Okavango Swamp, which will set the stage for much, much more of the same process, as the enclosed 1985 news article describes. (Since then, the scope of the dredging program has expanded considerably). After many years of bitter debate, the Government of Botswana has permitted one last opportunity for Environmentalists to demonstrate realistic, "Benefit-Cost-related," reasons for not proceeding with the Okavango Water Development scheme, and make some specific recommendations for modifications of the proposed work plan. The deadline for the draft report, being done by the International Union for Conservation of Nature (IUCN) is May, 1992. The project I propose to do with USAID must therefore generate a significant product in synchrony with the IUCN report.

Second, the Brazil Global Conference on Environment and Development will be held in June, 1992. The Botswana project is a perfect example of U.S. technology capable of enabling "preservation and production" of Africa's critical natural and human resources - (a la McNamara's quote). With an ongoing coalition built among all of the interested Botswana parties, and monitored by other international institutions, USAID will be able to contribute, substantively, to the Brazil Conference.

Because of the urgency represented by the fixed May-June, 1992, dates described above, action must be taken immediately to fully evaluate the current situation in Botswana, identify and assemble the requisite technical team and databases, and build a (Botswana) national/international coalition of key water users, political leaders and environmentalists.

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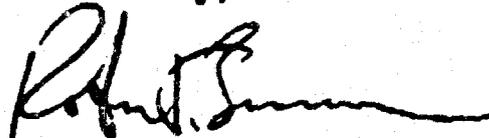
The timeframe to complete this "design" phase of the project (see attached descriptions) is 60 days and the "products" will include a written scope of work for the water mapping program, with all key participants identified, plus a high level USAID verbal, "interactive" briefing on the results of the "field" work, with recommendations from key participants and discussion of policy implications at USAID.

During the design phase, I will be using a considerable amount of data from my own archive and intend to use a D.C.-based GIS contractor, plus several other specialized consultants in the U.S., Europe and Africa. In addition, I expect to travel within the USA, to Europe and Southern Africa extensively.

I propose a fixed price of \$90,000 for these services.

I very much look forward to the chance to contribute to this effort.

Sincerely,



Robert Bisson

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## The Problem

Botswana possesses many natural resources, from the diamonds in the ground to the ingenuity of its people, but the most remarkable resource of all is the freshwater bounty of the Okavango. Therein also lies the problem.

Because the ancient Okavango River and delta system is of such enormous proportions (over 10,000 square km) and contains fresh surface water throughout its domain, it has long been the focus of major attention from man and beast alike.

In his forward to the book Okavango, Raymond F. Dasmann, Chief Ecologist, International Union for the Conservation of Nature and Natural Resources, Switzerland, wrote:

"Where water spreads out over otherwise dry land it becomes of interest to all people and an almost irresistible attraction to engineers and developers. All of Africa's great swamps from the Nile Sudd to the Okavango have received attention from those who want to do something different with the land or water. Wetlands are usually highly productive ecosystems, and most tropical swamps are unusually productive."... "Primitive peoples have learned to adapt, to live in harmony with, and thrive on this complexity of life. The technicians of the modern world are less patient, less willing to understand diversity, to use what the natural world can of itself produce. Instead, where diversity occurs in rain forest or swampland we find efforts to simplify, to narrow the range, and force the system into directions determined by mankind. Thus swamps are drained, their waters channelled elsewhere, their life destroyed. Perhaps it did not matter when people were few and wild nature was in the ascendant. But it has happened too often in too many places. Now the wildness everywhere is threatened such losses are less tolerable.... In Botswana water is scarce and precious. Its presence determines how well people survive, its absence leaves large areas uninhabitable. Yet Botswana has one of the world's great wetlands where the abundance of water limits human occupancy. The contradiction brings temptation to change the pattern to direct the water elsewhere. It is easy to measure short-term gains that could result from water transfer. It is much more difficult to quantify the long-term losses that would result from the impairment or destruction of one of the world's great wildlife habitats. One could reasonably ask that, for once, sufficient time be allowed for comprehension of the real values of the natural diversity of the Okavango, and for developing the means for maintaining a sustainable balance between natural requirements and human demands.... Unlike most African nations Botswana is still blessed with a richness of wildlife that will grow in

value as time passes and the world changes. The original people of Botswana survived and lived well with only that wildlife to support them. It is an open question whether people could long survive the disappearance of wildlife. One hopes it will not be put to the test. So, let us consider the Okavango."

Over the past 60 years, from Colonel Charles Reys' leaky dams to the present day dam, canal, pipeline, etc. proposals, people have been seeking some method to extract water from the Okavango without sacrificing the most productive and awe-inspiring ecosystem in southern Africa.

In the book Okavango (Page 47) Johnson and Bannister discuss the results of a 1976 symposium on Okavango water schemes and quote Keith Thompson's summation of the conference "...The Okavango Delta is a huge natural resource but its economic potential is not as great as many people imagine....Deltas are very difficult systems to develop successfully. They are complex and they are fragile and many mistakes have been made in the past. Man's technology is nowhere good enough to approach the efficiency of a natural swamp ecosystem...."

Nevertheless if the country is to continue to prosper the public and private sector of Botswana are convinced they require expanded reliable water resources and they continue to focus their creative efforts on discovering a way of reconfiguring the swamp to meet their water needs. By June 1992, decisions will be taken by the Botswanan Government to take some action with the least perceivable impact of the Okavango Delta ecosystem.

### The Ground Water Solution

It is well known that Botswana is crosscut by faults which have been very active through geologic history. For the past 100 years, field work and seismic monitoring performed by scientists and explorers, ranging from Dr. Livingston and James Chapman, to U.S. Geological Survey Seismic experts, have noted that the Okavango straddles a very active fault system, with large earthquakes a normal occurrence and with profound, well documented influence over the surface water of the Okavango River and delta system. For example, in 1952, 23 earthquakes shook the region and the Boro River, which had been nearly dry for 30 years, began to flow again. An average of three earthquakes per year still occur below the Okavango.

Further, the freshness of the surface waters throughout the Okavango River and delta system is so extraordinary that when David Livingston first explored the water (Southeast) extremities of the Delta, in 1849, he wrote "...We found the water to be so clear, cold and soft the higher we ascended that the idea of melting snow was suggested to our minds..."

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The combination of active continuous rift-faulting and massive annual freshwater flows, with the lack of salt build up in the surface water must lead one to suspect the existence of a very leaky bedrock system, which is open over a very large area to receive the annual deluge of new water from the River systems of Botswana.

Given that water is a "universal solvent" and that when so much water (as us evidenced in the Okavango), eventually leaves the earth's surface as vapor, it must leave behind its dissolved salts in very significant quantities, then one only has to search for this "water spoor" using appropriate techniques. In fact, when one looks at Botswana from 500 miles altitude, the natural groundwater discharge points of the Okavango megawatershed become obvious. The great pans of the Kalahari, in addition to receiving and reporting local rainfall, are most certainly the major discharge areas for the great underground water systems The African Rifts have created. Again, from the clear perspective attained by satellite remote - sensing one can clearly see the relationship of the regional great faults to the surface and groundwater flow regime.

This first discovery addresses the basic geography of the regional water cycle in Botswana, which provides us with the opportunity to discover the critical attributes of the actual water balance of the region. In practical terms, a substantial percentage of fresh surface water inflows from the Okavango and Chobe River basins actually flows into, and through a groundwater transmission system which extends over almost all of Botswana plus parts of Angola, Zambia, ~~Nairobi~~ and Zimbabwe. The amounts of water involved in this system of underground conductors is likely to represent a large percentage of the previously assumed "potential" evapotranspiration from the Okavango delta. This represents tens of billions of cubic feet per year of renewable water, coursing through fracture systems pervading the region and currently evaporating directly from the water table, leaving only its salt burden as evidence of its passing.

These discoveries represent a real near-term opportunity for U.S. - initiated solutions to water-related problems plaguing the western SADCC states. In addition, the eastern splay of the African Rift System penetrates the remaining SADCC countries, with similar promise for problem-solving and economic development.

## Design Phase - Scope of Services

1. Identify and assemble Project Team
2. Contact/re-contact key individuals in government and private sector in Botswana and Internationally. Build coalition group of key players for near and long term project benefits (to Botswana, other SADCC states and USAID)
3. Identify primary data sources and arrange access
4. Set up and begin using GIS capability in D.C. for Exploration Phase of project (GIS output and databases will be compatible with, and provided to, the IUCN GIS, the Botswanan government, and others, as appropriate)
5. Investigate (preliminary) inter-institutional public and private-sector funding for future test drilling and development programs.
6. Identify and evaluate Botswana drilling contractors using Bisson's fractured rock drilling specifications as well as for relevance and accuracy of existing well logs.
7. Write Recommendations and "scope of work" for mapping program and carry out full project briefing with key USAID participants.

**MEGAWATERSHED GROUNDWATER MAPPING AND TESTING - "PROOF OF CONCEPT" PROJECT - FOR ECONOMIC DEVELOPMENT AND ENVIRONMENTAL CONSERVATION IN BOTSWANA AND THE SADC STATES**

**1st Stage - Botswana - Target completion date: March 23, 1992\***

ks  
Establish highest level U.S.-Botswana political rapport with regard to Megawatershed model socioeconomic/environmental implications for Botswana. Receive agreement of Botswana government to carry out phases I and II of project, for inputs to 1992 International Union for Conservation of Nature and Natural Resources (IUCN) Environmental report.

Update Botswana database from sources in Africa and in Europe/U.S.A.

Establish linkages with appropriate Botswana government/private agencies for subsequent data acquisition/analysis and ongoing communications with key Botswana players.

Obtain commitments for (future) logistical support for Phase II field work.

⊙ Construct preliminary Botswana basemap for megawatershed analyses, working with appropriate experts and Geographic Information System (G.I.S.) capability in U.S. and Botswana.

Coordinate with appropriate institutional representatives in U.S./Europe/Africa to optimize dissemination and constructive impact of megawatershed demonstration (Phase II) in Botswana, especially with regard to the SADC regional development implications and the global environmental conservation objectives of the June, 1992 U.N. conference on Environment and Economic Development.

**products - March 23, 1992**

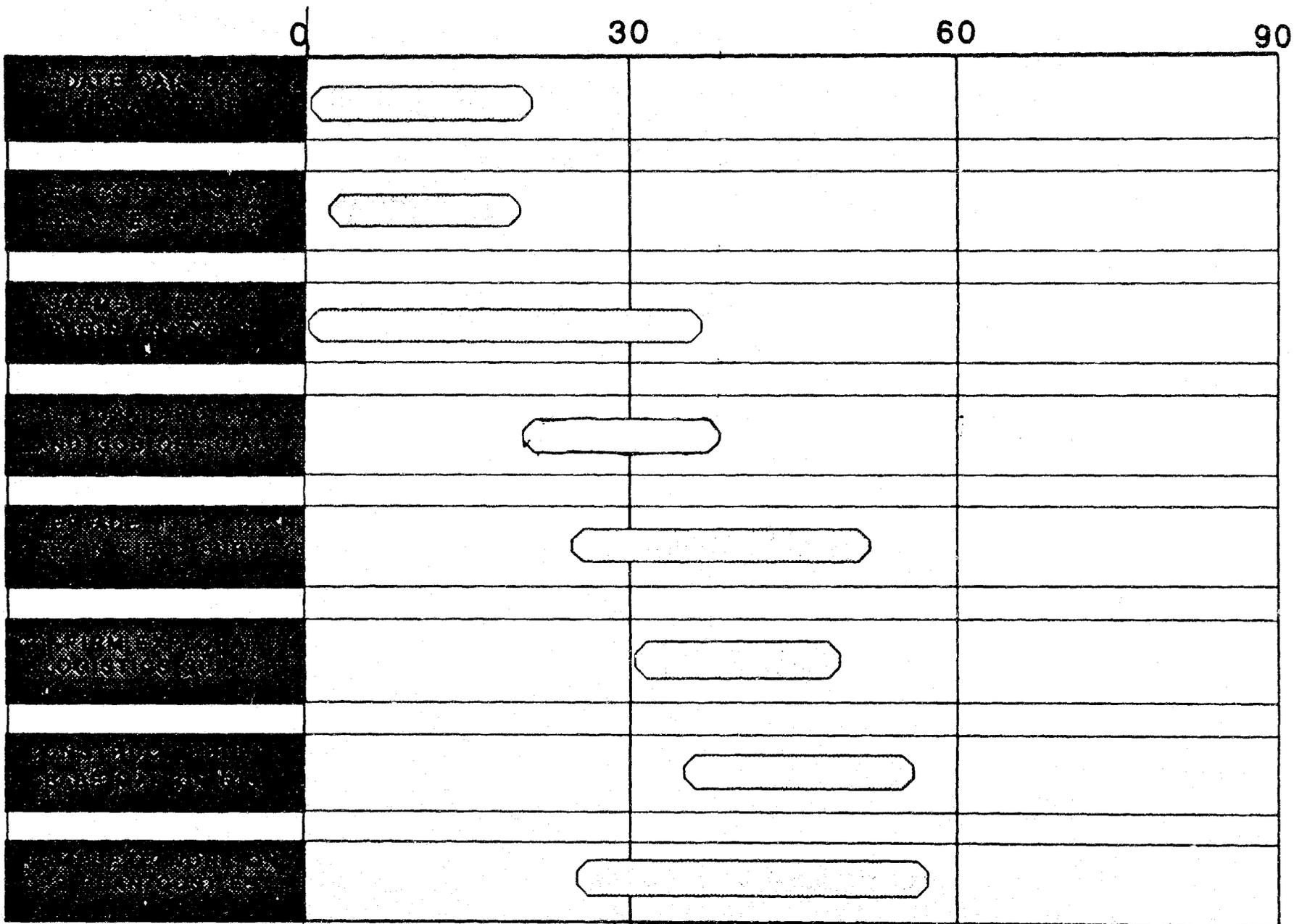
Written feasibility Plan for Phase II Megawatershed Mapping and Test Drilling Project, ready for immediate implementation, with team and resources identified and all permissions, etc. researched and/or committed.

Working Base Maps for Phase II Botswana Megawatershed analyses established on Geographic Information System (GIS) in U.S. and compatible with IUCN system.

\* Assumes work begins under contract during first week of January, 1992

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# PREFEASIBILITY TASK SCHEDULING (BOTSWANA)



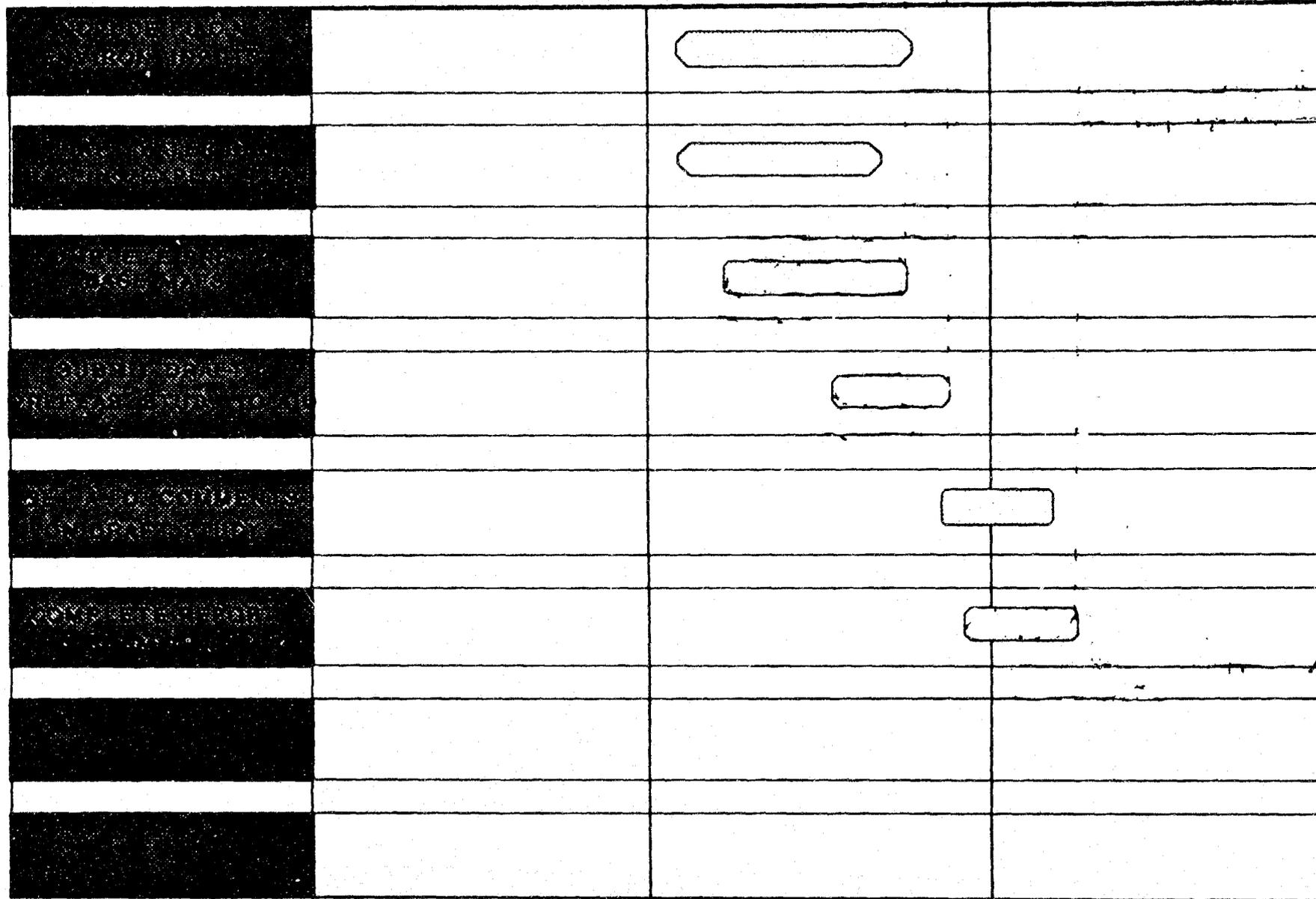
# PREFEASIBILITY TASK SCHEDULING (BOTSWANA)

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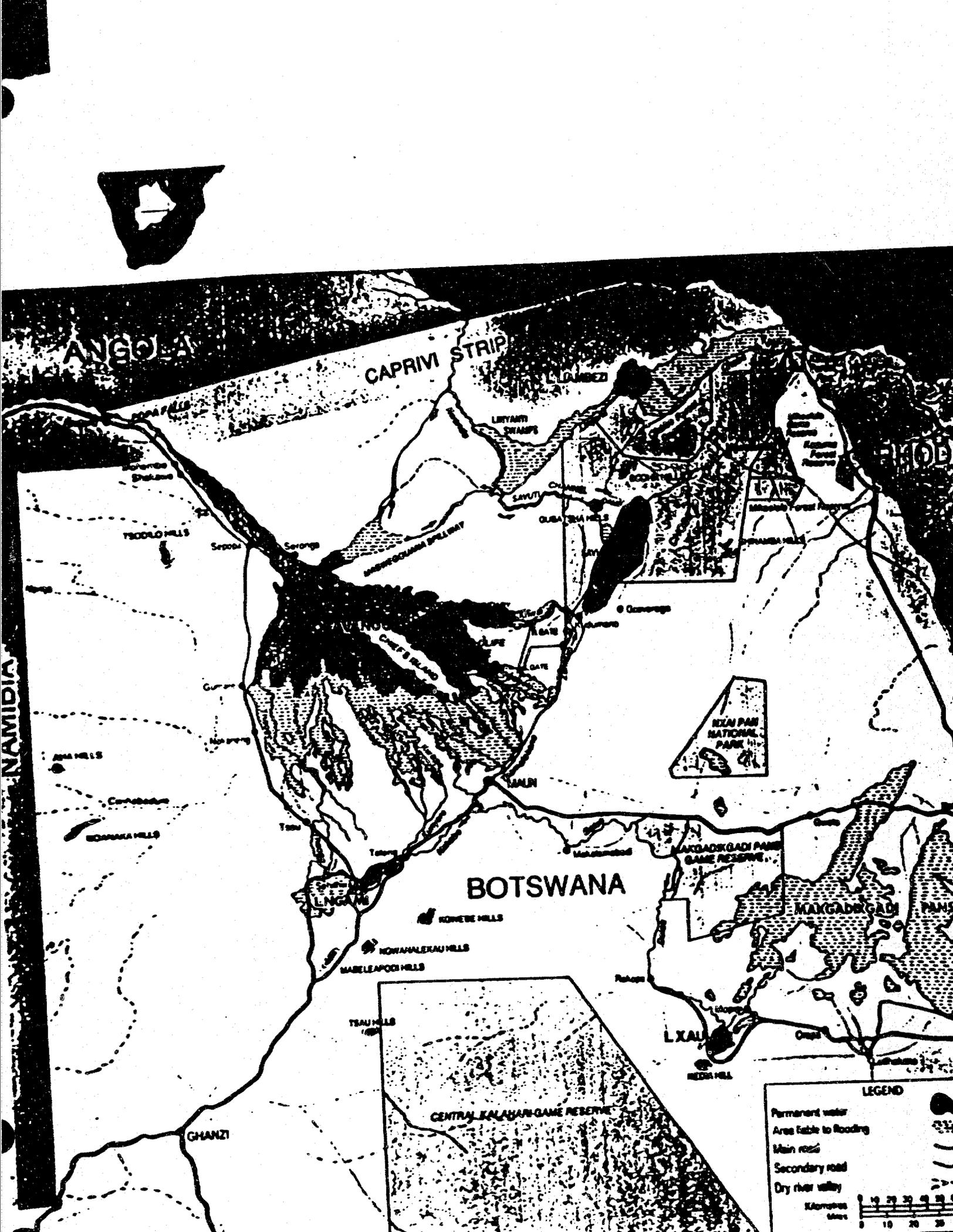
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ANGOLA

CAPRIVI STRIP

BOTSWANA

NAMIBIA

ZIMBABWE

CENTRAL KALAHARI GAME RESERVE

NXAI PAN NATIONAL PARK

MAKGADIKGADI PANS GAME RESERVE

**LEGEND**

- Permanent water
- Area liable to flooding
- Main road
- Secondary road
- Dry river valley

Kilometers  
Miles

0 10 20 30 40 50

0 10 20 30

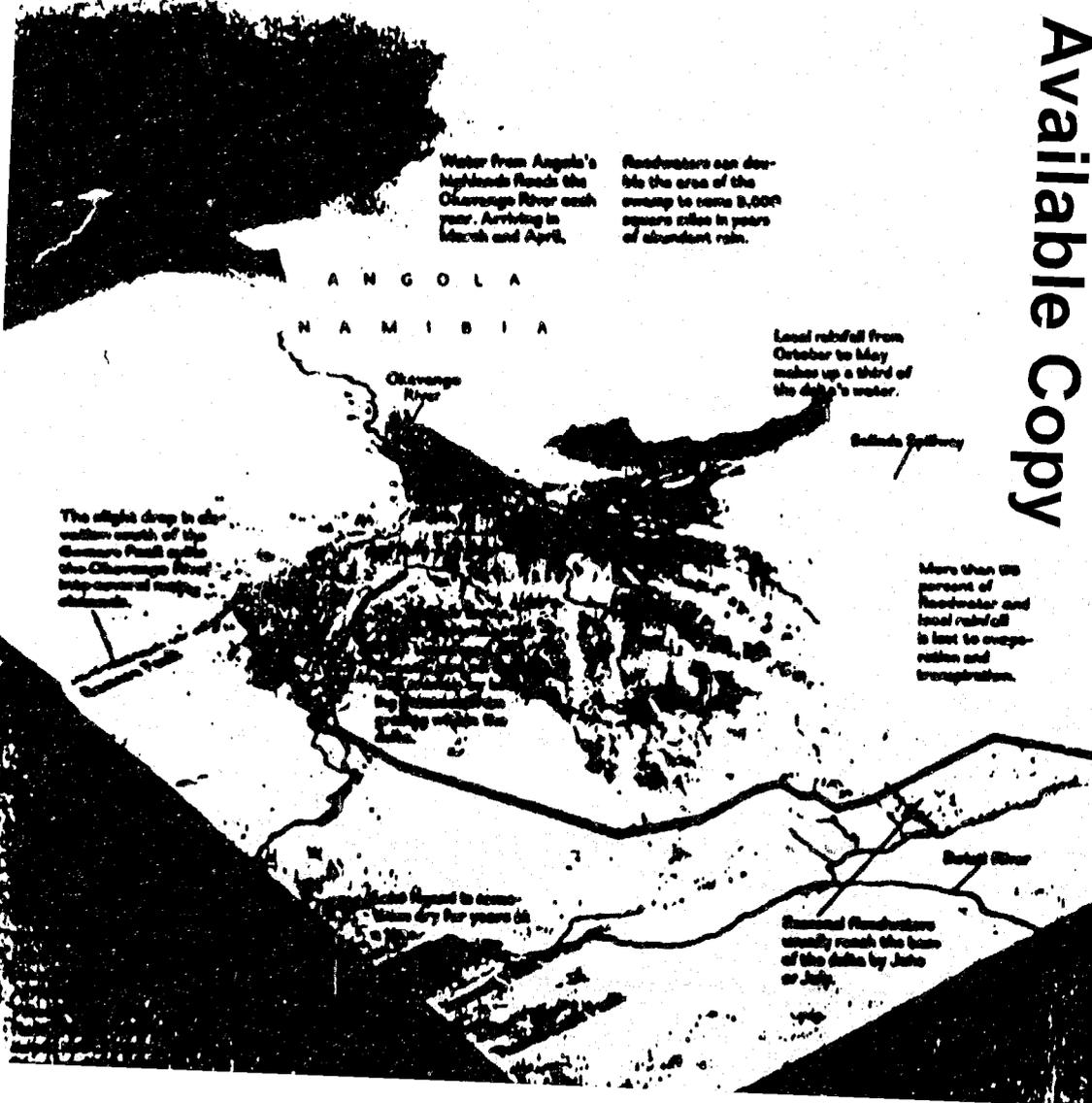
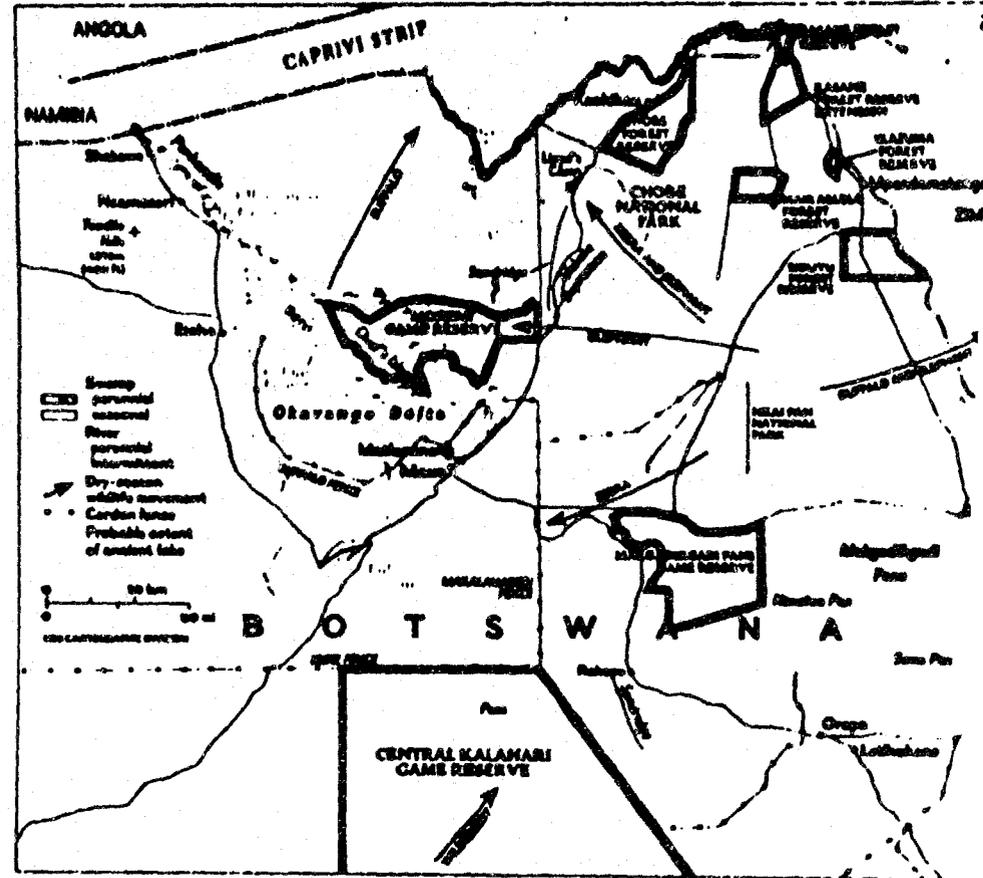
# Land of disappearing rivers

**F**ED BY RAINS in the mountains of Angola, the Okavango River flows southeast through Namibia's Caprivi Strip before entering landlocked Botswana. There the river meanders for 60 miles between two parallel faults in the earth's crust, creating

the Panhandle floodplain. Spilling over the Gomsere Fault, the river divides into several main channels and a labyrinth of shallower watercourses. In all, seasonal flooding causes some 350 billion cubic feet of water carrying as much as 727,000 tons of sediment to

spread out into an alluvial (an, the world's largest inland delta. Practically all the water evaporates. What little remains runs up against the Thamalakane Fault and flows southeast down the Boteti River toward the Makgadikgadi Pans or southwest toward Lake Ngami.

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Water from Angola's highlands floods the Okavango River each year. Arriving in March and April, floodwaters can double the area of the swamp to some 8,000 square miles in years of abundant rain.

Local rainfall from October to May makes up a third of the delta's water.

Boteti Railway

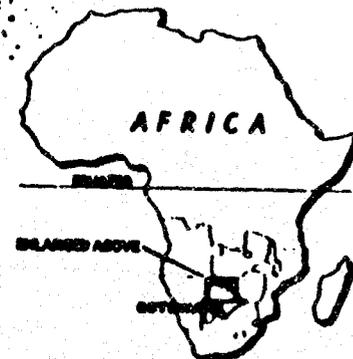
More than 90 percent of floodwater and local rainfall is lost to evaporation and transpiration.

The Boteti River has been dry since 1982, but the rain-fed Boteti Marsh remains an important wildlife habitat.

The slight dip in elevation south of the Gomsere Fault splits the Okavango River into several main channels.

Some floodwaters remain dry for years at a time.

Seasonal floodwaters usually reach the base of the delta by June or July.



Botswana has set aside 17 percent of its land as national parks or game reserves, one of the highest percentages of any nation. However, measures to protect the cattle industry have sometimes proved disastrous for wildlife. Beginning in the 1970s, the government built fences to control disease in commercial herds, which must comply with tough standards set by the European Community disease-free beef. Some of these fences restrict migration to and from national water sources, result in many animals dying — more than 50 wildebeests in 1981.





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**IUCN**

**World Conservation Union**

**SOIWDP Review  
INCEPTION REPORT**

Gaborone, Botswana  
October 1991

## I. Introduction

In a Memorandum of Understanding signed in October 1991 between the World Conservation Union (IUCN) and the Government of Botswana (GOB), it was agreed that IUCN would "undertake an independent review of the Southern Okavango Integrated Water Development Project [SOIWDP], the studies that led to this proposal, and the criticisms that have currently been made of this [proposal]." The review started on 11 October 1991 and its final report is scheduled to be produced on 10 June 1992. The primary purpose of this Inception Report is to outline the schedule of activities leading to the presentation of the final report within that time period. In the text that follows, Figure Two illustrates this proposed schedule in bar graph form. Appendix One summarises activities initiated during the first three weeks of the Review, while Appendix Two summarises the expertise and terms of reference of the eleven team members.

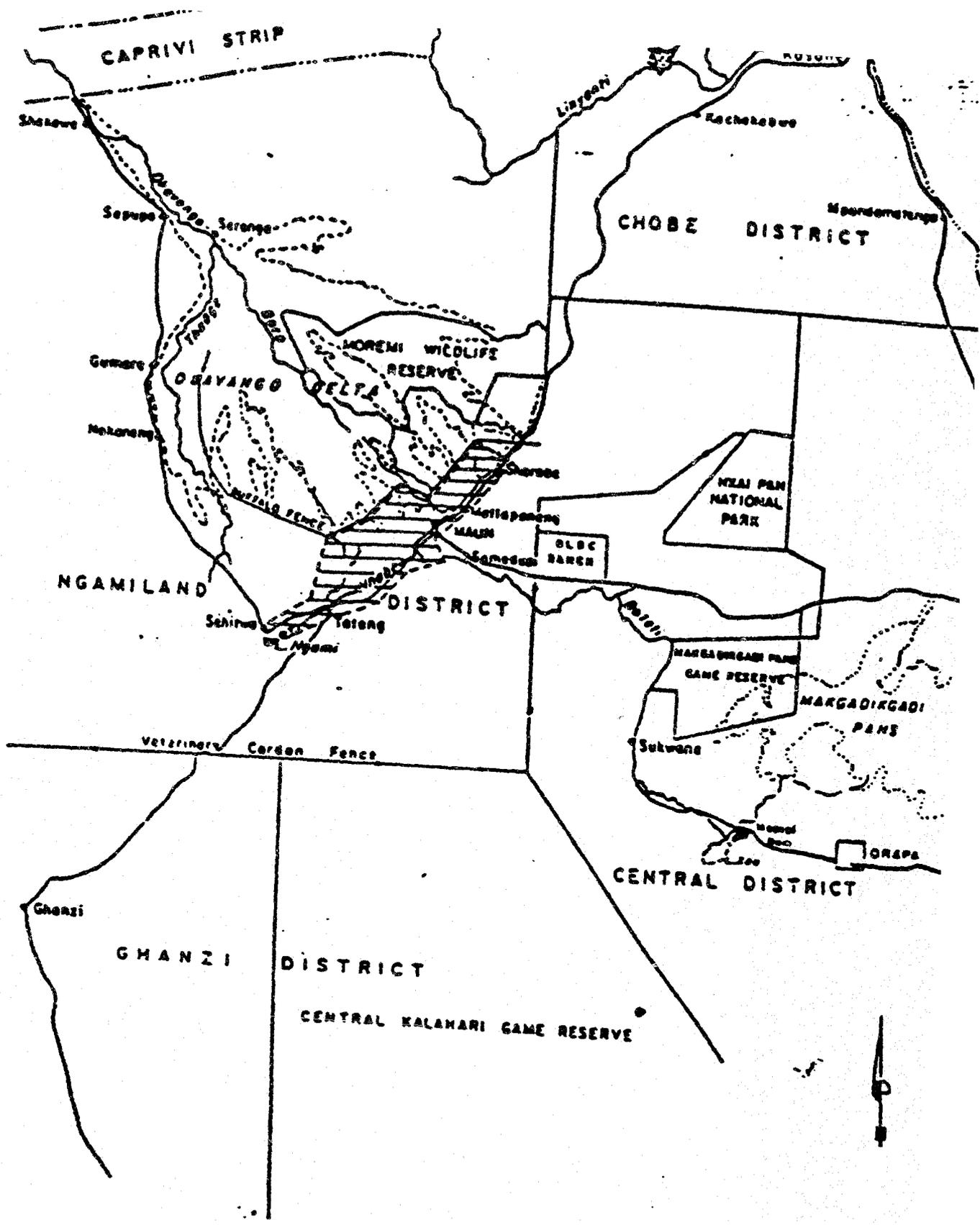
## II. IUCN's Conceptual Approach

Under the Memorandum of Understanding, the Scope of Work states that the objective of IUCN's independent review "is to undertake a detailed assessment of the Southern Okavango Integrated Water Development Project and in particular the Lower Boro Improvement Works" as proposed in reports prepared by Snowy Mountains Engineering Corporation (hereafter referred to as the Consultant). Since the results of the Consultant's modelling are crucial to the proposals, special attention will be paid to the hydrological, hydraulic and system models.

To carry out an assessment "in sufficient detail that the GOB and other concerned parties can feel confident all the key issues have been adequately addressed" requires IUCN not only to carefully assess the SOIWDP but also to compare it with other alternatives. The IUCN will emphasize alternatives that have a relatively local impact on the delta, such as those that involve well fields adjacent to Maun and Okavango Delta channels and wetlands that lie outside the Veterinary Cordon Fence. IUCN, however, will also consider alternatives of broader scope that lie within the Okavango region. For this purpose, the Okavango region includes the entire Okavango basin and its historic and prehistoric connections with the Linyanti-Chobe-Zambezi system (Figure 1).

While it will not be possible for IUCN to make a detailed assessment of past, present, and future conservation and development activities in Angola and Namibia as they affect the Okavango River, IUCN's review of alternatives will attempt to consider, on the one hand, possible implications of activities in those countries as they relate to different options for Botswana and, on the other hand, possible implications of Botswanan activities as they relate to Angola and Namibia.

Pages 13-14 of the Terms of Reference stipulate that IUCN shall consider what may happen beyond the 25 year planning horizon of the SOIWDP, especially if "demands increase more rapidly than anticipated. IUCN shall examine this issue in relation to the National Water Master Plan (NWMP) and ascertain what



0 50 100 Km

 Target Agricultural Area

**SOUTHERN OKAVANGO STUDY  
PROJECT REGION**

**FIGUR**

alternatives could be considered. The IUCN team to incorporate Chobe District within its scope of work. Consider, in relationship to the SOIWDP and other alternatives, various long-term proposals to off-take water from the Zambezi system, and to recommend further studies.

### III. Methodology

Starting with the SOIWDP, IUCN's methodology will concentrate on differential demand for water resources of the relevant categories of users within Ngamiland and Central Districts, and on sources of supply within the Okavango system and adjacent aquifers (including those outside the Veterinary Cordon Fence in the vicinity of Maun and those adjacent to and southeast of the Orapa mining complex).

#### A. Demand

→ During the review, a key objective is to evaluate the demand for water resources, and to select one or more methods for meeting that demand. In assessing demand, IUCN will emphasize the Okavango basin within Botswana. Larger than the SOIWDP area but smaller than the Okavango region as previously defined, the Okavango basin in Botswana must be dealt with as a whole if IUCN is to review management plans for the Okavango Delta, and if IUCN is to provide guidance on the economic value of the Delta as requested in the Terms of Reference (Appendix 1: pp 13-14).

Current demand, and projected demand over the next 25 years under different demographic and development scenarios, will be assessed for at least six categories of users: (1) domestic and commercial users with special emphasis on Maun and outlying communities, and on communities along the Boteti and Nhaba Rivers; (2) industrial users with special emphasis on the Orapa mining complex; (3) villagers and herders with special emphasis on gathering, hunting, fishing, flood recession (molapo) cultivation, and livestock management activities; (4) more intensive commercial irrigation; (5) tourism, safari hunting, and commercial utilization of wildlife; and (6) new ventures which may make a significant demand for water within the planning horizon.

While cost must figure prominently in any solutions proposed to meet future demands, environmental, demographic, health, sociological, and political factors must also be emphasized. The relationship of such factors to possible ways of reducing demand, such as tighter regulations on connections, water charging policies, and zoning activities (in Maun, for instance, and other service centers within the basin, and within the basin as a whole) need be carefully assessed before proposing solutions.

#### B. Supply

The hydrological data used by the Consultant; hydrological, hydraulic, and system supply models; and design of physical works in connection with the SOIWDP will be reviewed in detail. Data review will include its

completeness and accuracy, .....  
new data collected since the completion of the Consultant's study. The appropriateness of the data, and of the models used by the Consultant, will be assessed. The models may be run with additional data and/or different values of their parameters to estimate the influence of these factors on the conclusions. In particular the effect of basing the model calibration on the "low flow regime" will be considered.

If it is felt that more reliable results would be produced by modifications to the models used by the Consultant or by the use of different models then, if time permits, the IUCN will use such models. Otherwise recommendations for future modelling studies will be proposed.

#### IV. Schedule of Activities

Because of time constraints (a draft final report is due within six months), and constraints on the availability of team members, it will be necessary to combine IUCN's review of the SOIWDP with assessment of a wider range of alternatives. Figure Two outlines the proposed work schedule for the IUCN Team. Figure Three in Appendix Two illustrates in-country visits for each team member. In terms of data collection and preliminary analysis, two orientation tours of the Okavango basin within Botswana have been scheduled for team members. The first, involving the IUCN coordinator, the hydraulic engineer, the hydrologist, and the team leader, occurred from October 16 through October 23. It is described in Appendix One. The second is scheduled for early January and will involve most members of the IUCN team. Throughout the Review the team leader will be based in Maun and the hydrologist in Gaborone.

As illustrated by Figure Two, data collection (including extensive interviewing of users and interested parties in both Gaborone and the Okavango region) and on-going data analysis will continue into March. In December the hydrologist and the hydraulic engineer will travel to Australia to meet with the Consultant passing through Boston on their return to meet with the IUCN water resources planner. Synthesis will commence in January with the Draft Final Report submitted in April. It is at that time, but not before, that the IUCN team will be in a position to discuss its conclusions and recommendations as they relate to the SOIWDP and to possible alternatives to the SOIWDP.

**Best Available Copy**

**Schedule of Activities  
for Reviewing SOIWDP and Possible Alternatives**

	1991			1992					
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
<b>Demand Analysis</b>	Review land use								
	Review water needs								
	Analyse demands and management alternatives*								
<b>Supply analysis</b>	Review input data								
	Review existing models								
	Run existing or new models*								
<b>Synthesis and report writing</b>	Review existing design								
	Preliminary design of alternatives*								
	Integrate demand and supply analysis*								
	Inception report								
	Draft final report*								
	Final report								

*Business preferences\*  
input to 5 Jun*

for completion of the Final report. Should any material or further data collection, the Terms of Reference for the Review allow for further work if agreed upon by the Government of Botswana and IUCN.

V. Reports

In addition to this Inception Report, a Draft Final Report will be submitted to the Government of Botswana. This will be circulated to all interested organizations and parties for comment within one month. A Final Report will be submitted by June 10.

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## I. Meetings

During the first three weeks, IUCN Team meetings included the following individuals and representatives of concerned parties:

- The Director, Deputy Director and Principal Hydrological Adviser, Department of Water Affairs, Gaborone, and the Station Co-ordinator and Officer-in-Charge, Operation and Maintenance, Maun
- The District Commissioner and the District Officer (Lands), Ngamiland
- The Council Secretary, North West District
- The Secretary, Batawana Tribal Administration
- The Secretary, Tawana Land Board
- The Consulting Engineer and Group Secretary of Anglo American Botswana
- The Chief Engineer, the Deputy Chief Engineer, and the Chief Geologist, Debswana, Orapa
- The Team Leader, Snowy Mountains Engineering Corporation
- Members of the Technical Committee and the Conservation Officer, Kalahari Conservation Society
- The Chairman and members of the Kalahari Conservation Society, Maun
- The Chairman and members of Tshomerelo Okavango Conservation Trust
- The Head and Senior Programming Officer of the Development Co-operation Office, Swedish Embassy

## II. Report Reading and Data Collection

In addition to commencing their review of over 40 feasibility, environmental impact assessment, ecological zoning, and design documents prepared by the Snowy Mountains Engineering Corporation and their consultants, IUCN team members obtained and commenced review of the following documents:

- Botswana National Water Master Plan (in 12 volumes), Department of Water Affairs, June 1991.
- Okavango Delta Region, Volume I (Natural Resource and Utilisation Inventory) and Volume II (Draft Final Report: Programme Phase), Swedeplan, 1989.
- UNDP/FAO, Investigation of the Okavango Delta as a Primary Water Resource for Botswana, 1977
- Symposium on the Okavango Delta, Botswana Society, 1976
- Jamie Skinner, Review of Environmental Impact Studies Concerning the Southern Okavango Development Project, Botswana, July, 1989
- P.A. Smith, The Southern Okavango Integrated Water Development (SOIWD) Project, June-July, 1989
- L.J. van der Heiden, Land Use and Development Plan: Kwando and Okavango Wildlife Management Areas. First draft. Tawana Land Board. April 1991.
- Moremi Game Reserve Management Plan. Volumes I - III. Department of Wildlife and National Parks. July 1991.

and reports will be requested as needed.

### III. Activities

During the October 16-23 period, field visits commenced using Maun as a base. Approximately eight hours were spent in aerial reconnaissance. Three familiarization flights were taken covering the Okavango Delta; the Thamalakane, Nhabe, and Boteti Rivers; and Lake Ngami. Also included were low level aerial inspection of Okavango Delta outflows from the Gomoti, Santantadibe, Boro, and Kunyere rivers.

Another eight hours were spent on the water inspecting the 42 kilometers of the Boro River that would be impacted upon should the SOIWDP be implemented. Channel characteristics and emergent and submergent channel vegetation were observed. Also, existing channel excavation and bund construction were inspected. Ground inspection was carried out at the proposed structure sites; specifically Toteng on the Nhabe, Samedupi on the Boteti, and Matlapaneng on the Thamalakane. The Shashe well field was also visited.

**Best Available Copy**

## I. Introduction

Stipulated in the Terms of Reference for the SOIWDP Review is that no team members should have had direct or indirect involvement with the project. Nor should they have been recently utilized by the Government of Botswana or other interested parties. At the IUCN end, an early decision was made to recruit team members internationally based on the relevance of their expertise, with the result that only one team member (G. Howard) is an IUCN official (and in that case he was recruited not because of his recent employment by IUCN but because of his expertise relating to Zambia's Kafue Basin wetlands, and to the Middle Zambezi).

In recruiting international personnel, IUCN selected the team leader because of his 35 years of experience in analyzing the impacts of river basin development projects on local, regional, and national populations, with special emphasis on African river basins. Team members were selected on the basis of three criteria. The first was disciplinary expertise, with the result that the team includes two biologists, three engineers, four physical scientists, and five social scientists (the total number of disciplines exceeding eleven since some members are qualified in more than one discipline). The second was extensive experience with riverine ecosystems in Africa, with special emphasis on Central and Southern Africa (hence selection of Howard, Lawry, Manley, Scudder, Taylor, Turner, and Wright, with Howard, Manley, and Scudder having also worked elsewhere in the Tropics and subtropics). The third was extensive experience with wetland environments elsewhere in the world (hence selection of Coley, Davis, Rogers, and White).

Where persons with special local knowledge or complementary expertise are needed the team may make use of such people. They will not form part of the IUCN review team.

## II. Biodata and Terms of Reference

Ronald W. Coley (Hydraulic Engineer).

A civil engineer, Ron Coley is currently Chief Engineer of Ducks Unlimited, Canada, with responsibility for coordinating all phases of Ducks Unlimited's wetlands development program. With 25 years experience in project design, cost-estimating, cost-benefit analysis, and construction management, his special areas of expertise concern open channel hydraulics and associated modelling.

His terms of reference are to evaluate the soundness of the proposed design of the SOIWDP with particular emphasis on physical works including open channel hydraulics and associated modelling; establish the adequacy of the above design to meet water demand at minimal environmental impact to the overall area; and determine the feasibility of possible alternative solutions from an economic, environmental, and practical engineering viewpoint.

Currently Senior Associate at the University of Colorado - Behavioral Science, Robert K. Davis served as Assistant Director for Economics in the U.S. Department of Interior's Office of Policy Analysis from 1976 to 1985. With degrees in Agriculture, Soil Science, Public Administration, and Economics (PhD, Harvard University), Davis has specialized throughout his career on the economics of natural resource management, including water resources, fisheries, rangelands, and wildlife. From 1967-1970 he worked in Kenya, serving first as Ford Foundation economic adviser to the Kenya Ministry of Tourism and Wildlife and subsequently as Visiting Senior Research Fellow at Kenyatta University's Institute for Development Studies.

His terms of reference are to undertake social benefit-cost and/or other analyses as appropriate to assess the advantages and disadvantages of the SOIWDP in regard to other possible alternatives for meeting present and future local, regional and national demand for water resources in a fashion that is sustainable environmentally, economically and institutionally. More specifically, he will advise on the economic value of the Okavango Delta in terms of its biological productivity and current and future uses of that productivity, assess the accuracy of forecasts of future water demand, and advise on the economic feasibility and impact of water pricing and other water conservation measures for village, urban and industrial users.

3. Geoffrey W. Howard (Biologist)

Recently appointed Coordinator of IUCN's wetland activities in East Africa, Geoffrey Howard was a member of the faculty of biology at the University of Zambia from 1973-1989. During the last eight years of that period he was Chairman of the University's River Basin Research Project and Committee which concentrated on the Kafue Flats and the Mid-Zambezi. An Australian, Howard took his PhD in Veterinary Entomology and Parasitology at Adelaide. Current research interests emphasize environmental effects of development in African river basins, with special emphasis on ecology of tropical wetlands and population dynamics of wildlife.

Under his terms of reference, Howard will review the SOIWDP and other alternatives (including those suggested by the IUCN team) as they relate to the diversity and productivity of vertebrate and invertebrate communities, and the ecological integrity of the Lower Boro River system. He will also assess the local, regional, national and international importance of the vertebrate and invertebrate diversity of the Lower Boro River system and provide guidance on appropriate mitigating measures for whatever project or projects that may be recommended by the IUCN team.

4. Steven W. Lawry (Land Use Planner)

With a PhD in Land Resources, Steven W. Lawry is Associate Director and Africa Program Coordinator of the University of Wisconsin's Land Tenure Centre. During the latter half of the 1970s he was employed as a regional planner for four years by the Government of Botswana's Department of Town and Regional Planning. During 1981 he was a consultant on regional planning and development

management in connection with the Sudan Government's Jonglei Canal Scheme, and in the mid 1980s he was a social scientist with the U.S. Agency for International Development-funded Land Conservation and Range Management Development Program in Lesotho.

Lawry's Terms of Reference are to advise the IUCN team on issues that relate to land use planning within the Okavango region. More specifically he is to advise the IUCN team on the land use planning implications of the SOIWDP and other alternatives as they relate to the conservation and development of the Okavango region.

5. Ronald E. Manley (Hydrologist)

Ronald Manley is a Chartered Civil Engineer who worked on a number of water resources projects over a 5 year period and then began a time of research in hydrology which led to the development of the HYSIM rainfall run-off model. In 1980 he started his international career with a firm of consulting engineers. Since then he has worked in some 25 countries world wide. Recent projects have included the management of flow forecasting projects for the Niger river basin, in the course of which he developed a model of the inner delta of the Niger, and for a river basin in Java, Indonesia. He is currently a free-lance consultant in engineering hydrology.

In the SOIWDP review project his principal activities will concern the models used by the consultants and the data they used with these models. Of the three models he will be concerned largely with the hydrological model of the delta and the water resources system model. His work will include an evaluation of the performance of these models and may include development of new models if this is considered necessary. He will work closely with the hydraulics consultant on the third model which studied the hydraulics of the natural and modified river channels. He will be based in Gaborone for 6 months of the study.

6. Peter R. Rogers (Water Resource Planner)

Since 1974, Peter Rogers has been Gordon McKay Professor of Environmental Engineering and Professor of City and Regional Planning at Harvard University. His major research areas include improved methods for managing natural resources and the environment, with emphasis on the use of analytic optimising methods to incorporate both the natural phenomena and the engineering controls, and development of mezo-scale models of resource management that relate directly to macro-economic parameters. Since 1978, he has been actively involved in water resource development issues in Bangladesh and India. He is senior author of the 1989 Eastern Waters Study: Strategies to Manage Flood and Drought in the Ganges-Brahmaputra Basin.

In consultation with the hydrologist and hydraulic engineer, Rogers' Terms of Reference are to evaluate the adequacy of the SOIWDP models. In the event that such models are inadequate, he is to recommend whatever changes and additional studies are required for an accurate evaluation of the water resources aspects of the SOIWDP, or for the design of other works that may be suggested by the IUCN team. He is also to evaluate the effects of the evolution of the delta due to morphological and climatological changes in terms of channel regime and

7. Thayer Scudder (Team Leader)

Thayer Scudder is Professor of Anthropology at the California Institute of Technology and a founding director of the Institute for Development Anthropology in Binghamton, New York. Since 1956, his activities have emphasized the impacts of river basin development projects on local populations in the tropics and subtropics, with special emphasis on the Kariba Dam (Middle Zambezi), Aswan High Dam and Jonglei Canal (the Nile), and, in Sri Lanka, the Accelerated Mahaweli Projects. Chair of the U.S. National Research Council's 1985-89 Juba Valley (Somalia) Study Panel, currently he is a member of the Environmental Panel of Experts for the Lesotho Highlands Water Project.

As team leader, Scudder's Term of Reference require him to direct and oversee the work of IUCN's SOIWDP Review; to ensure that the necessary reports are prepared on schedule; to maintain regular liaison with IUCN's office in Gaborone, and IUCN's Wetland Programme Office in Switzerland; and to solicit the views of government agencies, nongovernmental organizations, local communities, and interested individuals as they relate to the SOIWDP and to the conservation and development of the Okavango region.

8. Alan R.D. Taylor (Biologist)

Alan Taylor took his PhD in plant physiology/biochemistry at the University of Sussex in 1976. His more recent activities include direction of the national research programme on Uganda wetlands; joint organizer of the ODA Agroforestry and mycorrhiza research for semi-arid lands of East Africa; and Project Leader of the Kenya Indigenous Rice Collection Project.

Taylor's Terms of Reference are to assess the botanical diversity and productivity of the Lower Boro river system and to assess its local, national, regional, and global importance. He is also to review the environmental impact study of the SOIWDP in order to provide IUCN with a critical analysis of its strengths and weaknesses, and to advise IUCN on the likely ecological impact of alternative water resource development strategies.

9. Stephen D. Turner (Socioeconomist)

Stephen Turner is a geographer (Ph.D, University of London) whose research area of specialization is Southern Africa. Lecturer in Geography at the National University of Lesotho from September 1978 to September 1980, he served as Senior Sociologist and Head, Applied Research Unit, Ministry of Local Government and Lands, Botswana, from November 1980 through April 1983. From May 1987-December 1990 he was Social Development Officer in the Lesotho Highlands Development Authority. Currently he is a staff member, Centre for Development Cooperation Services, Free University, Amsterdam.

During a three month visit in early 1992, Turner is to analyse local populations in regard to the present and future demand of their economies and communities on the water resources of the Okavango region. He is also to assess the impacts of different development and conservation alternatives, including the

SOIWD, on local populations.

10. Gilbert F. White (Senior Adviser)

A geographer, Gilbert White is former President of Haverford College, Professor of Geography at the University of Chicago, and Director of the University of Colorado's Institute of Behavior Science. A member of the United States National Academy of Sciences, he received the Tyler Prize for Environmental Achievement in 1987. Member or Chair of many U.S. and International Commissions, he was Chair of the United Nations Panel on Integrated River Development, 1957-8; Chair of the Committee on Water of the U.S. National Research Council, 1964-1968; Scientific Adviser on man-made lakes to the Administrator of the United Nations Development Programme, 1966-1971; Chair of the Commission on Natural Resources of the National Research Council, 1977-1980, and Executive Editor of the journal Environment from 1983 to the present.

Gilbert F. White's Terms of Reference are to provide perspective and advice to IUCN's SOIWD Review team members as they assess the advantages and disadvantages of various alternatives, including the SOIWD, for the sustainable development of the Okavango region. He will also critique the Inception Report, individual reports of team members, and the Draft Final Report.

11. Edmund P. Wright (Hydrogeologist)

After 22 years of service with the British Geological Survey, Edmund Wright retired in November 1987 as Head of the Survey's Overseas Hydrogeology Section. Specializing in groundwater resources, he was also Adviser to the British Overseas Development Administration. Since taking his PhD at Oxford, he has worked in Africa, Asia, Latin American, and the Middle East. From 1987 to 1989 he was senior hydrogeological consultant to the World Bank/UNDP Sub-Saharan Hydrological Assessment.

Wright's Terms of Reference are to evaluate ground water supplies surrounding and adjacent to Maun, and surrounding and adjacent to downstream users including the Orapa mining complex, the impact of current use on quantity and quality of those supplies, the impact of the SOIWD and other water resource development alternatives on those supplies, and options for groundwater recharge. In cooperation with the hydrologist and water resources planner, he is also to evaluate the adequacy of the SOIWD models as they relate to the seismic history of the Okavango river basin system and surrounding regions.

**Best Available Copy**

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June
Team Leader (6 months)	-----								
Hydraulic Engineer (6 weeks)	--			-----					
Hydrologist (6 months)	-----			-----					---
Hydrogeologist (2 months)			-----	-----					
Land Use Planner (six weeks)			--		-----				
Economist (3 months)				-----					
Water Resource Planner (3 weeks)				---					
Socioeconomist (3 months)				-----					
Senior Adviser (2 weeks)				--					
Biologist (3 weeks)					---				
Biologist (3 weeks)					---				

## BIOGRAPHY OF ROBERT A. BISSON

Robert Bisson is the founder and past Chairman (retired June 28, 1991) of the groundwater development firm of BCI Geonetics, Inc., and is the principal architect of the firm's integral systems approach to natural resource exploration and management.

Mr. Bisson has, as Chief Executive of BCI Geonetics, initiated hydrogeologic and economic mineral exploration programs for private industry and public agencies, covering much of sub-Saharan Africa. He has worked closely with his colleagues at BCI on research and applications programs for water development in Somalia, Djibouti, Ethiopia, Kenya, Sudan, Mali, Botswana, Zimbabwe, Namibia, and the Republic of South Africa. Before joining BCI, Mr. Bisson had participated in privately-financed exploration programs in several west African states, with a focus on coastal Nigeria and the Camerouns.

In 1985, after personal field investigations, Mr. Bisson designed an unprecedented exploration program for water in Somalia. During the resulting successful project, he collaborated with Dr. Farouk El-Baz, Director of the Center for Remote Sensing at Boston University, on an experimental application of the shuttle-square-borne cartographic "Large Format Camera" (LFC), to a 14,000 square mile arid region of Somalia.

Bounded by Ethiopia and the Gulf of Aden, and without accurate ground control points from available maps, this desolate part of the Horn of Africa was mapped for water potential by Bisson's team using, as a navigation map base, the unique high-quality photographs generated by NASA's LFC, combined with the botanical and geologic information contained in the excellent Landsat coverage of the region. Using innovative exploration methods, the study region was found to possess substantial amounts of water, proven by test wells drilled proximal to population centers for Somalia citizens and Ethiopian refugees. The test wells alone averaged over 200,000 gpd of fresh water per well. The 1986 political upheaval in Northwest Somalia prevented the full testing and development of this major regional fresh water resource.

In 1987-1989, Mr. Bisson and Dr. El-Baz once again teamed up in a BCI-designed water development program in Eastern Sudan, using NASA LFC photos as the "navigation map" base an Landsat and other satellite imagery for hydrogeologic interpretive purposes. The specialized exploration process was this time applied in context with an innovative private-sector partnership with USAID acting as development "catalyst" by funding the groundwater and socio-economic feasibility program. The private sector "pre-committed" its resources to the ultimate development of specific water-

dependent projects, including mining, agriculture and industry, all located in the principal target area -- the Red Sea Province.

The feasibility program was completed to the point of test drilling before political "force majeure" (i.e. a Coup d'etat) temporarily delayed the project. Nevertheless, the plan is in place and partners remain poised to proceed with the next stage of development in the firm belief that the outputs of this innovative joint venture with Sudanese business partners will be profit-producing ventures based on water availability, including agricultural, industrial and mining ventures.

Mr. Bisson's interest in natural and political water constraints in the Near East has led to extensive research and personal conferences with local ministry officials, water engineers, and hydrogeologists in Iraq, Jordan, Saudi Arabia, and elsewhere in the region.

In 1972-1975, Mr. Bisson and former NASA TIROS satellite program manager, Dr. William K. Widger, Jr., pioneered the use of digital computers to expedite the examination and analysis of multi-variate geographic-based data, involving the integral use of remotely-sensed data, including ERTS-1 (the first Landsat). This first-generation "Geographic Information System" was subsequently field tested on water pollution studies and regional land use planning.

1969-1972, Mr. Bisson gained extensive experiences as a professional consultant in natural resource assessments, including environmental baseline data collection and impact statements. He participated in project management and senior technical roles in more than sixty environmental projects, including power plant siting and impact analysis, (hydro-, fossil-, an nuclear - fueled), oil refinery site evaluations, sewage treatment plan watershed impacts, highway impacts, and non-point water pollution studies.

As a student and ocean explorer from 1964 to 1969, Mr. Bisson received formal liberal arts and science education at the University of New Hampshire and The Faculte des Sciences (Marseilles), while pursuing "hands-on" training in the U.S., France and England in modern exploration concepts.

As a research assistant in Marseilles and Monaco, under the patronage of Captain Jacques Yves Coustea, Mr. Bisson participated in the development of modern man-in-the-sea technology and was involved in research concerned with deep-diving technology and human physiology. He later joined a London-based commercial diving company and used his academic training and research experience as a member of one of the first teams of professional divers to work with mixed-gas apparatus of 200-meter depth capability. He went on

to become a project manager for continental shelf mineral exploration at Ocean Science and Engineering, Inc. in Palm Beach, Florida.

In 1988, Mr. Bisson was appointed by Commerce Secretary William Verity to the Industry Sector Advisory Committee for Trade Policy. He has also served on the D.O.C. "U.S. Water Technology Export Council."

Mr. Bisson is a U.S. citizen and maintains residence in New Hampshire and Washington, D.c.

#### Professional Association and Affiliation

At various times during his career, Mr. Bisson has been a member of the following professional organizations and boards.

- o Marine Technology Society
- o Association of Engineering Geologists
- o AAAS
- o Water Technology Export Council - U.S. Dept. of Commerce
- o International Desalination Association
- o National Water Supply Development Association
- o New England Water Works Association
  - o Explorers Club - Fellow

#### Selected Publications

Bisson, R.A., and El-Baz, Farouk, "Megawatershed Exploration Model." Presented at the Water and Wastewater International Conference. Barcelona, Spain, April 1990 (Pub. Conf. proceedings).

Bisson, R.A., and El-Baz, Farouk, "New Groundwater for Sudan -- The Megawatersheds Exploration Model." Proceedings of the 23rd International Symposium on Remote Sensing of Environment. Bangkok, Thailand, April 1990 (Pub. Conf. Proceedings).

Bisson, R.A., and El-Baz, Farouk, "Megawatersheds Exploration Model for African Water Development." Presented at the African Water Technology Exhibition. Nairobi, Kenya, February 1990 (prior published material distributed).

Bisson, R.A., and El-Baz, Farouk, "Megawatersheds Exploration Model." Presented by Robert Bisson to the Third World Academy of Sciences' International Conferences on Desert Environments. Trieste, Italy. November 1989. (Pub. Conf. proceedings).

Bisson, R.A., "Groundwater -- The Ultimate Economic Mineral." Proceedings of the 2nd Annual Conference on Profiting From Water. Santa Monica, California, May, 1989.

Bisson, R.A., Hoffman, Peter D., "Groundwater -- The Paradoxical Economic Mineral." Water and Wastewater Magazine. April, 1989.

Bisson, R.A., and Long, A.D., 1984. "Exploration for New Ground Water; Impact of the Space Age in the Third World." Third World Development. Grosvenor Press, London. Publication Date: December 1984.

Bisson, R.A., and Hofman, P.D., 1982. "No Risk/Turnkey Water Supply Contracts." Journal of the New Hampshire Water Works Association, February 1982.

Bisson, R.A., and Widger, W.K., Jr., 1977. "Innovative Techniques for Water Resources Studies," Journal of the New England Water Works Association, June 1977.

### Selected Lectures and Panel Participation

Sponsor and Panelist, Global Water Policy and Technology Summit for Africa. Cairo, Egypt, June 1990.

Bisson, R.A., "New Water for California." California Academy of Sciences, lecture series, 1988.

Panelist/Speaker, "The Application of Modern Exploration Methods to Strategic Water Mapping in the Mid East." Conference on U.S. Foreign Policy on Water Resources in the Mid East and Horn of Africa. Center for Strategic and International Studies (CSIS), Washington, D.C., 1986.

Bisson, R.A. and Bisson, L.G., 1986. (Speaker/panelist). "Discovery of Major New Brackish Water Supplies for Low Pressure Reverse Osmosis Treatment, Using Modern Exploration Techniques." Annual Conference of the Water Supply Improvements Association, Washington, D.C.

Speaker, "The Big Picture - A Look at the Water Planet From Space." Cape Canaveral Section of the American Institute of Aeronautics and Astronautics, Merritt Island, Florida, 1986.

Panelist/Speaker, "Ground Water Acquisition Problems - Locating Ground Water for Municipal Uses." Presented to American Bar Association: Workshop on Eastern Water Law. Baltimore, Maryland, 1984.

Bisson, R.A., 1983. (Speaker/Panelist) "Remote-Sensing Applications of Groundwater Development and Hazardous Waste Site Evaluations." Presented at European Economic Community Remote-Sensing Seminar, Trinity College, Dublin, Republic of Ireland.

Speaker, "Mineral Exploration Techniques Applied to Bedrock Water Discovery." Presented to 33rd Annual National Water Well Association Conference, 1981.

# International Wilderness Leadership Foundation



Executive Office:  
World Wilderness Congress  
Colorado State University  
Fort Collins, Colorado  
USA 80523  
(303) 491-5804

19 December 1985

Mr. Robert A. Bisson, President  
BCI Geonetics, Inc.  
Airport Road  
P. O. Box 529  
Laconia, NH 03247

Dear Mr. Bisson:

Paul Weingart has suggested that I contact you, feeling that your work and that of our principal project would have much in common.

I listened with interest as Paul told me of your ideas concerning the hydrology of the Okavango swamps and your innovative approaches to conservation. I would certainly like more information, if it is available.

Enclosed is the Prospectus for our principal project, **WORLDWIDE CONSERVATION** - the 4th World Wilderness Congress. This Congress is being planned as the most significant and far reaching conservation event in America in many years, and will address a wide range of international conservation challenges by using wilderness - wild and remote areas - as a unifying, central theme. We are making rapid progress, and all signs point to a stimulating and effective Congress.

We have a special interest in Africa, as the World Wilderness Congress was conceptualized and first convened there. Also, Michael Sweatman (Chairman of the Board of Advisors of this 4th Congress and an international banker with experience throughout Africa, Europe and North America) personally feels that the Okavango swamps would make one of the best case studies for convincing multilateral agencies to re-shape international development and conservation policies.

I hope you find the Congress of interest, and I look forward to hearing more of your interesting work.

Yours sincerely,

Vance G. Martin  
President

cc: Paul Weingart

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a non-profit foundation  
23-7389749

Directors: Dr. R.N. Cleaves, Chairman (USA), Dr. John Hendee (USA), Dr. Ian Player DMS (RSA), Sir Laurens van der Post OBE (UK), Dielle Fleischmann Seignious (USA), Brigadier M.J.A. Wilson OBE, MC (UK), Michael Sweatman (Canada)

President: Vance G. Martin (USA)

able. Even its politics are stable, democratic and increasingly open under President Quett Masire.

### **Project Forces Reassessment**

But the Okavango Integrated Water Project, which would drain water from one of the world's last true wilderness areas, is forcing Botswana to rethink its love affair with progress.

The government is poised to begin work on the \$60 million project to channel water from the 15,000-square-mile Okavango Delta to reservoirs serving the tourist hub of Maun and the South African-owned diamond mines at Orapa.

The dredging and recasting of 15.6 miles of the winding Okavango River into a concrete-lined duct is intended to boost annual water flow from 182 million cubic meters to 232 million cubic meters.

Botswana, dominated by the spreading Kalahari desert, needs

assessment is made by the International Union for the Conservation of Nature.

If the foreign experts decide that damage to the delta would outweigh the project's human benefits, the government will probably halt it, said Olebeng Balapin, the regional officer in charge of water affairs in Maun.

He strongly favors the Okavango project and said threats by Greenpeace aroused resentment. "That was interference to some people," he said.

Balapin has seen many borehole wells go dry during the 20 years, during which Maun was transformed from a village visited by zebras to a city of 20,000 with one of the busiest airports in southern Africa.

"Nature is for us to use," he said. "If we have got no life, nature will not benefit anything."

U.S. official said the Okavango plan differs from such American cases as the poisoning of the Everglades and the filling of parts of San Francisco Bay because it would use water only after it passes through much of the delta.

But African environmental experts say the project will set a precedent for further tapping of the Okavango's headwaters by neighboring Angola and Namibia.

"In the future, I think Botswana will have problems," said Tabeth Matiza, regional wetlands coordinator for the International Union for the Conservation of Nature, referring both to the subjugation of indigenous interests and the limits of sustainability in such a dry area.

### **Limits on Hunting**

Those pressures are felt keenly by Chief Seriri in his village of Khwai.

He is now unable to hunt without permission of soldiers, a consequence of the government's policy of protecting wildlife in order to draw foreign tourists. The delta is one of the finest game areas left in Africa, and hunters come there from all over the world.

The chief is slowly accepting that his Bushman tracking and trapping skills, which he called "a gift from God," are becoming outdated. Much like the American Indians of a century ago, nomadic tribes here are being forced to settle in defined areas and their children required to attend schools that stress assimilation.

"It's part of development to improve the standard of living," the chief said sadly, surrounded by village boys just returned from a school near Maun.

He smiled wanly at a Polaroid photo of himself and encouraged the boys to study hard so that their people would no longer depend on animals to live.

# Review Committee

February 5, 1992

## MEMORANDUM

TO: R&D, Anthony Tummarello

FROM: Robert Bisson, Exploration Consultant  
Unsolicited Water Exploration Proposals for  
Ethiopia/Botswana



### Introduction

This memo and accompanying documents summarize my prior, unsolicited proposals (enclosed) to OFDA and the USAID Operations Office describing a proven highly innovative technical solution to urgent water-related problems in Ethiopia and Botswana. The problems addressed include: refugee relief, crisis mitigation, severe economic development constraints, and the inflicting of potentially severe environmental damage on one of Africa's great natural wonders, the Okavango Delta.

Successful project completion will contribute significantly to solving the above described problems, and will generate other benefits, including immediate expansion of pilot areas to national (Ethiopia) and International (Botswana and surrounding States) status, as well as setting the stage for transferring the generic form of the groundwater model elsewhere in Africa and around the globe. (e.g. via timely introduction of pilot program results at the 1992 U.N. Conference on Environment and Economic Development).

### Target regions - Problems and Solutions.

1. Ethiopia - This unsolicited proposal addresses the needs of Ethiopian people currently in priority refugee, urban, and/or remote areas who don't have access to potable water. A highly developed, proven technology for mapping groundwater resources including accurate locating and tapping of basin-integrated fractured bedrock water systems, is offered to increase the immediate availability of and predictability of this vital commodity. The technology to be used was developed over the past 15+ years by Robert Bisson who has led the proposed exploration team in numerous mapping projects in Africa and the U.S., and has been proven by them in two bordering states (Eastern Sudan, Northwestern Somalia) under funding and sponsorship by A.I.D.

Beyond the feasibility assessment (Phase I), the overall Ethiopia effort entails: (1) development of a project strategy/plan and (2) proceeding to map priority regions, drill test wells, and assemble the public and private sector capacity to oversee, operate, and maintain these water supply points. A future stage of the undertaking (Phase III) would logically include

completing a national water resources map and preparing the project participants to expand into a regional/national water development program, including effective national use policies and a legitimate role for the private sector in the location, development, use and the ecologically sound and sustainable maintenance of these water sources. This technical information, training, and enhanced water development capacity will expand strategic options for the future development of the economy and country.

### Environmental and Other Consideration

Since I believe that the environmental aspects of water development ~~anywhere~~ in the world are a fundamental requirement for real functional solutions, the integrated exploration programs I have designed and carried out always include adequate study of environmental factors from day one of the program, as the attached flowchart of a typical exploration program indicates. (tab 1).

Proof of the existence and environmentally-safe accessibility of these "megawatershed" sources will provide the Third World with a new lease on life and permit USAID and other institutions to contribute long-term, affordable solutions to chronic, water-related, debilitating problems.

In addition I have attached a copy of my Dec. 6 letter to Andrew Natsios, (tab 2) which discusses some important specific points of the Ethiopia proposal.

### 2. Botswana - The Problem

Botswana possesses many natural resources, from the diamonds in the ground to the ingenuity of its people, but the most remarkable resource of all is the freshwater bounty of the Okavango. Therein also lies the problem.

Because the ancient Okavango River and delta system is of such enormous proportions (over 10,000 square km) and contains fresh surface water throughout its domain, it has long been the focus of major attention from man and beast alike.

Over the past 60 years, from Colonel Charles Reys' leaky dams to the present day dredging, dam, canal, pipeline, etc. proposals, people have been seeking some method to extract water from the Okavango without sacrificing the most productive and awe-inspiring ecosystem in southern Africa.

Nevertheless if the country is to continue to prosper the public and private sector of Botswana are convinced they require expanded reliable water resources and they continue to focus their creative efforts on discovering a way of reconfiguring the swamp to meet their water needs. By June 1992, decisions will be taken by the Botswanan Government to take some action with the least

perceivable impact of the Okavango Delta ecosystem. The International Union for the Conservation of Nature (IUCN) is currently undertaking an environmental impact study, which will result in a June, 1992 report to the Botswana government concerning the environmental "costs" of the proposed dredging program, along with alternative water supply concepts.

### The Ground Water Solution

It is well known that Botswana is crosscut by major faults which have been very active through geologic history. For the past 100 years, field work and seismic monitoring performed by scientists and explorers, ranging from Dr. Livingston and James Chapman, to U.S. Geological Survey Seismic experts, have noted that the Okavango straddles a very active fault system, with large earthquakes a normal occurrence and with profound, well documented influence over the surface water of the Okavango River and delta system. For example, in 1952, 23 earthquakes shook the region and the Boro River, which had been nearly dry for 30 years, began to flow again. An average of three earthquakes per year still occur below the Okavango.

Further, the freshness of the surface waters throughout the Okavango River and delta system is so extraordinary that when David Livingston first explored the water (Southeast) extremities of the Delta, in 1849, he wrote "...We found the water to be so clear, cold and soft the higher we ascended that the idea of melting snow was suggested to our minds..."

The combination of active continuous rift-faulting and massive annual freshwater flows, with the lack of salt build up in any nearby surface water must lead one to suspect the existence of a very leaky bedrock system, with hydraulic continuity over a very large area in order to receive and distribute the annual deluge of over 10 million acre feet of new water from the rain and River systems of Botswana.

Given that water is a "universal solvent" and that when so much water (as is evidenced in the Okavango), eventually leaves the earth's surface as vapor, it must leave behind its dissolved salts in very significant quantities, then one only has to search for this "water spoor" using appropriate techniques to identify the points of departure. In fact, when one looks at Botswana from 500 miles altitude, the natural groundwater discharge points of the Okavango megawatershed become obvious. The great evaporation pans of the Kalahari, in addition to receiving and evaporating local rainfall, are most certainly the major discharge areas for the great underground water systems The African Rifts have created. Again, from the clear perspective attained by satellite remote-sensing one can clearly see the relationship of the regional great faults to the surface and groundwater flow regime.

## Regional Implications - SADCC countries.

During the proposed Botswana pilot project, our first two phases will reasonably document the basic geography of the regional water cycle in Botswana, which will provide us with the opportunity to discover the critical attributes of the actual water balance of the region. In practical terms, a substantial percentage of fresh surface water inflows from the Okavango and Chobe River basins actually flows into, and through groundwater transmission systems which extend over almost all of Botswana plus parts of Angola, Zambia, Nairobi, and Zimbabwe. The amounts of water involved in this system of underground conductors is likely to include a large percentage of the previously assumed "potential" evapotranspiration from the Okavango delta. This "interbasin" system may transmit tens of billions of cubic feet per year of renewable water, coursing through fracture systems pervading the region and currently evaporating directly from the water table, leaving only its salt burden as evidence of its passing.

These discoveries represent a real-term opportunity for U.S. - initiated solutions to water-related problems plaguing the western SADCC states. In addition, the eastern splay of the African Rift System penetrates the remaining SADCC countries, with similar promise for problem-solving and economic development.

### 2. Special Considerations and Constraints

In addition to the "obvious paradigm shift" opportunities in Third World Development strategies, one of the principal reasons for choosing Ethiopia and Botswana for these first pilot projects is the urgent need for answers to be forthcoming before Summer 1992. Even from a pure cost perspective, there is a driving need to find potable water. For example, in the Ethiopia case, the U.N. is spending \$400,000 per month (U.S. pays 25%) to truck dirty surface water to Ogaden refugee camps. (They have spent \$10+ million over the past several years).

Meanwhile, the rainy season in Eritrea normally begins to make its appearance in June - requiring careful pre-planning of exploration and drilling rig logistics and early, (April-May) mapping of favorable ground water areas for drilling purposes.

Botswana has a different, but equally difficult time constraint with profound near and long term environmental implications, because the Botswana government intends to make a decision in June, 1992, to either initiate a major capital works water program (dredging, dams, etc.) in the Okavango, or to discover a viable sustainable alternative water supply.

The second Botswana program time constraint represents a major opportunity to transfer the model into a global context, by introducing the results of the pilot model to other donors at the U.N. Conference on Environment and Economic Development which begins in June, 1992. The first "Megawatershed Exploration Model", was developed by Bisson, and with Dr. Farouk El Baz, in the eastern province of Sudan, was previously published and presented at the Africa Water Summit in Cairo (1990), the Third World Academy of Sciences Conference on desert Environments at Triest (1989) and the ERIM Remote Sensing Conference in Bangkok, (1989). The Botswana model will therefore serve as a corroborative second-generation model, with direct, practical application generating near-term tangible benefits.

### Bisson and his team

Uniqueness test. The proposed groundwater mapping/testing projects address complex geographic regions and peoples. The project proposer, Robert Bisson, and his team of subconsultants have worked together for over a decade in the U.S., and successfully developed fractured rock aquifers in the Horn of Africa for refugee relief camps purposes. In these proposals, Bisson is offering the highly (time) efficient application of a proven methodology by an experienced team already possessing substantial personal learning curve of local conditions and a comprehensive data base of appropriate nature for groundwater mapping, combined with advanced knowledge of specialized requirements for drilling technology and skills in fractured bedrock aquifers.

The unique combination of factors includes: 1) successful Ogaden (Somalia/Ethiopia) application of technologies for groundwater exploration developed by this team; 2) Initial discovery and publication regarding the "Megawatershed" phenomenon; 3) the unprecedented documented observation that the "megawatershed" phenomenon exists in Ethiopia (as in Sudan) and in Botswana; 4) the time constraints for success which require "hit the ground running" capabilities Bisson and his team can design, implement and deliver the products described in the unsolicited proposals.

December 16, 1991

Mr. Howard M. Fry  
Acting Associate Administrator  
for Operations  
Room 3942 - NS  
Washington, D.C. 20523-0072

Dear Mr. Fry:

In order to achieve my ultimate goal of "paradigm shift" for water-related USAID (and other agencies) disaster mitigation and development-related projects, I believe it is helpful to provide two or more model projects demonstrating the success of this unique approach in water-limited environments.

During the past two months, I have submitted unsolicited proposals for multi-phased projects in Ethiopia and Botswana. While I am perfectly willing to proceed with the projects as they are approved, (if any delay would be caused by the contracting process), it would be most efficient if I were to carry out the design phase of both these projects in a single, coordinated effort. Further, I would recommend that I plan an integrated mapping and refugee-related drilling project for both Northern and Eastern Ethiopia simultaneously rather than simply one or the other.

I have previously submitted two separate budgets totalling \$135,000 for my work in Ethiopia and Botswana. If we were to include the (Ogaden) Eastern Ethiopia region with which I am quite familiar, the additional cost would be \$30,000, involving the use of another specialist (with Ogaden mapping experience) during the initial field trip and in the planning process.

I also strongly recommend that USAID provide appropriate locally expert advice in the subject area of water and sanitation and drilling capabilities in Ethiopia in order to better integrate results from the projects into USAID S.O.P. and to expedite the process of actual drilling for refugee relief in a timely manner. The best person I know for this function is the recently retired UNICEF coordinator for worldwide community water supply and sanitation, Mr. Martin Beyer, who is well-known to USAID W.A.S.H. Program senior staff.

As I have indicated in the enclosed documents, time is of the essence in the success of these projects, due to weather (Ethiopia) and politics (Botswana), neither of which are under our control.

I am prepared to begin work on the integrated design program immediately upon USAID authorization.

Sincerely,

A handwritten signature in black ink, appearing to read "Robert A. Bisson". The signature is fluid and cursive, with a large initial "R" and "B".

Robert A. Bisson

\*Budget Combined Projects Prefeasibility Studies

	person-months
Principal Exploration Consultants	4.5
Senior Consultants (e.g. Ethiopian & Botswana drilling logistics experts, consult, etc.)	1.1
Scientists/technicians (geologists, hydrologists, etc.)	2.5
Project Administration consultation (project/contract flow control, accounting, secretarial, legal, etc.)	3.9
	<hr/>
	12.0 person-months
	Budget: \$105,000

Travel & Subsistence

Domestic	\$ 6,000
International	\$ 17,000

Support Services Equipment

<u>In Africa:</u> auto/driver/guides	\$ 25,000
airplane charter	
In U.S.: GIS Exploration Program Computer Analyses	
Administrative: Report Preparation - Office, telephone, fax, insurance, etc.	\$ 12,000
	<hr/>
Estimated Total	\$165,000

\* Budget Information is proprietary; NO RELEASE ALLOWED

MEGAWATERSHED GROUNDWATER MAPPING AND TESTING - "PROOF OF CONCEPT" PROJECT- FOR ECONOMIC DEVELOPMENT AND ENVIRONMENTAL CONSERVATION IN BOTSWANA AND THE SADCC STATES

Design Stage - Botswana - Target completion date: March 23, 1992\*

**Tasks**

1. Establish highest level U.S.-Botswana political rapport with regard to Megawatershed model socioeconomic/environmental implications for Botswana. Receive agreement of Botswana government to carry out phases I and II of project, for inputs to 1992 International Union for Conservation of Nature and Natural Resources (IUNC) Environmental report.
2. Update Botswana database from sources in Africa and in Europe/U.S.A.
3. Establish linkages with appropriate Botswana government/private agencies for subsequent data acquisition/analysis and ongoing communications with key Botswana players.
4. Obtain commitments for (future) logistical support for Phase II field work.
5. Construct preliminary Botswana basemap for megawatershed analyses, working with appropriate experts and Geographic Information System (G.I.S.) capability in U.S. and Botswana.
6. Coordinate with appropriate institutional representatives in U.S./Europe/Africa to optimize dissemination and constructive impact of megawatershed demonstration (Phase II) in Botswana, especially with regard to the SADCC regional development implications and the global environmental conservation objectives of the June, 1992 U.N. conference on Environment and Economic Development.

Products - March 23, 1992

1. Written feasibility Plan for Phase II Megawatershed Mapping and Test Drilling Project, ready for immediate implementation, with team and resources identified and all permissions, etc. researched and/or committed.
2. Working Base Maps for Phase II Botswana Megawatershed analyses established on Geographic Information System (GIS) in U.S. and compatible with IUCN system.

---

\* Assumes work begins under contract during first week of January, 1992

# OF ALL AVAILABLE INFORMATION

## and Acquire Available Information

History/Land Access  
Water Studies  
Ecological Studies

## Sort and Compile Existing Data/Remote Sensing into Preliminary Map and Matrix Format

**Tasks:** (ECO)  
Land accessibility and Mobility  
Water Quality Trends - Geographic & Time  
Water-Borne Nutrients & Stresses  
Ecological Classifications of Areas

(HG)  
Climatological/Hydrological Data  
Drainage/Storage  
Hydrologic Characteristics

**Tasks:** (HG)  
Map Surface Water Flows  
Produce Well Location Map  
Groundwater Flow Patterns Premapped  
K & T Maps for All Aquifers  
Table All Hydrological Parameters  
Table All Climate Parameters, Evapotranspiration  
Table All Recharge Data, All Aquifers

(RSSG)  
Aerial Imagery/Photos  
Orbital Missions - Special Data  
Satellite Photos/SIR/TSR  
Geologic Data  
Geological Data  
Geology (Historical)  
Structural Geology & Structures  
Geologic History  
Geologic Sedimentary Rocks

**Tasks:** (RSSG)  
Select Best Wet & Dry Season/Diurnal Imagery  
Input Fracture Fabric of Sediments  
Delineate Wetland & Unique Areas  
Plot Basement Rocks & Structures on Digital Overlays  
Plot Magnetic & Gravity Data on Digital Overlays  
Develop Preliminary Cross-Sections

(SED)  
Geologic Studies & Maps  
Geologic Logs  
Geologic Maps  
Geologic Construction Plans  
Geologic Consolidated Sediments  
Geologic Sedimentary Rocks

**Tasks:** (SED)  
Select Relevant Geologic Logs  
Rewrite Logs into Facies Format  
Decide Lines of Cross-Sections

## Matrix Analyses: Secondary Data; Remote Sensing

**Tasks: Matrix Analyses** (ECO)  
Draft Summary, All SEEB Data  
Predictions based upon Secondary and Remote Sensing Inputs

**Tasks: Matrix Analyses** (HG)  
Draft Summary, All HG Data  
Maps, Tables, Graphs

**Tasks: Matrix Analyses** (RSSG)  
Draft Summary, All RSSG Data  
Relationship Structure/Groundwater

**Tasks: Matrix Analyses** (SED)  
Lithofacies Data Encoded/Ratioed  
All Logs Reclassified  
Facies vs. Groundwater Flow Interpreted  
Lithofacies Cross-Sections Completed

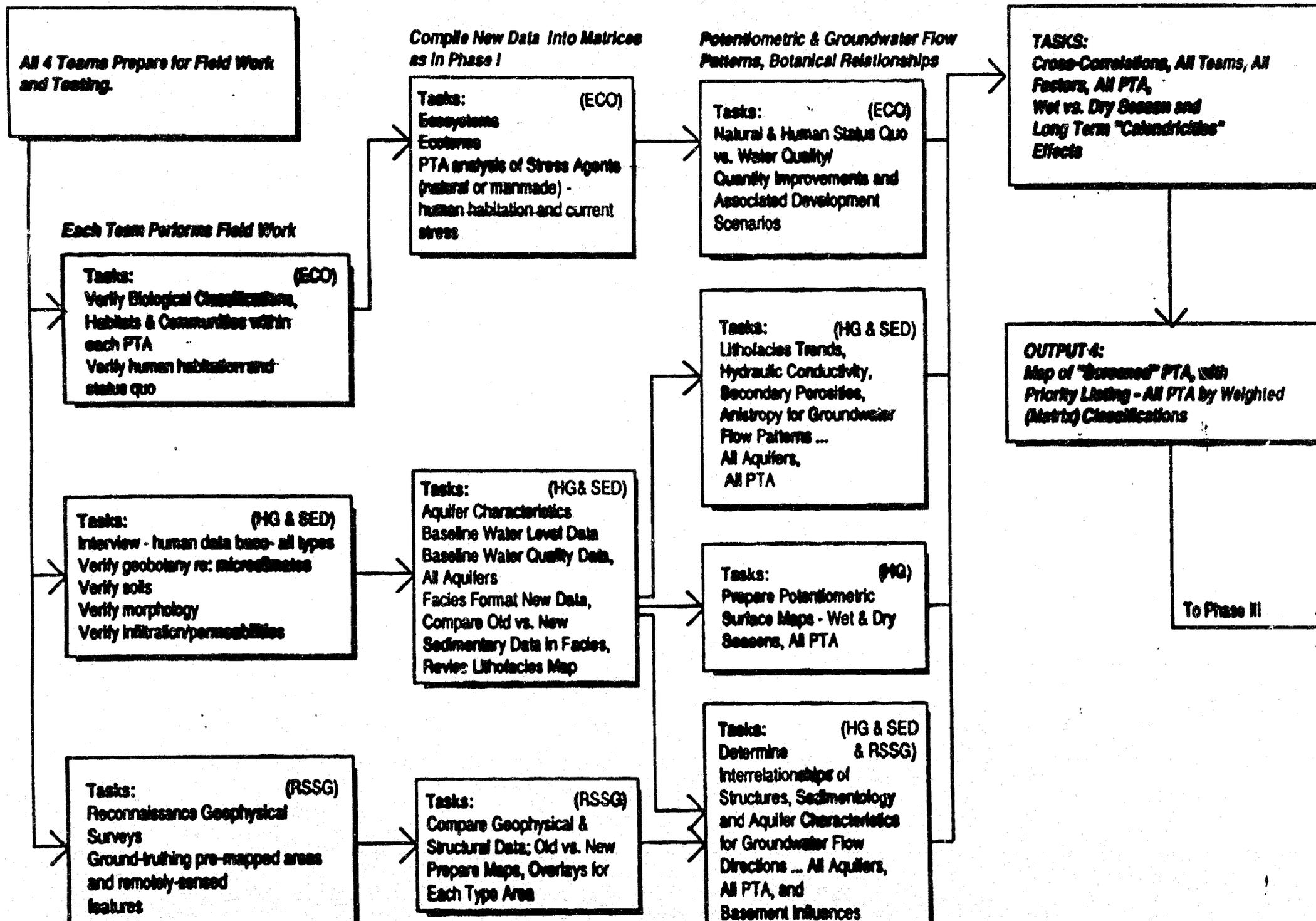
**OUTPUT 1:**  
Map of "Priority Target Areas" (PTA's) for detailed studies; based upon matrix comparative analyses

**OUTPUT 2:** (SE)  
Preliminary Economic Analysis on PTA

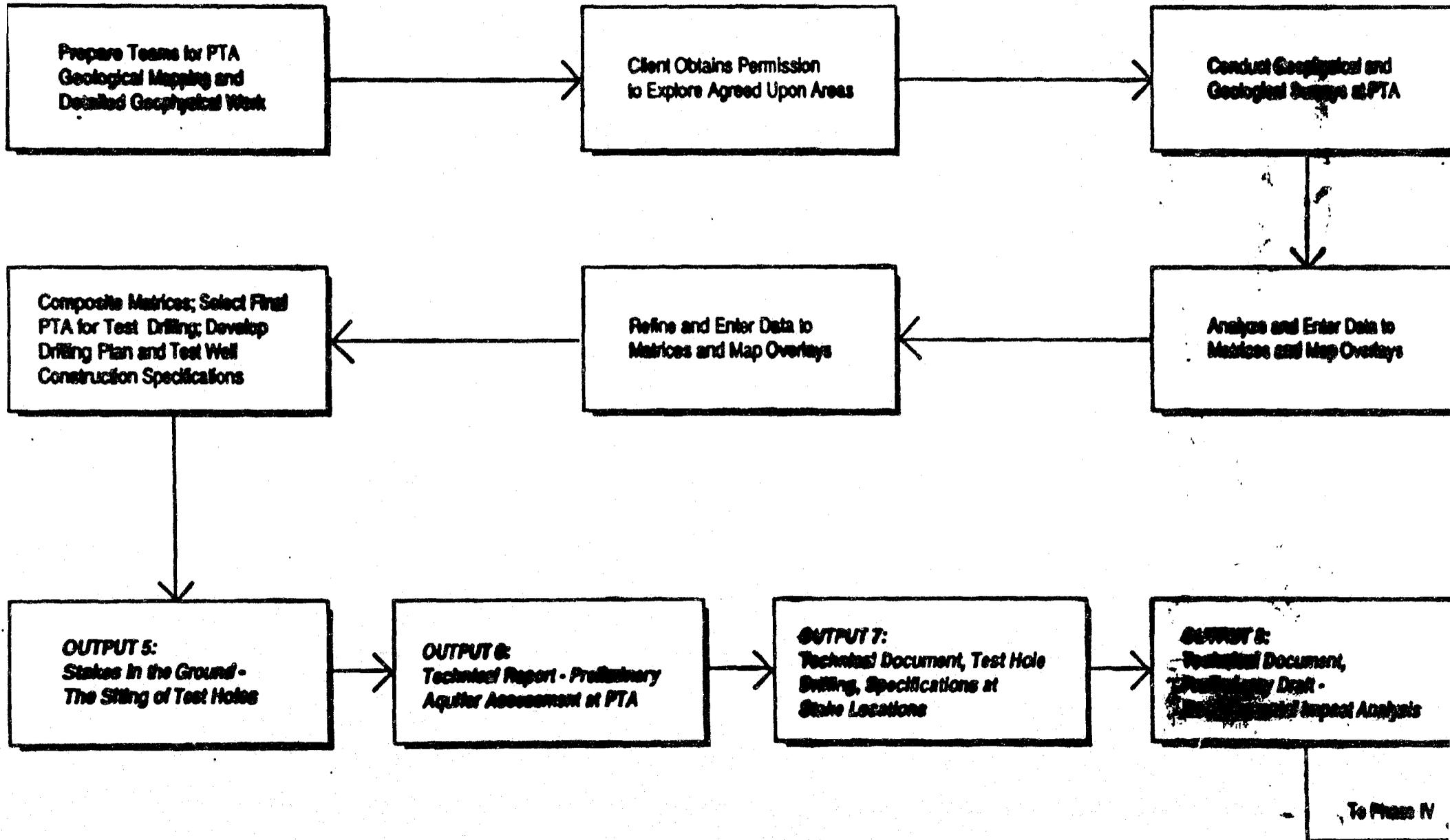
**OUTPUT 3:**  
Identification of Preliminary Environmental Impact Factors at PTA

To Phase II →

# PHASE II - FIELD RECONNAISSANCE OF DESIGNATED "PRIORITY TARGET AREAS" (PTA)



### PHASE III - HIGH-RESOLUTION MAPPING - LOCATING OF TEST WELLS



~~CONFIDENTIAL~~  
December 20, 1991

**M E M O R A N D U M**

**TO:** AFR/ONI/PMO, Donald W. Muncy  
**FROM:** AA/OPS, Robert A. Bisson, Consultant  
**SUBJECT:** Africa Megawatershed Proposals/Environmental Issues

I was quite concerned about apparently unresolved questions regarding environmental impact considerations during my proposed groundwater mapping, testing and (ultimate) development programs. Since I believe that the environmental aspects of water development anywhere in the world are a fundamental requirement for real functional solutions, the integrated exploration programs I have designed and carried out always include equal study of environmental factors from day one of the program, as the attached flowchart of a typical exploration program indicates.

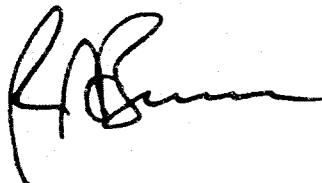
I have also attached a copy of the letter I sent to Andrew Natsios concerning my technical response to the environmental question, as a logical follow-up to prior correspondence regarding other technical questions (also enclosed).

Mr. Muncy, the groundwater resources of the regions targeted for these model projects have been dealt with only in the most superficial fashion and are most definitely underutilized.

Proof of the existence and environmentally-safe accessibility of these "megawatersheds" will provide the Third World with a new lease on life and permit USAID and other institutions to contribute long-term, affordable solutions to chronic, water-related, debilitating problems.

I continue to be prepared to meet with you or any of your staff to answer any question you may have concerning these projects and their contribution to achieving U.S.A.I.D.'s goals.

Thank you for your consideration.



(Enclosure)

December 6, 1991

Mr. Andrew Natsios  
Assistant Administrator for Food  
and Humanitarian Assistance  
Room 1262A NS  
Washington, D.C. 20523

Dear Mr. Natsios,

Following up on my previous October 31, 1991, unsolicited proposal, regarding OFDA objectives in Ethiopia, I wish to clarify certain points which may not have been adequately described in my proposal:

1. My proposed water mapping and drilling project has two goals; first, to accurately identify where the ground water really exists in your crisis mitigation area(s), so that refugees can be provided clean water ASAP. Due to the nature of my program, during our mapping process, we (USAID-OFDA team) will be able to determine which drilling targets are appropriate for which purpose, including a hefty amount of "reality check" for refugee water requirements, such as time and equipment constraints, USAID and Ethiopian socioeconomic priorities (i.e., don't encourage permanent settlements in the wrong places, etc.), while at the same time providing the USAID/Ethiopian principals the real opportunity to plan ahead! Not only can decisions be made about today's crisis, but also tomorrow's needs to present a (near-term) recurring crisis. (i.e. wells that do dry up next month).

Second, the mapping project, while Refugee water requirements are being met, will also provide planners with the ability to design development scenarios on their GIS, based on a field-verified (refugee wells) preliminary groundwater development map of a very large region of Ethiopia. Obviously, the drilling of high yield, sustainable sources will also require suitable drilling equipment and personnel, which can readily be provided by UNICEF and SIDA teams already on site, (personal comm. Martin Beyer) and Ethiopian private-sector contractors which spring up in the region. All of the drillers will benefit considerably by some further specialized training, provided by my team, in fractured rock well drilling, development, pumping and maintenance.

2. The proprietary water mapping program of which I have written so much, has little in common with either academic attempts at "fracture-trace" well siting, or running about in the field with magnetometer/resistivity meters, blindly seeking geophysical "anomalies". Further, while fractured crystalline rock can produce large quantities of water under the right conditions (as in

much of Sudan and Ethiopia), many of the most prolific water-producing sites of my experience are under hundreds feet of sand in fractured sedimentary (not crystalline) rock. In fact, the megawatershed model clearly states, from experimentally-derived results, that the best of all worlds is fractured limestone or sandstone (sedimentary) overlain by as much porous sand and as nature can provide, with an active recharge mechanism to the entire ensemble. While the precise, predictable targeting of wells under these ideal groundwater conditions ironically represents quite a challenge (which is why we have a water problem) and is impossible using the traditional (or neo-traditional) approaches described above, teams using my methods have a better than 86% "hit rate" under all conditions.

3. Properly sited and drilled bedrock wells in regions where the groundwater is near the surface (unconfined) or under pressure (confined), are commonly less than unconfined 150m deep. Our wells in Somalia, for example, averaged less than 100 meters depth, with individual yields exceeding 150 gallons per minute. (216,000 gal per day).

My meetings with your staff have helped me understand some of my short comings in fully and clearly stating these points and I hope this letter will help.

I look forward to assisting the OFDA effort to mitigate this disaster in Ethiopia.

Sincerely,



Robert Bisson

CC:

A/AA/OPS, Mr. Fry  
AA/AFR, Mr. Spangler  
Mr. Koehring

# Long Drought Threatens

km  
travel

## Eritrea's Recovery

*While efficient relief efforts are under way, long-term food security will come only by revising the province's agriculture system*

**By Dan Connell**

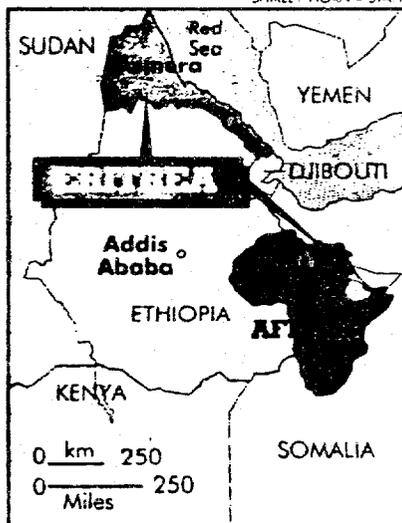
Special to The Christian Science Monitor

=====  
NACFA, ERITREA  
=====

**H**AMED NUR squats in the thick brown dust and stochically swings his small wooden-handled scythe at the brittle stalks of dried sorghum. "There is no grain, only fodder for the animals," he says.

The dead plants are casualties of a prolonged drought that has withered Eritrea. For this peasant farmer, the crop failure means there will be no food apart from emergency relief for his wife and

SHIRLEY HORN - STAFF



10 children for the second year in a row. Not only hunger, but also frustration with his failed efforts are sapping Hamed's spirit.

Eritrea has been burdened with chronic drought since the early 1980s, when famine swept the Horn of Africa killing more than a million people. In the past three decades, Eritrea has also

been the locale for an intense war for independence from Ethiopia, which annexed the former Italian colony in 1962.

Relief workers say that although the war with Ethiopia ended last May with a pact to hold a referendum on Eritrea's future in 1993, most of the population is so impoverished that every downturn in the climate threatens renewed human disaster. Meanwhile, Eritrea's peculiar political status as a territory administered separately from Ethiopia, but not yet formally independent, appears to be blocking it from receiving more subsistence food.

An estimated 2.8 million people of the country's 3.2 million are in serious need and are receiving relief rations, say officials of the Eritrean Relief Association (ERA), a quasi-state agency.

Widespread starvation appears unlikely here this year because fighting has stopped, and because there is an extremely efficient relief operation under way, officials say. What is more worrisome, they say, is the impact of prolonged dependency on recipients' morale and motivation.

"There is still a great need for emergency assistance, but this will not solve the problem here," says Arild Jacobsen, director of Norwegian Church aid, a major supplier of relief aid to Eritrea. "What they need more than ever are funds for rehabilitation and development to get out of this evil circle of dependence."

During a five-week tour of Eritrea, the effects of the drought were visible everywhere. On the road south of the capital of Asmara were burned hillsides and

empty fields with only a stubble of stunted barley and wheat poking through rocky soil.

North to Nacfa, where the rains failed almost entirely last year, the road is littered with dead cattle, goats, and camels. Even thorny *belas*, plants that provide a food of last resort for Eritreans, have become a casualty as desperate camels devour them after stripping the few remaining acacia trees of their sparse foliage.

### **Sprawling refugee camp**

Despite the widespread crop failure, Eritrean farmers can be seen plowing fields in the hopes that next year will bring rain. With 50 percent or more of all livestock reported dead, many people use improvised shovels and hoes to cultivate soil.

In dusty towns, however, many businesses remain shuttered and

thousands of people out of work. As the war intensified in the last two years, almost all industrial and commercial activity in Eritrea ground to a halt, say officials, relief workers, and civilians.

With much of the rural and urban population subsisting on aid, the country has begun to resemble a single, sprawling refugee camp. In each city, town, and rural district, ERA distributes wheat and vegetable oil occasionally supplemented by lentils and milk powder. Asmara has nine such centers. Since fighting ended, the World Food Program of the United Nations has become the main food supplier, bringing in 33,000 tons monthly through the war-damaged port of Massawa.

Officials from the United States Agency for International Development (USAID) will travel



TUESDAY 10:17 AM EST

3X03MH7WB4K-4-1D  
REF: USC/ETHIOPIA

FOR THE THIRD TIME IN LESS THAN TEN YEARS, ETHIOPIA IS CONFRONTED WITH A DROUGHT OF CATASTROPHIC PROPORTIONS. IN 1984-85 UP TO ONE MILLION PEOPLE STARVED TO DEATH IN THE NORTHERN REGIONS OF THE COUNTRY. IN 1987-88 A SIMILAR TRAGEDY WAS AVERTED BECAUSE OF A PROMPT RESPONSE FROM INTERNATIONAL AGENCIES. NOW MILLIONS ARE THREATENED AGAIN. HUNDREDS OF THOUSANDS ARE CHILDREN.

THIS TIME THE SITUATION IS CONSIDERED WORSE THAN IN 1984-85.

A NEARLY TOTAL CROP FAILURE IS BEING REPORTED IN THE WHOLE ERITREAN REGION DUE TO LACK OF RAIN. IN TIGRAY THE CROP FAILURE IS ESTIMATED TO BE 40%. THESE TWO REGIONS ARE ALSO AFFLICTED BY CIVIL WARS.

APPROXIMATELY 1.5 MILLION PEOPLE ARE ESTIMATED TO BE DIRECTLY AFFECTED BY THE DROUGHT. THE NUMBER COULD REACH 2 MILLION AS FAMINE CONDITIONS WORSEN.

FOOD, MEDICAL SUPPLIES, TENTS, WATER PUMPS AND OTHER SHELTER RELIEF EQUIPMENT ARE URGENTLY NEEDED. UNICEF NEEDS \$9.5 MILLION FOR THIS LIFESAVING EFFORT.

PLEASE RUSH YOUR CONTRIBUTION TO THE U.S. COMMITTEE FOR UNICEF AS QUICKLY AS POSSIBLE TO HELP WITH UNICEF'S LIFESAVING WORK. CHILDREN'S LIVES ARE AT STAKE.

HUGH DOWNS  
CHAIRMAN

December 20, 1991

Mr. Andrew S. Natsios  
Director  
Office of Foreign Disaster  
Assistance  
Room 1262-A NS

Dear Mr. Natsios,

Pursuant to my December 6 letter which answered some preliminary questions posed by OFDA and other USAID personnel (copy attached), in response to further feedback from USAID staff, I would like to address the question of potential environmental impacts resulting from my proposed water mapping/testing projects.

The comprehensive groundwater exploration program that I employ to map "Megawatersheds" addresses regional and local groundwater recharge, storage, transmission and discharge in an unprecedented holistic fashion. Environmental impact consideration and ecological constraints are an integral part of individual site, as well as, larger model exploration program, as illustrated in the attached flow chart depicting a prior project's multi-variate approach. This is the basic method for Ethiopia, Phase II and beyond.

With specific regard to "hydrological impact" of either the refugee camp/"test" wells or any future production facilities, the exploration program survey will clearly identify projected boundary conditions of the groundwater resources, the method of measuring local safe-sustainable well yields for production well construction, as well as the environmental issues relevant to the individual wells.

While the simply-constructed refugee relief wells will serve the dual purpose of providing sufficient potable water for direct human use and generating important data for the exploration model, it is important to note that these emergency supply wells will be sited to optimize the practicability of their humanitarian use, not to demonstrate the best location for high water yields.

The test wells do not have to be sited right on top of the most favorable part of the megawatershed to provide great value to local people as well as the exploration team, because the team will know where in the model the well is located and hence will

benefit by the "downhole" data produced. The issues of , e.g., local environmental impact, access, drilling, production off-takes, water use, demographic/political changes, will all be included as part of the overall decision process and planning for Phase III program implementation.

If you or your staff have any further questions, I will be pleased to answer them to the best of my ability.

Sincerely,



Robert A. Bisson  
Consultant  
AA/OPS

cc: AFR/ONI:RWMuncy

December 6, 1991

Mr. Andrew Natsios  
Assistant Administrator for Food  
and Humanitarian Assistance  
Room 1262A NS  
Washington, D.C. 20523

Dear Mr. Natsios,

Following up on my previous October 31, 1991, unsolicited proposal, regarding OFDA objectives in Ethiopia, I wish to clarify certain points which may not have been adequately described in my proposal:

1. My proposed water mapping and drilling project has two goals; first, to accurately identify where the ground water really exists in your crisis mitigation area(s), so that refugees can be provided clean water ASAP. Due to the nature of my program, during our mapping process, we (USAID-OFDA team) will be able to determine which drilling targets are appropriate for which purpose, including a hefty amount of "reality check" for refugee water requirements, such as time and equipment constraints, USAID and Ethiopian socioeconomic priorities (i.e., don't encourage permanent settlements in the wrong places, etc.), while at the same time providing the USAID/Ethiopian principals the real opportunity to plan ahead! Not only can decisions be made about today's crisis, but also tomorrow's needs to present a (near-term) recurring crisis. (i.e. wells that do dry up next month).

Second, the mapping project, while Refugee water requirements are being met, will also provide planners with the ability to design development scenarios on their GIS, based on a field-verified (refugee wells) preliminary groundwater development map of a very large region of Ethiopia. Obviously, the drilling of high yield, sustainable sources will also require suitable drilling equipment and personnel, which can readily be provided by UNICEF and SIDA teams already on site, (personal comm. Martin Beyer) and Ethiopian private-sector contractors which spring up in the region. All of the drillers will benefit considerably by some further specialized training, provided by my team, in fractured rock well drilling, development, pumping and maintenance.

2. The proprietary water mapping program of which I have written so much, has little in common with either academic attempts at "fracture-trace" well siting, or running about in the field with magnetometer/resistivity meters, blindly seeking geophysical "anomalies". Further, while fractured crystalline rock can produce very large quantities of water under the right conditions (as in

much of Sudan and Ethiopia), many of the most prolific water-producing sites of my experience are under hundreds feet of sand in fractured sedimentary (not crystalline) rock. In fact, the megawatershed model clearly states, from experimentally-derived results, that the best of all worlds is fractured limestone or sandstone (sedimentary) overlain by as much porous sand and as nature can provide, with an active recharge mechanism to the entire ensemble. While the precise, predictable targeting of wells under these ideal groundwater conditions ironically represents quite a challenge (which is why we have a water problem) and is impossible using the traditional (or neo-traditional) approaches described above, teams using my methods have a better than 86% "hit rate" under all conditions.

3. Properly sited and drilled bedrock wells in regions where the groundwater is near the surface (unconfined) or under pressure (confined), are commonly less than unconfined 150m deep. Our wells in Somalia, for example, averaged less than 100 meters depth, with individual yields exceeding 150 gallons per minute. (216,000 gal per day).

My meetings with your staff have helped me understand some of my short comings in fully and clearly stating these points and I hope this letter will help.

I look forward to assisting the OFDA effort to mitigate this disaster in Ethiopia.

Sincerely,



Robert Bisson

CC:  
A/AA/OPS, Mr. Fry  
AA/AFR, Mr. Spangler  
Mr. Koehring

**MEGAWATERSHED WATER MAPPING AND TESTING  
FOR "PROOF OF CONCEPT" REFUGEE RELIEF AND DISASTER MITIGATION IN ETHIOPIA**

**Design Phase - Tasks - Completion date: March 23, 1992\***

- 1. Identify Target Regions Precisely, with inputs from
  - U.S.A.I.D. - Washington
  - U.S.A.I.D. - Addis
  - UNHCR - Geneva
  - etc.

- { Eritrea - Regional boundary
- { - Refugee subareas (real & projected)
- { Ogaden - Regional boundaries
- { Refugee subareas (real & projected)

- 2. Locate and access databases for critical criteria (updated sources)
- 3. Assess logistical situations, support systems availability & drilling capability
- 4. Evaluate Ethiopian private sector preliminary interest in long term water-related socioeconomic development
- 5. Coordinate with (expected) coalition of appropriate institutional representatives for refugee relief, disaster mitigation & future development in Ethiopia

- { Hydrogeological
- { Anthropological
- { Exploration field mapping
- { Test drilling

- 6. Contact and obtain commitments from technical team for exploration phase & test well drilling/pump supervision

- { Ethiopian
- { U.S.
- { etc.
- { U.S.A.I.D.
- { U.N. institutions
- { ADB
- { Arab Bank
- { Kuwait fund
- { etc.
- { U.S.
- { Ethiopian
- { NGOs, UNICEF, etc.

- 7. Confirm required support for Phase II (Exploration & Test Drilling) will be available and seek written/oral permissions from Ethiopian and regional government and tribal functionaries for Phase II exploration work

- { Addis government
- { Eritrean leadership
- { Ogaden tribal leaders
- { NGO logistical support
- { Private sector support

**Product - Completion date: March 23, 1992**

**Refugee relief, water development Action plan:** A megawatershed mapping/testing program will be designed and ready for immediate implementation in Eritrea and the Ogaden. This feasibility study/program package will identify key players, costs, time frames, and program priorities for emergency water well siting/drilling and set the stage for A.I.D. program decision and as Phase II demonstration of the contextual significance to U.S.A.I.D. O.F.D.A. Planners, of megawatershed models in Northern and Eastern Ethiopia, to disaster mitigation and future economic development in the region.

**Best Available Copy**

OF ALL AVAILABLE INFORMATION

**With and Acquire Available Information**

**Tasks:**  
 Isomaps/Map Land Access  
 Including G-Map/Cluster Studies  
 Including Ecological Studies

**Tasks:** (HG)  
 Published Climatological/  
 Microclimatological Data  
 Surface Drainage/Storage  
 Hydraulic/Hydrologic Characteristics

**Tasks:** (RSSG)  
 Satellite/Aerial Imagery/Photos  
 Manned Orbital Missions - Special Data  
 Space Shuttle Photos/SIVTR  
 Geomagnetic Data  
 Gravitational Data  
 Seismological Data  
 Seismicity (Historical)  
 Basement Lithologies & Structures  
 Tectonic History  
 Consolidated Sedimentary Rocks

**Tasks:** (SED)  
 Existing Studies & Maps  
 Geologic Logs  
 Soil Reports/Maps  
 Highway Construction Plans  
 Soils/Unconsolidated Sediments  
 & Consolidated Sedimentary Rocks

**Sort and Compile Existing Data/Remote Sensing into Preliminary Map and Matrix Format**

**Tasks:** (ECO)  
 Land accessibility and Mobility  
 Water Quality Trends - Geographic & Time  
 Water Borne Nutrients & Stresses  
 Ecological Classifications of Areas

**Tasks:** (HG)  
 Map Surface Water Flows  
 Produce Well Location Map  
 Groundwater Flow Patterns Premapped  
 K & T Maps for All Aquifers  
 Table All Hydrological Parameters  
 Table All Climate Parameters, Evapotranspiration  
 Table All Recharge Data, All Aquifers

**Tasks:** (RSSG)  
 Select Best Wet & Dry Season/Diurnal Imagery  
 Input Fracture Fabric of Sediments  
 Delineate Wetland & Unique Areas  
 Plot Basement Rocks & Structures on Digital  
 Overlays  
 Plot Magnetic & Gravity Data on Digital Overlays  
 Develop Preliminary Cross-Sections

**Tasks:** (SED)  
 Select Relevant Geologic Logs  
 Rewrite Logs into Facies Format  
 Decide Lines of Cross-Sections

**Matrix Analyses: Secondary Data/Remote Sensing**

**Tasks: Matrix Analyses** (ECO)  
 Draft Summary, All SEEB Data  
 Predictions based upon  
 Secondary and  
 Remote Sensing Inputs

**Tasks: Matrix Analyses** (HG)  
 Draft Summary, All HG Data  
 Maps, Tables, Graphs

**Tasks: Matrix Analyses** (RSSG)  
 Draft Summary, All RSSG Data  
 Relationship Structure/Groundwater

**Tasks: Matrix Analyses** (SED)  
 Lithofacies Data Encoded/  
 Ratted  
 All Logs Reclassified  
 Facies vs. Groundwater Flow  
 Interpreted  
 Lithofacies Cross-Sections Completed

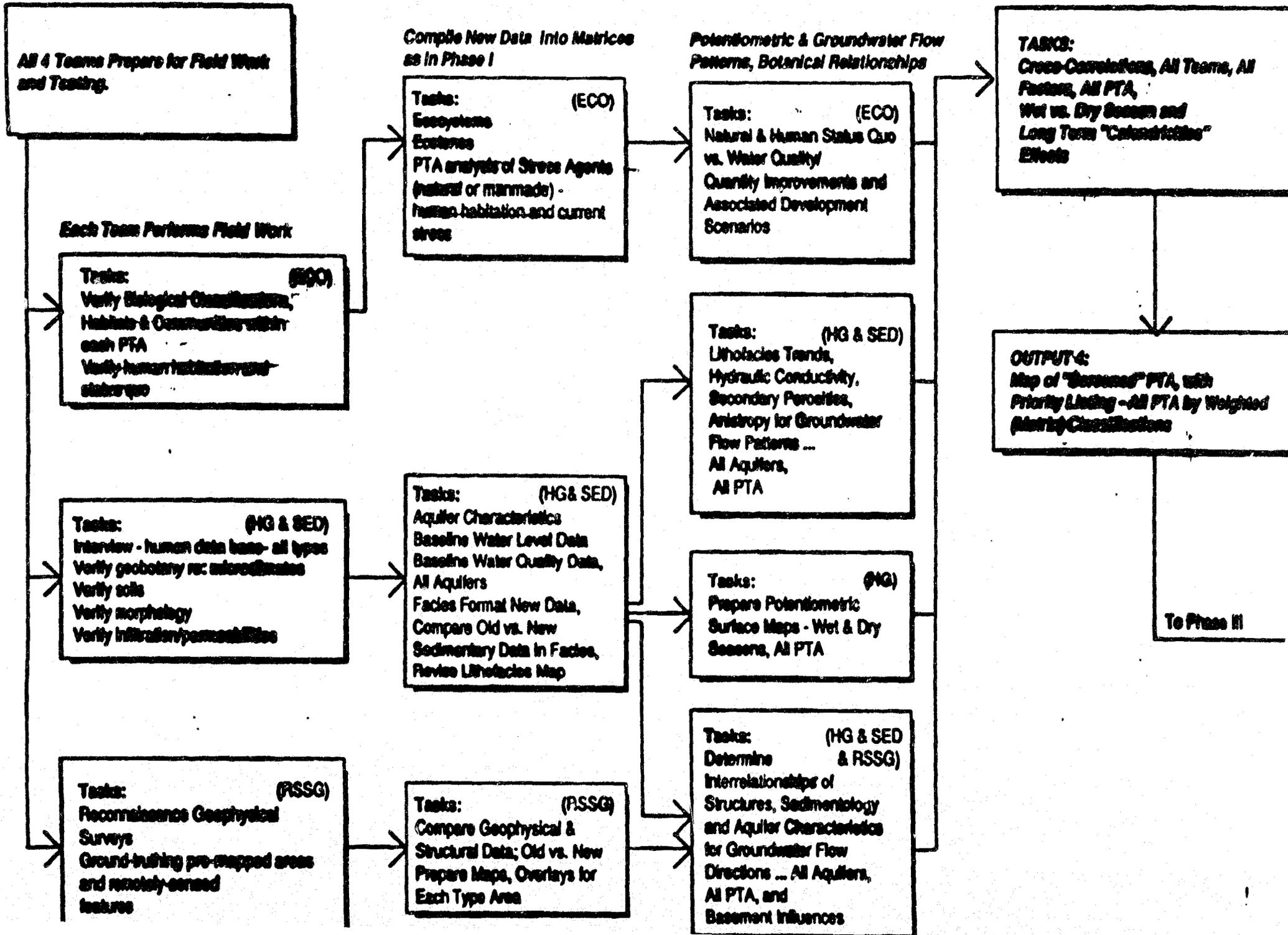
**OUTPUT 1:**  
 Map of  
 "Priority Target Areas" (PTA's)  
 for detailed studies; based upon  
 matrix composite analyses

**OUTPUT 2:** (SE)  
 Preliminary Economic  
 Analysis on PTA

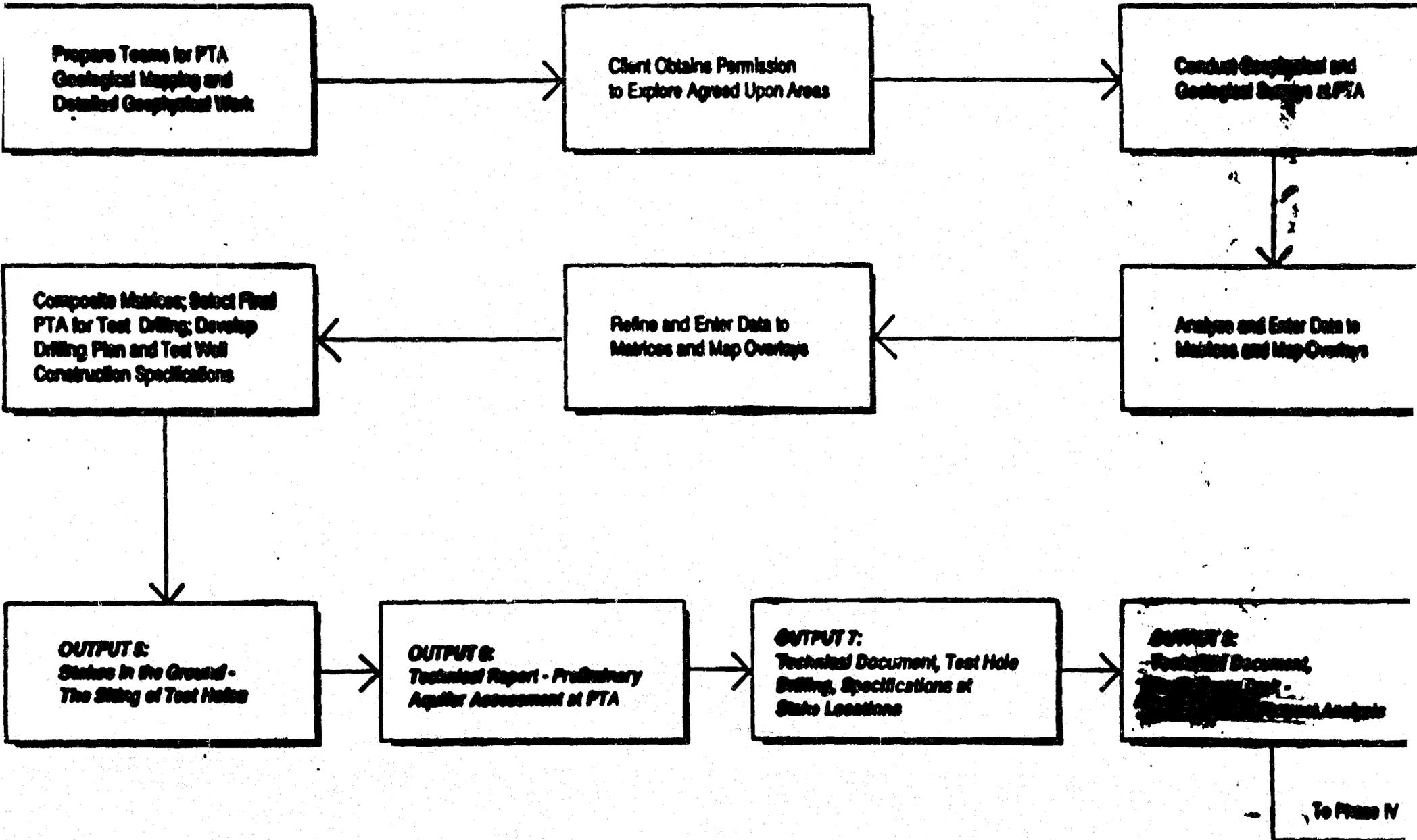
**OUTPUT 3:**  
 Identification of  
 Preliminary Environmental  
 Impact Factors at  
 PTA

To Phase II

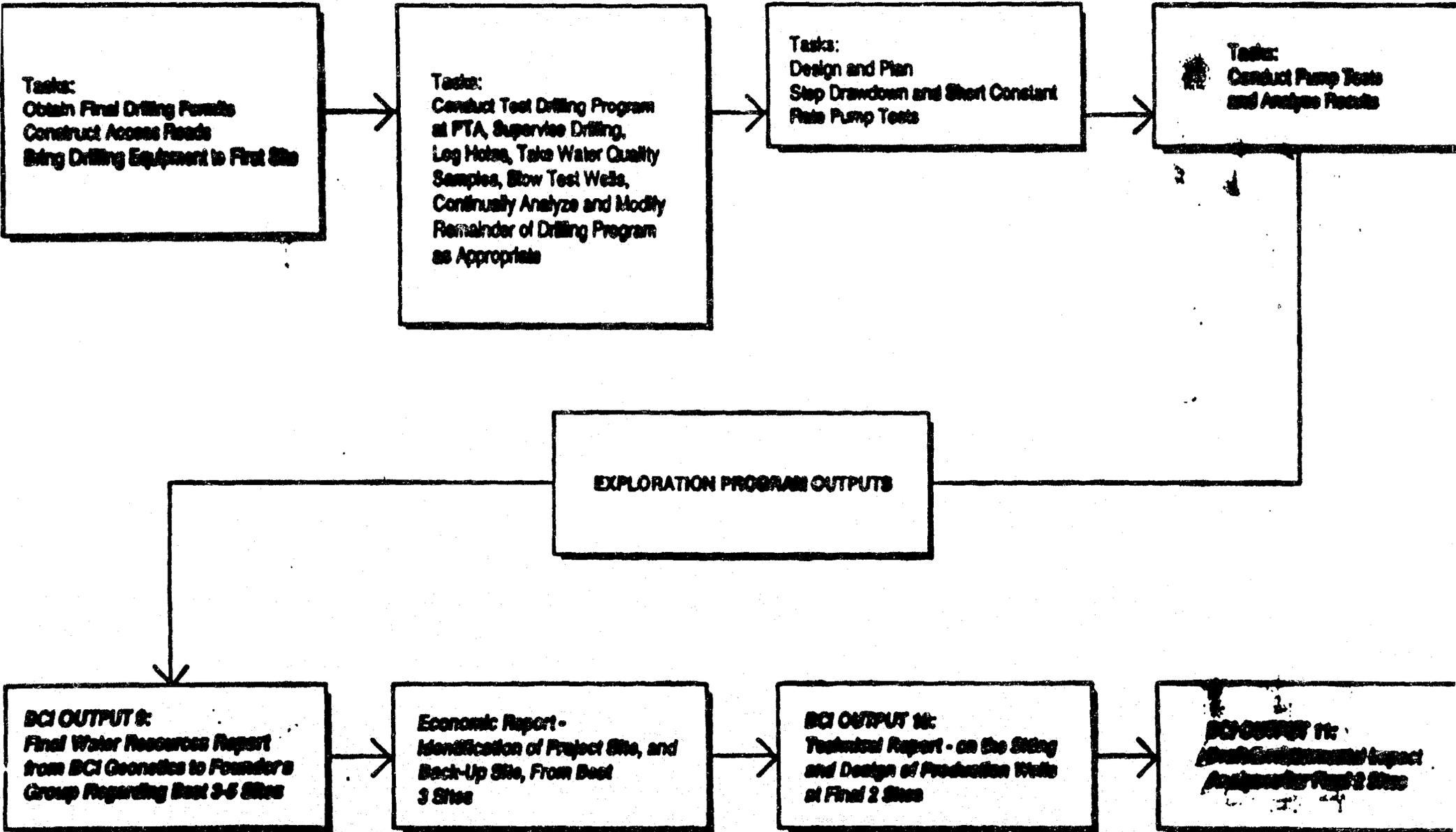
# PHASE II - FIELD RECONNAISSANCE OF DESIGNATED "PRIORITY TARGET AREAS" (PTA)



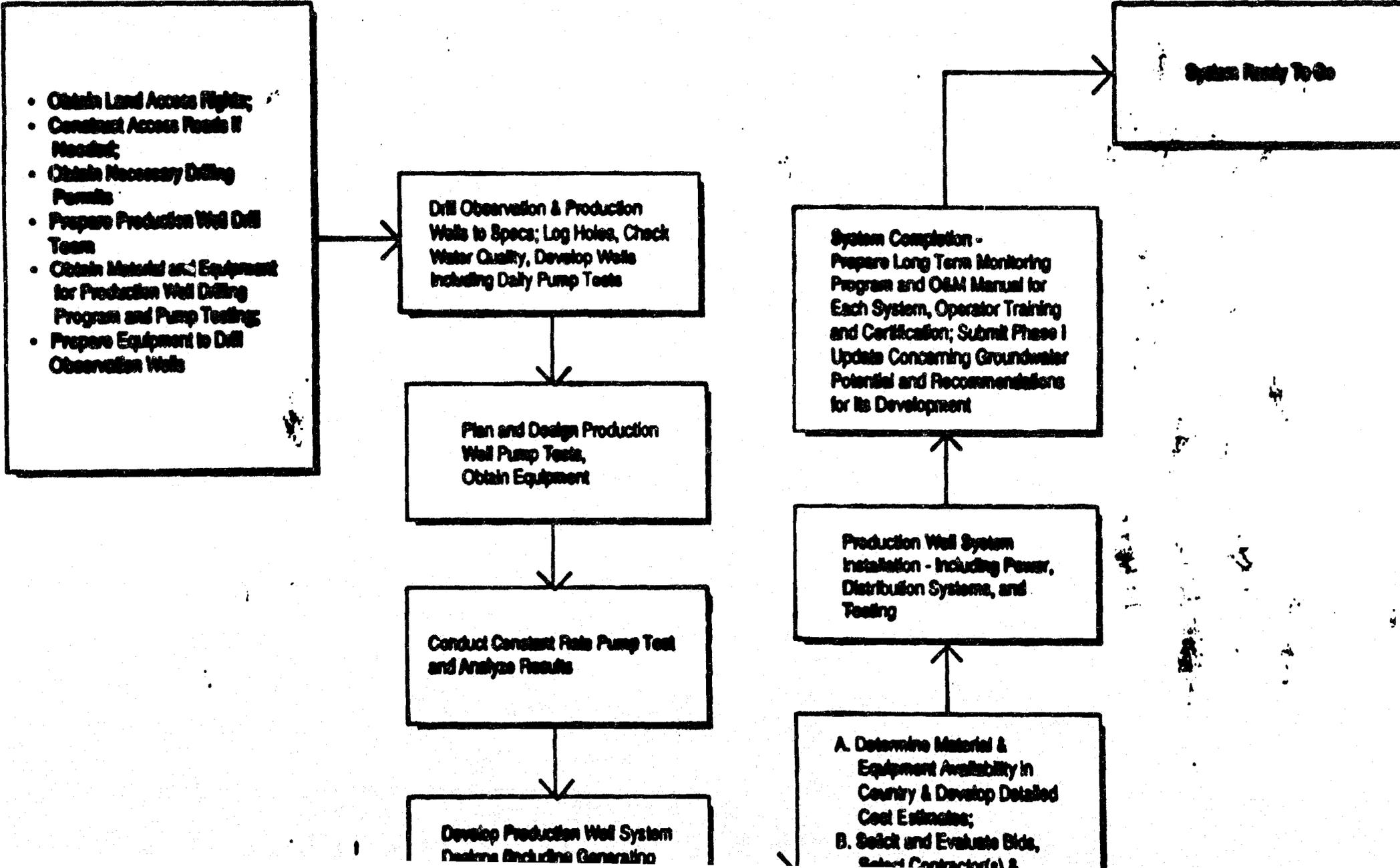
### PHASE III - HIGH-RESOLUTION MAPPING - LOCATING OF TEST WELLS



## PHASE IV - TEST HOLE DRILLING AND PUMPING TESTS



**(FUTURE) PHASE V - PILOT DEVELOPMENT PROJECT: PRODUCTION WELL SYSTEM INSTALLATION**



- Obtain Land Access Rights;
- Construct Access Roads if Needed;
- Obtain Necessary Drilling Permits
- Prepare Production Well Drill Team
- Obtain Material and Equipment for Production Well Drilling Program and Pump Testing;
- Prepare Equipment to Drill Observation Wells

Drill Observation & Production Wells to Specs; Log Holes, Check Water Quality, Develop Wells Including Daily Pump Tests

Plan and Design Production Well Pump Tests, Obtain Equipment

Conduct Constant Rate Pump Test and Analyze Results

Develop Production Well System Design Including Generating

System Completion - Prepare Long Term Monitoring Program and O&M Manual for Each System, Operator Training and Certification; Submit Phase I Update Concerning Groundwater Potential and Recommendations for its Development

Production Well System Installation - Including Power, Distribution Systems, and Testing

A. Determine Material & Equipment Availability in Country & Develop Detailed Cost Estimates;  
B. Solicit and Evaluate Bids, Select Contractor(s) &

System Ready To Go

**MEGAWATERSHED GROUNDWATER MAPPING AND TESTING - "PROOF OF CONCEPT" PROJECT- FOR ECONOMIC DEVELOPMENT AND ENVIRONMENTAL CONSERVATION IN BOTSWANA AND THE SADCC STATES**

**Design Stage - Botswana - Target completion date: March 23, 1992\***

**Tasks**

1. Establish highest level U.S.-Botswana political rapport with regard to Megawatershed model socioeconomic/environmental implications for Botswana. Receive agreement of Botswana government to carry out phases I and II of project, for inputs to 1992 International Union for Conservation of Nature and Natural Resources (IUNC) Environmental report.
2. Update Botswana database from sources in Africa and in Europe/U.S.A.
3. Establish linkages with appropriate Botswana government/private agencies for subsequent data acquisition/analysis and ongoing communications with key Botswana players.
4. Obtain commitments for (future) logistical support for Phase II field work.
5. Construct preliminary Botswana basemap for megawatershed analyses, working with appropriate experts and Geographic Information System (G.I.S.) capability in U.S. and Botswana.
6. Coordinate with appropriate institutional representatives in U.S./Europe/Africa to optimize dissemination and constructive impact of megawatershed demonstration (Phase II) in Botswana, especially with regard to the SADCC regional development implications and the global environmental conservation objectives of the June, 1992 U.N. conference on Environment and Economic Development.

**Products - March 23, 1992**

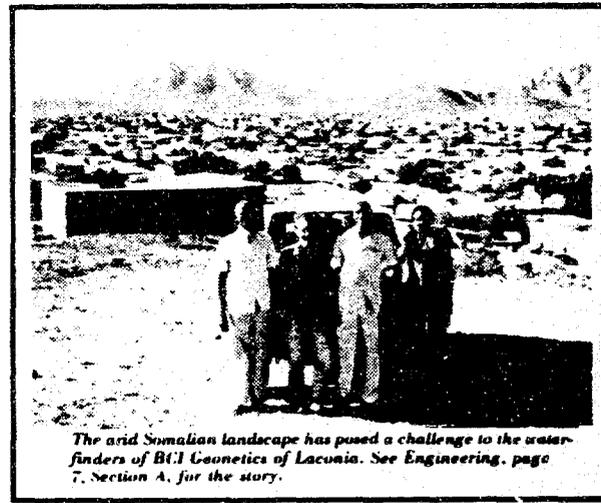
1. Written feasibility Plan for Phase II Megawatershed Mapping and Test Drilling Project, ready for immediate implementation, with team and resources identified and all permissions, etc. researched and/or committed.
2. Working Base Maps for Phase II Botswana Megawatershed analyses established on Geographic Information System (GIS) in U.S. and compatible with IUCN system.

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\* Assumes work begins under contract during first week of January, 1992

# NEW HAMPSHIRE BUSINESS REVIEW

Special Section  
**ENGINEERING**



The arid Somali landscape has posed a challenge to the water finders of BCI Geonetics of Laconia. See Engineering, page 7, Section A, for the story.

## Engineering

### Laconia firm's engineers hunt for water in Africa

Through a contract with the New TransCentury Foundation, BCI Geonetics of Laconia has embarked on a search for water in the parched northwestern section of Somalia, East Africa. There live an estimated quarter million refugees from famine and the Ethiopian-Somalian border fighting.

TransCentury was founded by Warren Wiggins, the architect of the Peace Corps



during the Kennedy administration. The foundation provides a variety of social, economic, and agricultural development services, primarily government-related and in the Third World. It is working with the Agency for International Development and the Somali government on this project.

The TransCentury Foundation invited BCI to join the project after employees read an article about the Laconia firm in the April 1983 issue of *Yankee* magazine. "They're very interested in water, and what we do fits in very well with their focus and opportunities," said Peter Hosman, BCI executive vice president. "The article also mentioned that I'd been

in the Peace Corps, and that may have indicated some sort of affinity."

Overall, the TransCentury project in Somalia involves the development of water resources and roads. "Quite simply, if we can find water, they can irrigate and grow crops," said Hosman. "The roads are necessary for taking the food to market and to the people. But we're looking just at the water side of the project."

Hosman expects the Somali project to take three to four years to complete. A member of his firm has already made a trip to the site, while three more are expected to depart for East Africa shortly. They are company founder and president Robert A. Bisson; hydrogeochemist Roland B. Hoag Jr., and a third person, probably geologist Joseph Ingari.

Although BCI's contract calls for the firm to deliver a report to TransCentury in October and to begin drilling for water only after that, Hosman is hopeful that drilling may begin sooner. "If we discover conclusive enough evidence of water, we may ask to move that date up and possibly begin drilling in as little as six months."

Hosman is confident that BCI will succeed in finding water in Somalia where others have failed. "We've reviewed the documents of others who've tried — the Chinese have been there, the Italians, the British — and concluded that their efforts have been too narrow in scope. We don't guarantee always finding water, but we're very confident from looking at the geology of the area that our approach can develop a water supply in this region." ■



BCI president Robert Bisson surveys a potential drill site, while Somalis visit the earthen dam that is their current water source.



197663 TRANSCEN

MSG DD362

TO: ROBERT BISSON

FROM: LOUIS L. MITCHELL, CEO  
TRANSCENTURY CORPORATION

DATEC NOV 20, 1986

I HAVE JUST RETURNED FROM SOMALIA AND AM ABLE TO CONFIRM SUCCESS  
OF THE FIRST OF TWO TARGET AREAS, WITH INITIAL TESTING OF MORE  
THAN 200 GPM FROM EACH OF THREE WELLS. I CAN ALSO CONFIRM  
THROUGH INFORMATION FROM MY ASSOCIATES THAT TWO FURTHER WELLS IN  
THE SECOND TARGET AREA HAVE BEEN TESTED AT 200 GPM.

WITH THESE EXTREMELY PROMISING ACHIEVEMENTS, WE ARE PRESENTLY  
PURSuing IMMEDIATE FUNDING FROM EUROPEAN ECONOMIC COMMISSION THROUGH  
THE UNITED NATIONS HIGH COMM. FOR REFUGEES IN ORDER TO COMPLETE  
PRODUCTION FACILITIES AT TARGET AREA NO. 1 IN THE CITY OF BOROMA.  
USING YOUR RECENT COST AND MANPOWER FIGURES, OUR PROJECT MANAGER  
GIBSON AND I WILL FORWARD THE NTF-BCI PROPOSAL TO EEC-AID  
HEADQUARTERS IN GENEVA AT OUR EARLIEST OPPORTUNITY.

I LOOK FORWARD TO SEEING YOU IN WASHINGTON THIS WEEKEND.

197663 TRANSCEN

BCI GILO

.....

0825 11/21

PLS REPLY VIA TRT

**national  
water well**

**association**

PROVIDING AND PROTECTING  
GROUND WATER FOR THE WORLD

6375 Riverside Dr./Dublin, OH 43017/614-761-1711, Telex 241302

March 24, 1986

Robert A. Bisson, Chairman  
BCI GEONETICS, INC.  
Corporate Headquarters  
Airport Road P.O. Box 529  
Laconia, New Hampshire 03247

Dear Bob:

I really appreciate your comprehensive letter of March 13th and the very excellent reports you included with it. I am very, very impressed with the work you did in Somalia. Your report may not be as fancy as the Dames and Moore-style you referred to, but there is little doubt of the tremendous information you obtained. I was also impressed by the innovative illusion of the color xerox copies of photos.

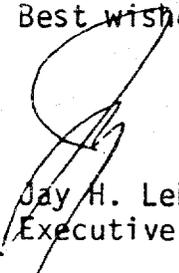
I have been in the office less than 4 days in the past 2 months, and a trip to New Hampshire in the near future would not be possible. I have to be in Massachusetts on the 1st of June and might be able to work something out on the 2nd of June.

Well before that, however, it may be possible to get together on the Bangladesh situation. I am going to be making a presentation on this subject to top officials at the Bank on May 23rd, and as you will be in the country, I will make an effort to have you included in this day-long, educational program and official reception that evening. Please let me know if you would be interested and available.

Under separate cover, I'm sending you my copy of the "Geology and Groundwater Resources of Bangladesh" report prepared by Paul Jones, formerly of the U.S. Geologic Survey. Please peruse it and return it within two weeks. Any comments will be appreciated.

I think you would be an outstanding firm to work on this project, and I will strongly recommend your services.

Best wishes,

  
Jay H. Lehr, Ph.D.  
Executive Director

JHL/pcf

REFERENCE.

1 October 1986

Dear Mr. Bisson,

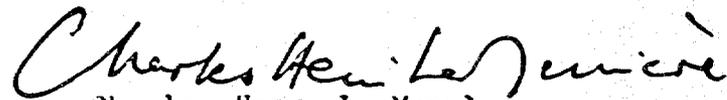
Mr. Maurice Strong has asked me to review the documentation on the Northwest Somalia Ground-water Development programme which you sent to him under cover of your letter of 29 September.

We are familiar, in OEOA, with a good deal of the work being carried out in Northwest Somalia, because of our close association with the refugee/returnee assistance programmes being implemented in that part of the country. Clearly, improved water availability both for human and animal consumption is of key importance throughout the area, both for the refugees and the local population.

Unfortunately, OEOA will be disbanded, as a separate office of the United Nations, on 31 October 1986. You can well imagine that under these conditions our capacity to mobilize resources for emergency assistance programmes is virtually non-existent.

As our own financial resources are totally expanded, I have forwarded the material you sent to Mr. Strong to the Regional Bureau for Arab States of UNDP. Their field office in Mogadiscio manages an important programme of technical assistance, and I am certain that they will be interested in the objectives and results of your activities. I would suggest that you contact UNDP directly regarding a possible association in the further implementation of the programme.

Yours sincerely,



Charles-Henri La Munière

Executive Co-ordinator

Office for Emergency Operations in Africa

Mr. Robert A. Bisson  
Chairman  
BCI Geonetics, Inc.  
Airport Road  
P.O. Box 529  
Laconia, N.H. 03247

April 8, 1986

A. H. Shibusawa  
Special Adviser to Vice President  
South Asia Region  
THE WORLD BANK  
1818 H Street, N.W.  
Washington, D.C. 20433

Dear Alphonse:

I am eagerly looking forward to my visit with you in Washington on May 23rd. As you well know, I am dedicated to the notion of seeing the ground water potential in Bangladesh explored prior to the expenditure of vast sums of money on surface water projects.

I am writing, at this time, to determine whether or not it would be possible to bring an associate of mine to the meeting in Washington. Mr. Robert Bisson, who is President of BCI Geonetics, is an extremely knowledgeable ground water scientist with experience throughout the world. The nature of his company, which specializes in international ground water assessments, is such that he could add tremendous support to our arguments to promote the exploration of ground water in Bangladesh prior to the expenditure of extensive monies for surface water development. He is willing to journey to Washington on May 23rd at his own expense to participate in this meeting, and I feel his technical support could be a tremendous contribution. Mr. Bisson is capable of marshaling influential support on behalf of our interests in this area. Recently, he had occasion to discuss this controversy with Sir Edmund Hillary who is presently High Commissioner to India for New Zealand and found Sir Edmund favorably disposed to projects that would waste less human and economic resources in bringing adequate water supplies to any portion of that continent.



DEPARTMENT of RESOURCES and ECONOMIC DEVELOPMENT

OFFICE of the COMMISSIONER

172 Pembroke Road P.O. Box 856 Concord, New Hampshire 03301

STEPHEN K. RICE  
Commissioner

603-271-2411

FAX: 603-271-2629

August 28, 1991

Mr. Steven Lewis  
Societ, Poland

FAX: 48/58/713200

Dear Stevens:

I am pleased to inform you that Mr. Robert A. Bisson, a New Hampshire businessman and distinguished international expert in the field of groundwater exploration, development and protection, will be arriving in Poland on September 8, 1991. Mr. Bisson will be staying at the Hotel Forum in Warsaw through September 12th, and would like to meet with you in Gdansk.

Mr. Bisson has led many pioneering technologies in his field and has been responsible for the mapping of previously unsuspected groundwater resources and consequently studying the economic impact of these resources in the U.S.A., the Middle East and Africa, and has worked extensively with U.S. AID. He would like to launch an analogous project in Poland, with the potential for forming a Polish company. This is a tremendous opportunity to initiate technological and economical breakthroughs in an area I know is of great concern to Poland, with the added benefit of training Polish nationals in an innovative field.

I have forwarded this information both to Julian and Dr. Plazynski. Mr. Bisson will contact you upon his arrival in Warsaw and I would appreciate it if you would assist in making his trip as productive as possible. I very much look forward to this being a tremendously beneficial project between New Hampshire and Poland.

I hope you and your family are settling in well in your new home. I look forward to speaking with soon, and in the meantime, thank you for your attention to this matter.

Sincerely,

Stephen K. Rice  
Commissioner

SR/dw



### Bisson and his team

Uniqueness test. The proposed groundwater mapping/testing projects address complex geographic regions and peoples. The project proposer, Robert Bisson, and his team of subconsultants have worked together for over a decade in the U.S., and successfully developed fractured rock aquifers in the Horn of Africa for refugee relief camps purposes. In these proposals, Bisson is offering the highly (time) efficient application of a proven methodology by an experienced team already possessing substantial personal learning curve of local conditions and a comprehensive data base of appropriate nature for groundwater mapping, combined with advanced knowledge of specialized requirements for drilling technology and skills in fractured bedrock aquifers.

The unique combination of factors includes: 1) successful Ogaden (Somalia/Ethiopia) application of technologies for groundwater exploration developed by this team; 2) Initial discovery and publication regarding the "Megawatershed" phenomenon; 3) the unprecedented documented observation that the "megawatershed" phenomenon exists in Ethiopia (as in Sudan) and in Botswana; 4) the time constraints for success which require "hit the ground running" capabilities Bisson and his team can design, implement and deliver the products described in the unsolicited proposals.

## BIOGRAPHY OF ROBERT A. BISSON

Robert Bisson is the founder and past Chairman (retired June 28, 1991) of the groundwater development firm of BCI Geonetics, Inc., and is the principal architect of the firm's integral systems approach to natural resource exploration and management.

Mr. Bisson has, as Chief Executive of BCI Geonetics, initiated hydrogeologic and economic mineral exploration programs for private industry and public agencies, covering much of sub-Saharan Africa. He has worked closely with his colleagues at BCI on research and applications programs for water development in Somalia, Djibouti, Ethiopia, Kenya, Sudan, Mali, Botswana, Zimbabwe, Namibia, and the Republic of South Africa. Before joining BCI, Mr. Bisson had participated in privately-financed exploration programs in several west African states, with a focus on coastal Nigeria and the Camerouns.

In 1985, after personal field investigations, Mr. Bisson designed an unprecedented exploration program for water in Somalia. During the resulting successful project, he collaborated with Dr. Farouk El-Baz, Director of the Center for Remote Sensing at Boston University, on an experimental application of the shuttle-square-borne cartographic "Large Format Camera" (LFC), to a 14,000 square mile arid region of Somalia.

Bounded by Ethiopia and the Gulf of Aden, and without accurate ground control points from available maps, this desolate part of the Horn of Africa was mapped for water potential by Bisson's team using, as a navigation map base, the unique high-quality photographs generated by NASA's LFC, combined with the botanical and geologic information contained in the excellent Landsat coverage of the region. Using innovative exploration methods, the study region was found to possess substantial amounts of water, proven by test wells drilled proximal to population centers for Somalia citizens and Ethiopian refugees. The test wells alone averaged over 200,000 gpd of fresh water per well. The 1986 political upheaval in Northwest Somalia prevented the full testing and development of this major regional fresh water resource.

In 1987-1989, Mr. Bisson and Dr. El-Baz once again teamed up in a BCI-designed water development program in Eastern Sudan, using NASA LFC photos as the "navigation map" base an Landsat and other satellite imagery for hydrogeologic interpretive purposes. The specialized exploration process was this time applied in context with an innovative private-sector partnership with USAID acting as development "catalyst" by funding the groundwater and socio-economic feasibility program. The private sector "pre-committed" its resources to the ultimate development of specific water-

dependent projects, including mining, agriculture and industry, all located in the principal target area -- the Red Sea Province.

The feasibility program was completed to the point of test drilling before political "force majeure" (i.e. a Coup d'etat) temporarily delayed the project. Nevertheless, the plan is in place and partners remain poised to proceed with the next stage of development in the firm belief that the outputs of this innovative joint venture with Sudanese business partners will be profit-producing ventures based on water availability, including agricultural, industrial and mining ventures.

Mr. Bisson's interest in natural and political water constraints in the Near East has led to extensive research and personal conferences with local ministry officials, water engineers, and hydrogeologists in Iraq, Jordan, Saudi Arabia, and elsewhere in the region.

In 1972-1975, Mr. Bisson and former NASA TIROS satellite program manager, Dr. William K. Widger, Jr., pioneered the use of digital computers to expedite the examination and analysis of multi-variate geographic-based data, involving the integral use of remotely-sensed data, including ERTS-1 (the first Landsat). This first-generation "Geographic Information System" was subsequently field tested on water pollution studies and regional land use planning.

1969-1972, Mr. Bisson gained extensive experiences as a professional consultant in natural resource assessments, including environmental baseline data collection and impact statements. He participated in project management and senior technical roles in more than sixty environmental projects, including power plant siting and impact analysis, (hydro-, fossil-, an nuclear - fueled), oil refinery site evaluations, sewage treatment plan watershed impacts, highway impacts, and non-point water pollution studies.

As a student and ocean explorer from 1964 to 1969, Mr. Bisson received formal liberal arts and science education at the University of New Hampshire and The Faculte des Sciences (Marseilles), while pursuing "hands-on" training in the U.S., France and England in modern exploration concepts.

As a research assistant in Marseilles and Monaco, under the patronage of Captain Jacques Yves Cousteau, Mr. Bisson participated in the development of modern man-in-the-sea technology and was involved in research concerned with deep-diving technology and human physiology. He later joined a London-based commercial diving company and used his academic training and research experience as a member of one of the first teams of professional divers to work with mixed-gas apparatus of 200-meter depth capability. He went on

to become a project manager for continental shelf mineral exploration at Ocean Science and Engineering, Inc. in Palm Beach, Florida.

In 1988, Mr. Bisson was appointed by Commerce Secretary William Verity to the Industry Sector Advisory Committee for Trade Policy. He has also served on the D.O.C. "U.S. Water Technology Export Council."

Mr. Bisson is a U.S. citizen and maintains residence in New Hampshire and Washington, D.c.

### Professional Association and Affiliation

At various times during his career, Mr. Bisson has been a member of the following professional organizations and boards.

- o Marine Technology Society
- o Association of Engineering Geologists
- o AAAS
- o Water Technology Export Council - U.S. Dept. of Commerce
- o International Desalination Association
- o National Water Supply Development Association
- o New England Water Works Association
- o Explorers Club - Fellow

### Selected Publications

Bisson, R.A., and El-Baz, Farouk, "Megawatershed Exploration Model." Presented at the Water and Wastewater International Conference. Barcelona, Spain, April 1990 (Pub. Conf. proceedings).

Bisson, R.A., and El-Baz, Farouk, "New Groundwater for Sudan -- The Megawatersheds Exploration Model." Proceedings of the 23rd International Symposium on Remote Sensing of Environment. Bangkok, Thailand, April 1990 (Pub. Conf. Proceedings).

Bisson, R.A., and El-Baz, Farouk, "Megawatersheds Exploration Model for African Water Development." Presented at the African Water Technology Exhibition. Nairobi, Kenya, February 1990 (prior published material distributed).

Bisson, R.A., and El-Baz, Farouk, "Megawatersheds Exploration Model." Presented by Robert Bisson to the Third World Academy of Sciences' International Conferences on Desert Environments. Trieste, Italy. November 1989. (Pub. Conf. proceedings).

Bisson, R.A., "Groundwater -- The Ultimate Economic Mineral." Proceedings of the 2nd Annual Conference on Profiting From Water. Santa Monica, California, May, 1989.

Bisson, R.A., Hoffman, Peter D., "Groundwater -- The Paradoxical Economic Mineral." Water and Wastewater Magazine. April, 1989.

Bisson, R.A., and Long, A.D., 1984. "Exploration for New Ground Water; Impact of the Space Age in the Third World." Third World Development. Grosvenor Press, London. Publication Date: December 1984.

Bisson, R.A., and Hofman, P.D., 1982. "No Risk/Turnkey Water Supply Contracts." Journal of the New Hampshire Water Works Association, February 1982.

Bisson, R.A., and Widger, W.K., Jr., 1977. "Innovative Techniques for Water Resources Studies," Journal of the New England Water Works Association, June 1977.

#### Selected Lectures and Panel Participation

Sponsor and Panelist, Global Water Policy and Technology Summit for Africa. Cairo, Egypt, June 1990.

Bisson, R.A., "New Water for California." California Academy of Sciences, lecture series, 1988.

Panelist/Speaker, "The Application of Modern Exploration Methods to Strategic Water Mapping in the Mid East." Conference on U.S. Foreign Policy on Water Resources in the Mid East and Horn of Africa. Center for Strategic and International Studies (CSIS), Washington, D.C., 1986.

Bisson, R.A. and Bisson, L.G., 1986. (Speaker/panelist). "Discovery of Major New Brackish Water Supplies for Low Pressure Reverse Osmosis Treatment, Using Modern Exploration Techniques." Annual Conference of the Water Supply Improvements Association, Washington, D.C.

Speaker, "The Big Picture - A Look at the Water Planet From Space." Cape Canaveral Section of the American Institute of Aeronautics and Astronautics, Merritt Island, Florida, 1986.

Panelist/Speaker, "Ground Water Acquisition Problems - Locating Ground Water for Municipal Uses." Presented to American Bar Association: Workshop on Eastern Water Law. Baltimore, Maryland, 1984.

Bisson, R.A., 1983. (Speaker/Panelist) "Remote-Sensing Applications of Groundwater Development and Hazardous Waste Site Evaluations." Presented at European Economic Community Remote-Sensing Seminar, Trinity College, Dublin, Republic of Ireland.

Speaker, "Mineral Exploration Techniques Applied to Bedrock Water Discovery." Presented to 33rd Annual National Water Well Association Conference, 1981.



February 19, 1992

Mr. Robert A. Bisson  
The Representative  
1101 S. Arlington Ridge Road  
Arlington, VA 22202

Dear Mr. Bisson:

In confirmation of your discussion with Bob Porter, EarthSat has withdrawn its expression of interest and qualification statement for prime contractor consideration for the USAID East Africa Water Access and Technology programs.

It is my understanding that we will provide exclusive support with image processing and GIS work under this contract as follow-on in this region. If you are in agreement with this, please sign below and fax your response.

Should the project be competed as a result of other submissions of expressions of interest, we are prepared to formally team with you in a proposal submission.

Sincerely,

A handwritten signature in cursive script that reads "Max E. Miller".

Max E. Miller  
Manager, Program Development

AGREED:

A handwritten signature in cursive script that reads "Robert A. Bisson".

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**Peter D. Hofman**  
532 Shaker Road  
Canterbury, NH 03224  
Phone/Fax (603) 267-8910

February 19, 1992

Mr. Robert A. Bisson  
P.O. Box 440  
Melvin Village, New Hampshire 03830

Dear Bob:

I was pleased to receive your invitation today to participate with you in the groundwater exploration and development programs you will be carrying out in Africa for US AID. Given our long history together, my belief in your technical assessment of the groundwater potential in these areas (consistent with your MegaWatershed Model), and your inclusion of our former technical colleagues in the project team, I agree to serve as project administrator. As you requested, I have enclosed some background information.

I am well aware of your long term interest and involvement in groundwater development in Africa. Indeed, over the years we jointly carried out substantial in-house research, prepared numerous proposals, and worked on several projects -- in Somalia, Sudan, Zimbabwe, Botswana, Namibia and South Africa. With this background and knowledge of your intensive investigations in the areas targeted in the current projects, I am confident in the soundness of your approach and think the probability of success is high.

You described my job as assisting you in project design (including scheduling and budgeting) and administration (covering contract compliance, monitoring and cost control, as well as other administrative details necessary for timely project completion). A major reason for my accepting this role is my confidence in my ability to do the job right. As you may recall, we first met in the mid-1970's when BCI was one of the subcontractors on the EIS for the Franconia Notch section of I-93 I was managing for VTN under its contract with the Federal Highway Administration and the New Hampshire Department of Public Works and Highways. That job was the first of a series of federal projects I managed/administered before and after we worked together at BCI which involved complex scopes of work and heavy administrative duties:

- as project manager for VTN I managed our work in the late 1970's preparing a programmatic EIS for the General Services Administration related to the disposal of surplus federal properties at two bases in Rhode Island;
- as BCI's Executive Vice President I was responsible for contract administration and accounting for our extensive work on US DOE's NURE Program in the 1970's and early 1980's, as well as the Montana well inventory we did for USGS;
- as BCI's President and CFO I oversaw contract compliance, administration and accounting for the US AID groundwater exploration projects we carried out in Somalia and Sudan in the 1980's.

Mr. Robert A. Bisson

-2-

February 19, 1992

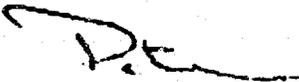
Clearly, the African projects were most similar to the work we will now be performing. As you remember, we worked closely together to comply with all of US AID's contract and financial/accounting requirements under these contracts. These projects involved considerable administrative duties:

- the Somalia project was a cost reimbursement contract which was subsequently audited and involved the complicated logistics associated with initial field exploration and test well drilling in a third world country;
- our work in Sudan involved the Sudanese joint venture and similar logistical challenges. Given everything we have been through together, I am confident we can handle the administrative responsibilities associated with these new African projects.

As you know, I habitually focus on ensuring we comply with our contracts, on time and within budget. Our ability to complete the first phase of these projects as contracted will be greatly enhanced by your inclusion of staff from HydroSource Associates (HSA) in the team. I can't think of anyone I would rather work with on these projects than HSA's keymen, people we have worked with since the late 1970's. Skip, Rose, Joe and Wayne know the process, have carried out similar programs in the past and know from experience how to handle the logistical hurdles we will surely face. Rose is the best person I know of to dig up any and all data that will be needed. Because of our close working relationships, communications will be effective and efficient, as will the overall program.

Again, I appreciate your invitation and look forward to working with you on these important projects. We have a great team and know we will get the job done right. As soon as the contracts are signed, I will plan to meet with you, finalize the terms of my involvement and get started. In the meantime, if you need any additional information, please contact me.

Sincerely yours,



Peter D. Hofman

encl.

## **Experience**

- 1991 -- Present**      **Consultant**
- 1979 -- 1991**      **BCI Geonetics, Inc. -- Laconia, NH -- specialists in groundwater exploration, development and protection**  
**Director, President, Executive V.P., CFO, and Treasurer**
- 1974 -- 1979**      **VTN Consolidated, Inc. -- Campton and Concord, NH -- engineers, architects and planners**  
**Project Manager, Project Coordinator, Resource Analyst on environmental impact statements**
- 1974**              **New England River Basins Commission -- Boston, MA -- regional water and related land resources planning agency**  
**Consultant in resource analysis, planning and issue resolution related to regional and interstate resource conflicts**
- 1972 -- 1974**      **New Hampshire Office of State Planning -- Concord**  
**Consultant in resource analysis and planning for a statewide water and related land resources plan**
- 1969 -- 1972**      **Peace Corps -- Tacna, Peru (special MBA program -- fluent in Spanish)**  
**Consultant to Agriculture Ministry and Federal Development Corporation**

*During my career, I have: prepared various technical reports and appendices, as well as documents for public distribution; had articles published in national and international journals; made numerous presentations to small groups and large audiences; lectured at Boston University and Tufts' Fletcher School of International Relations.*

## **Education**

**Amos Tuck School of Business Administration, Dartmouth College -- Hanover, NH**  
**MBA (1969) -- Distinction, Amos Tuck Scholar**

**Dartmouth College -- Hanover, NH**  
**BA (1968) -- Cum Laude**

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**Project Design and Management -- Government and Interest Group Liaison -- Management Consulting**

## PETER D. HOFMAN -- CONSULTANT

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532 Shaker Road, Canterbury, NH 03224 (603) 267-8910

### PROJECT EXPERIENCE

Directed a wide range, including: multi-disciplinary environmental impact statements; feasibility and planning studies; groundwater exploration programs involving environmental, economic, engineering, legal and regulatory issues.

- **Clients:** local, state and federal agencies, industrial and commercial businesses, and institutions.
- **Controversial Issues:** some of the projects involved major, controversial actions - such as the completion of I-93 through Franconia Notch, NH; the disposal of surplus federal property in Rhode Island; interstate water and related land resources conflicts.
- **Size:** ranged from one-person assignments to multi-million dollar multi-year programs involving up to six different companies and numerous outside parties.
- **Location:** the northeast, southeast and west coast USA; east and southern Africa; South America -- fluent in Spanish.

At senior technical and management levels, I have had line and staff responsibilities, including:

- **project scoping/proposal preparation/selling**
- **contract structuring and negotiations** -- with clients, subcontractors, landowners (for land access and water rights), investors and banks;
- **work plan design, budgeting, planning, and scheduling**
- **project management**
- **technical analysis** -- feasibility, planning, alternative evaluation/selection and impact analyses involving social, economic, financial, ecologic, environmental, aesthetic, air, noise, water, mineral, land use and legal/regulatory factors;
- **design and conduct of public participation/agency liaison/media relations programs**
- **organizing, writing, editing documents** -- multi-volume reports, technical appendices and executive summaries designed for wide circulation;
- **client relations** -- preparing regular project updates and special reports; directing document review sessions; planning, organizing and conducting client briefings.

Details upon request.

## PETER D. HOFMAN -- CONSULTANT

---

572 Shaker Road, Canterbury, NH 03224 (603) 267-8910

### BUSINESS EXPERIENCE

With an MBA from Dartmouth's Amos Tuck School, I have 18 years of experience in engineering and scientific technical services with large and small businesses. My responsibilities encompassed all aspects of corporate operations.

- **Strategic Planning:** formulating mission statements, goals/objectives, business plans, organization design and restructuring programs.
- **Corporate Finance:** raising over \$9.5 million -- \$3.3 million from an initial public offering; more than \$6.2 million from individual investors, venture capitalists, industrial and other business entities, and banks. Financing methods included private placements, limited partnerships, joint ventures, lines of credit, convertible notes, secured/unsecured loans, debt conversion/forgiveness and asset sales.
- **Marketing/Sales:** directing marketing/sales in the northeast, southeast and west coast USA -- representing \$6 million in revenues over three years; playing a key role in developing over \$1 million of international projects.
- **Accounting/Financial Reporting:** handling single and multi-division corporations; limited partnerships.
- **SEC Compliance:** drafting quarterly and annual filings, special disclosure statements.
- **Shareholder/Board Relations:** preparing shareholder letters/reports, responses to inquiries, agendas and supporting materials for Board/Executive Committee meetings.
- **Corporate Administration and Contracts:** overseeing insurance, office operations, contract drafting and negotiations, legal matters -- working closely with outside counsel.
- **Personnel:** establishing and enforcing policies -- employee handbooks, performance reviews.

As an in-house consultant, I applied an outsider's perspective in assessing corporate direction/operations for major restructuring, normal evolutionary changes, or "due diligence" efforts of outside investors and banks.

Details upon request.

LINCOLN R. PAGE  
P.O. Box 171  
Melvin Village, New Hampshire 03850  
(603) 554-8451

February 19, 1992

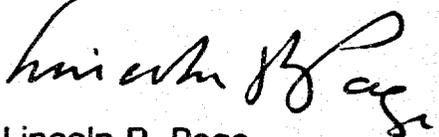
**VIA FEDERAL EXPRESS**

Robert A. Bisson  
c/O Bruce Gair  
Porter and Gair, P.C.  
3815 Plaza Drive  
Fairfax, VA 22030  
(703) 691-1465

Dear Bob:

As requested, I am sending you a resume of my experience. I enjoyed working with you on your Sudan project and look forward to working with you on future projects that involve map and photo interpretation to zones in fractured rocks that yield abundant water.

Sincerely,

  
Lincoln R. Page

LRP:cw

Enclosure

## TRAINING AND EXPERIENCE

of

### LINCOLN RIDLER PAGE

P.O. Box 171  
Melvin Village, NH 03850

Born: Lisbon, NH, February 11, 1910

<b>Degrees:</b>	A.B. 1931	Dartmouth Collage. Major: Chemistry
	M.B. 1932	University of Minnesota. Major: Geology; Minor: Metallurgy
	Ph.D. 1937	University of Minnesota. Major: Geology; Minor: Metallurgy and Petrography

#### Academic Experience:

1932 - 1935 Instructor in Geology, Dartmouth College. Lecture and laboratory. Elementary geology.

1935 - 1937 Instructor in Geology, University of Minnesota. Lecture and Laboratory. Four courses in Elementary Geology.

1938 - 1939 Assistant Professor, University of Colorado

1959 - 1960 Visiting Professor, Dartmouth College.

1971 Visiting Professor, Stanford University.

#### Field and Administrative Experience:

1930 Summer field assistant, sand and gravel survey of New Hampshire, State Highway Department.

1936 Summer field assistant mapping internal structure of the Saganaga and Snow Bank Lake granites; distribution and structure of anorthosites and associated diabbases, northern Minnesota.

1937-1938 Junior Geologist, Standard Oil Co. of Texas. Logging well samples, making stratigraphic sections and correlation of surface and subsurface geology of the Permian Basin in Texas and New Mexico.

1938-1939 Consulting geologist, Slide mines, for Au, Ni and Co Properties in Colorado.

1939 U.S. Geological Survey (WAE 1959-1960 and 1973 (retired) to 1983). Junior Geologist (P-1) -- mapping chromite mines and prospects in Southwestern Oregon and northern California.

**Field and Administrative Experience (Cont.):**

- 1940 Chief of party. Mapping and diamond drilling of tin-bearing pegmatites at Tinton, S.D. Mapping of tin and tungsten pegmatites in Eastern Washington; tungsten veins, Germania, Washington; and tin-tourmaline veins, Temescal, California, and tin and limestone at Cima, California.
- 1941 Mapping tin pegmatites of North Carolina and Alabama and tungsten veins, Isla de Pinos, Cuba.
- 1942 Investigation of tantalum and beryllium resources of pegmatites in New England, South Dakota, Wyoming and Colorado.
- 1942-1943 Mapping and sampling of tin deposits of Majuba Hill, Nevada and Gorman, California.
- 1943-1948 Geologist in charge of South Dakota office. Surface mapping, diamond drilling exploration, underground mapping, exploration, sampling and economic appraisal of mica, lithium, beryllium and feldspar pegmatites of Black Hills, S.D.
- 1948-1950 Geologist in charge of the U.S.G.S. National beryllium program for the Atomic Energy Commission. Some 35 geologist engaged in geologic appraisal and sampling of pegmatite beryllium deposits of the U.S.
- 1950-1952 In charge of U.S.G.S. Reconnaissance Group. Up to 50 geologist engaged in investigations for uranium throughout U.S., except the Colorado Plateau. Carried out for the Atomic Energy Commission.
- 1952-1954 Geologist in charge of uranium investigations in S. Dakota. Up to 15 people engaged in areal mapping, mine mapping, and diamond drilling exploration of Cretaceous uraniferous sandstones.
- 1954-1959 Assistant Chief Geologist in charge of Trace Elements Program Office. Up to 300 employees. Engaged in geologic, geochemical, geobotanical, geophysics and photo geologic activities relating to the finding and appraising of uranium and thorium deposits for the Atomic Energy Commission throughout the United States. In addition, special studies were made relating to underground nuclear explosions, waste disposal, and other nuclear projects.
- 1959-1960 W.A.E. writing reports on uranium and thorium deposits.
- 1960-1973 Geologist in charge of the Boston office, Chief of the New England Regional Geology Branch. Up to 35 geologists engaged in geologic mapping of surficial and bedrock throughout New England. Many of the projects were cooperative ventures with the State Geologists of Rhode Island, Connecticut, Massachusetts and New Hampshire. One was a pilot project on the use of geology in environmental concerns.
- 1973-1983 W.A.E. (Uranium and Thorium Branch and Office of International Geology (U and Th resources of Egypt.)
- 1984-1986 State Geologist of New Hampshire
- 1986- Consultant. Fracture zones, Sudan, map interpretation of Greece and Africa.

**Field and Administrative Experience (Cont.):**

- 1955 and 1958 Technical Advisor to the U.S. Delegation, United Nations, Atoms for Peaceful Uses Conference, Geneva. Visited uranium mines of Italy, France, Portugal and England twice/
- 1957 Visited uranium, gold and diamond mines of Transvaal, South Africa; copper mines of Zimbabwe; uranium, copper, lead, and germanium mines in Zaire; thorium deposits of Malawi; tin and niobium mines of Nigeria; and uranium mines of Canada.
- 1963-1970 Member African Science Board National Academy of Sciences, concerned with training of scientists. Delegate to the Second Annual Meeting of the East African Academy of Arts and Sciences in Nairobi, Kenya (1963). Member of team to visit Ghana, Nigeria, Sierra Leone, and Algeria, 1965.
- 1972 Member of team to discuss training of Zairian geologists and earth scientists.
- 1977 Distinguished lecturer, Nigerian Geological Society.
- 1978 Member of Joint Egypt-United States cooperative energy assessment team. Responsible for U and Th resources.
- 1980 Member of team for the assessment of mineral resources of Egypt for U.S.A.I.D. responsible for metals and
- 1960-1973 Member Dept. of Interior Field Committee and Boston Federal Executive Board.
- 1980 Chairman, Working Group I, Uranium Geology, Inter. Atomic Energy Agency, Paris meetings at Inter. Geological Congress.
- 1980-1983 Coordinating vice-chairman, IAEA Working Groups on Uranium Geology. 1982 Meetings in Paris and Vienna; 1983 meeting in Vienna.
- 1984 Meetings of the Working Group on Uranium Geology in August at Inter. Geologic Congress, Moscow, USSR. Also presenting paper on "Source of Uranium in Ore Deposits" at IGC

**Fellow or Member:**

Geological Society of America, Society of Economic Geologists, American Association of Petroleum Geologists, American Mineralogical Society, American Geophysical Union, Norwegian Geological Society, Nigerian Geological Society, Washington Geological Society, American Association for the Advancement of Science, Sigma Xi, Alpha Chi Sigma, Lambda Chi Alpha, Cosmos Club, Northern New England Academy of Science, Association of Geology of International Development, Geochemical Society, Association of State Geologist, Geological Society of New Hampshire.

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\_\_\_\_\_ and Kruger, F.C., 1936, Laboratory exercises for general geology: Minneapolis, Burgess Printing Co., 55p.

\_\_\_\_\_ 1938, The deposition of native copper under hydrothermal conditions: Econ. Geology, v. 33, no. 5, p. 522-541.

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\_\_\_\_\_ and Smith. W.C., 1941, Tin-bearing pegmatites of the Tinton district, Lawrence County, S. Dak., a preliminary report: U.S. Geol. Survey Bull. 922-T, p. i.v.. 595-630.

\_\_\_\_\_ 1941, Igneous and metamorphic rocks of the Rumney quadrangle, N.H. (abs.): Geol. Soc. America Bull., v. 51, no. 12, pt. 2, p. 1936-1937; 1941, Am. Mineralogist, v. 26, no. 3, p. 200.

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\_\_\_\_\_ 1946, Contact metamorphic deposits of cassiterite in California (abs.): Am. Mineralogist, v.31, nos. 3-4, p.202; 1945, Min. Soc. American Program 26th Ann. Mtg., p.19-20; 1945, Geol. Soc. America Bull., v.56, no. 12, pt 2, p.1187; 1945, Econ. Geol., v. 40, no. 8, p.601.

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\_\_\_\_\_ with Kaiser, E.P., and others, 1951, Distribution of uranium deposits in the United States (abs.): Geol. Soc. America Bull., v. 62, no. 12, pt. 2, p. 1537; 1952, in selected papers on uranium deposits in the United States: U.S. Geol. Survey Trace Elements Investigations Report 168; 1952, in U.S. Geol. Survey Circ. 220, p.1-7.

\_\_\_\_\_ and Redden, J.A., 1952, The carnotite prospects of the Craven Canyon area, Fall River County, South Dakota: U.S. Geol. Survey Circ. 175.

\_\_\_\_\_ with McKelvey, V.E., and others, 1952, Uranium deposits in the United States (abs.): Econ. Geology, v. 47, no. 1, p.125-126.

\_\_\_\_\_ and others, 1953, Pegmatite investigations 1942-1945, Black Hills, South Dakota: U.S. Geol. Survey Prof. Paper 247. 228.p.. 45 pls., 37 figs.

\_\_\_\_\_ 1954, Petrology of spodumene-bearing pegmatites (abs.): Geol. Soc. America Bull., v. 65, no. 12, pt. 2, p. 1293.

\_\_\_\_\_ 1956, Geologic prospecting for uranium and thorium: Proceedings of the International Conference on the Peaceful Uses of Atomic Energy, United Nations, New York, v. 6, p. 688-691; also in Contributions to the geology of uranium and thorium by the United States Geological Survey and Atomic Energy Commission for the United States International Conference on Peaceful Uses of Atomic Energy, Geneva, Switzerland, 1955, compiled by Page, L.R., Stocking, H.E., and Smith, H.B., 1956, U.S. Geol. Prof. Paper 300, p.627-631.

\_\_\_\_\_ with Stocking, H.E., 1956, Natural occurrence of uranium in the United States--a summary; U.S. Geol. Survey Prof. Paper 300, p.5-12.

\_\_\_\_\_ with Foote, R.S., 1956, Techniques for prospecting for uranium and thorium--a summary: U.S. Geol. Survey Prof. Paper 300, p.621-625.

\_\_\_\_\_ with Norton, J.J., 1956, Methods used to determine grade and reserves of pegmatities: Am. Inst. Min. Eng. Trans., v. 205, p.401-414.

\_\_\_\_\_ 1960, The source of uranium in ore deposits: Int. Geol. Cong., XXI session, Norden, Part XV, p.149-164.

\_\_\_\_\_ 1962, Ed., Beryllium: Beus, A.A., (1956) 161 p. W.H. Freeman and Co., (San Francisco and London).

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\_\_\_\_\_ 1966, Ed., Geochemistry of beryllium and genetic types of beryllium deposits: 401 p., W.H. Freeman and Co. (San Francisco and London).

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\_\_\_\_\_ 1971, Petroleum potential of New England: in Future petroleum provinces of the United States--their geology and potential, Cram, I.H. ed., Am. Assoc. of Pet. Geol., Mem. 15, p. 1274-1285.

\_\_\_\_\_ 1971, Southwest side of the Ossipee Mountains, New Hampshire, New England Intercollegiate Geol. Cong. guide book, 6p.

\_\_\_\_\_ 1978, Introduction and summary, p. 1-23, in Contributions to the stratigraphy of New England, Page, L.R., ed., Geol. Soc. of Am. Memoir 148, 445.p.

\_\_\_\_\_ 1978, Assessment of uranium and thorium resources in Egypt. In joint Egypt/United States Report on Egypt/United States Cooperative Energy Assessment: U.S. Dept. of Energy, DOE/IA-0002/02 vol. 2, Annex 1, p. 70-93.

\_\_\_\_\_ 1980, Guides to prospecting for uranium and thorium in New Hampshire and adjacent areas. U.S. Geol. Survey open file report 80-657 23p.

\_\_\_\_\_ 1980, Mineral Assessment, Egypt. Project paper for U.S. State Department.

\_\_\_\_\_ and J. Dykstra Eusden, Fracture and Fracture Zones in New Hampshire Based on Straight Reaches of Streams and Lake Shores. Office of State Geologist manuscript -- 3 maps in N.H. GIS series (1990)

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Telephone 1-609-683-1762

## CURRICULUM VITAE

January 2nd, 1990

Name: Martin G. BEYER

Born: December 12, 1929 in Munich, Germany

Civil State: Married

Citizenship: Sweden

Present occupation: Consultant for water supply and sanitation in international development.

Academic Background: University of Stockholm, Sweden: Degrees of Filosofie kandidat 1951, Filosofie licentiat (PhD - Geology) 1960.

Associate Professor (Adjunct), International Health, Graduate School of Health, New York Medical College (A Medical University), Valhalla, NY 10595.

Languages: Fluency in English, French, Spanish, German, Swedish, Danish, Norwegian. Operational in Portuguese, Italian, Dutch.

Previous work:

1990 Executive Secretary, Global Consultation on Safe Water and Sanitation for the 1990s, United Nations Development Programme (UNDP).  
Responsible for organization of first global meeting sponsored by United Nations, on water supply and sanitation, New Delhi, India, 10-14 September 1990.

1973 - 1989 Senior Adviser (until 1980 Adviser), Drinking Water and Sanitation, United Nations Children's Fund (UNICEF), New York Headquarters.  
Coordination of UNICEF's global cooperation in government programmes world-wide for community water supply and sanitation in rural and poor urban areas. - During 1988-1989 part-time secondment to the World Bank, Washington, D.C., Water Supply and Sanitation

Division, Department for Infrastructure and Urban Development.

- 1972 - 1973 Deputy Regional Director, UNICEF, The Americas Regional Office, Santiago, Chile.  
Administrative responsibilities and liaison with other international organizations for social development programmes.
- 1965 - 1971 Chief Geologist, Terratest AB, Stockholm, Sweden. Consultants and contractors for minerals and groundwater exploration: Mineral and groundwater surveys, market surveys.
- 1962 - 1964 Consultant Geologist, Granges Corporation, Stockholm, Sweden.  
International mining exploration.
- 1956 - 1962 Geologist, from 1960, Chief Geologist, Liberian-American Minerals Company (LAMCO), Monrovia, Liberia.  
Geological mapping and exploration of Nimba Range for largest iron ore mining operation in Africa.
- 1953 - 1955 Assistant Geologist, Geological Survey of Sweden (Sveriges geologiska undersokning), Stockholm, Sweden.  
Oil and uranium exploration.
- 1951 - 1952 Military service, The Royal Svea Guards, Sweden.

Work assignments before 1972 include assessment of national water well programme in India for UNICEF (1970), mineral exploration in Peru, mining investment studies in Africa, Iran, Algeria, France, company management in Chile (1967), groundwater exploration in Sweden, participation in planning for mine and harbour towns in Liberia for LAMCO.

Public Assignments:

(Partly ex officio as Representative of UNICEF)

Member (1973-1989), and Chairman (1987-1988), Intersecretariat Group for Water Resources, United Nations Administrative Committee for Co-ordination;

Member (1980-1989), Steering Committee for the International Drinking Water Supply and Sanitation Decade 1981-1990 (United Nations);

Chairman, Advisory Panel for the UNDP/World Bank Global Project for the Testing and Development of Handpumps, later the Joint UNDP/World Bank Global Programme for Water Supply and Sanitation (1980-1990);

Member, Governing Board of the International Water and Sanitation Centre (IRC - a WHO Collaborating Centre), The Hague, The Netherlands (1983-1989);

Member, Scientific Council, Centre de la Formation Internationale pour la Gestion des Ressources en Eau (CEFIGRE - International Training Centre for Water Resources Management), Sophia Antipolis, Valbonne, France;

Member, Advisory Panel to the editors of "Water for the World" (Technical Manual for USAID, Washington, D.C.);

Senior Advisory Consultant, Water and Sanitation for Health (WASH - a programme sponsored by the U.S. Agency for International Development/AID), Washington, D.C., (1987-1990);

Member, Advisory Panel, "Waterlines" (Journal of the Intermediate Technology Development Group, Ltd.), London, United Kingdom;

Member, Advisory Panel to the American Society of Civil Engineers for the International Conference on Water, Puerto Rico, 1987;

Member Designate, Advisory Board, International Designers' Assistance Commission, New York;

Ombudsman (Staff/Management Relations), UNICEF Headquarters, New York (1986-1987);

Chairman, Association of Natural Science Students, University of Stockholm (1953).

#### Major Conferences:

(Participation/Representation on behalf of UNICEF)

- \* Third Special Meeting of Health Ministers of the Americas, Santiago, Chile, 1972;
- \* United Nations Conference on Water, Mar del Plata, Argentina, 1977;
- \* United Nations Seminar on Water Supply and Sanitation,

Uppsala, Sweden, 1980;

- \* United Nations Groundwater Conference, Zagreb, Yugoslavia, 1982;
- \* 4th National Water Conference, Zaragoza, Spain, 1982 (Keynote Address);
- \* WHO/BMZ Consultative Meeting on Water and Sanitation with European Donors, Konigswinter, Federal Republic of Germany, 1984;
- \* Chinese Academy of Agricultural Mechanization Sciences/UNDP/World Bank/GTZ Seminar on Handpump Water Supply, Changsha, Hunan, People's Republic of China, 1984;
- \* United Nations Special Session on the Emergency in Africa, Geneva, 1985;
- \* Vth World Congress on Water Resources, Brussels, Belgium, 1985 (International Water Resources Association - IWRA: On behalf of UNICEF received first IWRA Award ever issued, the "Crystal Drop", for "excellence in making water resources available for human use");
- \* Keynote Speaker at International Water Conference of the American Society of Civil Engineers, Puerto Rico, 1988;
- \* Keynote Speaker and Plenary Chairman at "Water and Wastewater '90" Conference, Barcelona, Spain, 1990;
- \* Numerous other conferences, workshops and seminars in international and national contexts around the world, particularly related to water, sanitation and health (e.g. in Brasil, Burkina Faso, Oman, Burma, Vietnam).

Lectures and seminars (a selection):

On iron ores in Liberia:

- \* Geological Society of Sweden, Stockholm, 1959;
- \* American Institute of Mining Engineers (AIME), New York, 1960;
- \* University of Minnesota, Duluth, 1960;

On environmental health, UNICEF and United Nations:

- \* Universities of North Carolina (Chapel Hill), Southern Methodist University (Dallas, Texas), State University of

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California (San Diego, California), Grenoble (France), New York Medical College;

- \* UNICEF National Committees in Canada, Federal Republic of Germany, Finland, France, German Democratic Republic, Japan, The Netherlands, Norway, Spain, USA;
- \* Keynote speech at 4th National Conference on Water and Sanitation, Zaragoza, Spain, 1981.

Media campaigns on the International Drinking Water Supply and Sanitation Decade:

Spain 1981 (including Radio-Television-Espana "A Fondo"/Spain's "60 Minutes") and Canada, 1981 and 1988.

Papers, published:

- Faunan pa Ivon (The Cretaceous fauna of Ivon Island, Southern Sweden), Faltbiologen, Stockholm, 1949.
- Leptitberggrunden i området mellan Harg och Hargshamn. (The leptite formation between Harg and Hargshamn, Central Sweden.) Geologiska Foreningens Forhandlingar, Stockholm, 1953.
- with Brotzen, Fritz:  
Le Danien en Suede (Cretace superieur). [The Danian Formation in Sweden (Upper Cretaceous).] Lexique stratigraphique, International Geological Union, Paris, 1954.
- Geolog pa Nimba. (Geologist in Nimba). MALM, Granges Corporation, Stockholm, 1963.
- Groundwater production from the bedrock of Sweden. Wenner-Gren Center International Symposium Series, Vol. II, Groundwater Problems (Eriksson, Erik et al., Editors), p. 161-179. Pergamon Press, Oxford & London, 1968. [Also in Swedish: Grundvattenutvinning ur berg. Grundvatten, p. 196-214. P.A. Norstedt & Soners forlag, Stockholm, 1970.
- Mineralfysiska aspekter pa bergmaterials slitande egenskaper. (Mineral physics aspects of the properties of wear of rock materials.) Tryckluft 1, 1969, p. 6-13, Atlas Copco, Stockholm.
- Appropriate technologies for village water supply. Assignment Children/Carnets de l'Enfance, vol.34, UNICEF, Geneva, 1976.

- Partisipasi UNICEF dalam program air di duna. (UNICEF participation in drinking water programmes.) Berita UNICEF, No. 23, 1977/2, UNICEF, Jakarta, Indonesia. [Also in English, Turkish and Japanese publications.]
- The UN Water Decade 1981-1990. Assignment Children/Carnets de l'Enfance, vol. 45/46, p.44-49. UNICEF, Geneva, 1980.
- Water quality for children, mothers and others. Water Quality Bulletin, Vol. 9, No. 2, April 1984. Canada Centre for Inland Waters, Burlington, Ontario, Canada.
- UNICEF and the experience in low-cost water supply and sanitation. Proceedings from the Workshop on Rural Water Supply and Technology, Changsha, Hunan Province, People's Republic of China, August 1984. World Bank, Washington, D.C., 1988.
- Low-cost water supply and sanitation as part of Primary Health Care and Child Survival and Development - the social approach. (Abstract only.) Vth World Congress on Water Resources, IWRA (International Water Resources Association, Brussels, Belgium, 1985. Proceedings, No. 307 (Special Session), p. 1504.
- The WET History. Water and Sanitation in UNICEF 1946-1986. WET Monographs No. 2. UNICEF, New York, 1987. 172 p.
- with Balcomb, John (Editor):  
Water and sanitation in UNICEF 1946-1986. UNICEF History Series, Monograph VIII, 67 p. United Nations Children's Fund, New York, 1987.
- with Meager, Sharon (Editor):  
Water, Sanitation and Health for All by the Year 2000: UNICEF Actions for the Years to Come. United Nations, Economic and Social Council Document E/ICEF/1988/L.4, 9 February 1988. 29 p.
- with Heyward, E.J.R., Karlin, Barry and Ockwell, Ronald (Editor): Water Supply, Sanitation and Hygiene. Programme Guidelines, Vol.3, UNICEF, New York 1988. 524 p.
- with Heyward, E.J.R., Karlin, Barry and Ockwell, Ronald:  
Water Supply, Sanitation and Hygiene as factors of health and well-being. Water Supply and Sanitation in Developing Countries. Proceedings of a Regional Symposium at Columbia University, New York, January 1988. Interamerican Association of Sanitary Engineering and Environmental Services.

**Best Available Copy**

- The human factor. Decade Watch, Vol. 7, No. 1, March 1988. UNDP, New York. (Editorial on Human Resources Development.)
- Water- and waste-related problems for occupational health in the developing countries. C.I.C.S. Symposium on Occupational Health, Italy, 1988. Centro Internazionale di Cooperazione allo Sviluppo, Castello Lanciano, Castelraimondo, Macerata, Italy.
- The Future for Water: Strategy to the Year 2000. Water for World Development. Proceedings of the Vith IWRA World Congress on Water Resources, May 29-June 3, 1988. Ottawa, Canada. vol. I, p. 278-289.
- In pursuit of human happiness: The background to the quest for linkages. Workshop for developing strategies for strengthening linkages in water and sanitation and Child Survival. WASH, Water for Sanitation and Health Project (USAID), Washington, D.C., 15 June 1989.
- Safe Water Supply and Sanitation for the World in the 1990s. Proceedings of the Water and Wastewater '90 Conference, Barcelona, Spain, 24 April 1990. 17 p.
- Some For All Rather Than More For Some - The Global Consultation on Safe Water and Sanitation for the 1990s. New Delhi, India, 10-14 September 1990. For publication in Natural Resources Forum, United Nations, Division for Natural Resources and Energy, New York, February 1991. (Annex: The New Delhi Statement.)
- From the UNICEF Waterfront. Newsletter on water supply and sanitation for low-income populations. 33 issues, 1975-1986. UNICEF, New York (Distributed through the World Bank during 1982-1986 to over 100 countries.)
- Other brief articles on water supply, sanitation, hygiene and health in journals, newsletters and annual handbooks around the world.

### Honours

Honorary Fellow, Institution of Public Health Engineers (London, United Kingdom).

"Visitante Distinguido", Secretaria de Recursos Hidricos (Government Department for Water Resources), Republic of Argentina, Resolution No. 60/84.



# HydroSource Associates, Inc.

26 Winter Street • Ashland, NH 03217  
telephone (603) 968-3733 • fax (603) 968-7605

February 19, 1992

## VIA FEDERAL EXPRESS

Robert A. Bisson  
c/o Bruce Gair  
Porter and Gair, P.C.  
3815 Plaza Drive  
Fairfax, VA 22030  
(703) 691-1465

Dear Bob:

HydroSource Associates would be most pleased to work with you on these important groundwater exploration projects in Ethiopia and Botswana. As you know, HydroSource Associates personnel have over 50 man-years of combined experience in developing groundwater supplies in fractured bedrock. In addition, several of us have been involved in projects in Sudan, Somalia and Southern Africa.

I have enclosed resumes of HSA staff available to participate in these projects. We are looking forward to working with you.

Sincerely,

A handwritten signature in black ink, appearing to read 'Roland B. Hoag, Jr.', written in a cursive style.

Roland B. Hoag, Jr., Ph.D.  
President

RBH:cw

Enclosures

RBH2:Bisson.f19

Roland B. Hoag, Jr. has fourteen years' experience in the exploration and development of groundwater supplies. While at BCI Geonetics, Dr. Hoag participated in all aspects of groundwater exploration, including project management, geologic mapping, geophysical surveys, pumping tests and aquifer analysis. As Chief Scientist, Dr. Hoag had technical oversight of most of BCI's groundwater exploration projects and was instrumental in the development of BCI's systematic groundwater exploration program.

Prior to forming HydroSource Associates, Inc., Dr. Hoag worked with James E. Dougherty, President of the Western Division of BCI Geonetics, Inc., to develop a California-based exploration team. In addition, Dr. Hoag was Senior Project Manager on a large turnkey water supply project where groundwater was supplied to the City of Santa Barbara within 60 days of contract execution.

Dr. Hoag has conducted research on the relationship of groundwater chemistry to recharge mechanisms, regional flow systems, and mineral/water equilibria. The primary goal of this research is to develop methods of predicting long-term water quality changes in bedrock aquifers in response to prolonged pumping.

### **Education**

Ph.D., Exploration Geology and Geochemistry, McGill University

B.A., Geology, University of New Hampshire

### **Professional History**

4/91 - Present	President, HydroSource Associates, Inc., Ashland, New Hampshire
9/89 - 4/91	Senior Vice President, BCI Geonetics, Inc., Santa Barbara, California
8/88 - 9/89	Chief Executive Officer, BCI Geonetics, Inc., Laconia, New Hampshire
1985 - 9/88	Senior Vice President, BCI Geonetics, Inc., Laconia, New Hampshire
1977 - 1985	Vice President, BCI Geonetics, Inc., Laconia, New Hampshire
1976 - 1977	Independent Consulting Geologist

### Professional Affiliations

The Geochemical Society  
The Geological Society of America  
The Society of Exploration Geochemists  
Sigma Xi  
National Water Well Association  
Society for Economic Geologists  
The Newcomen Society  
SEE Project -- Board of Directors  
Certified Geologist, State of California

### Selected Publications

- Hoag, R.B., Jr. and Ingari, J.C., 1985, "Modern Approach to Groundwater Exploration in Arid and Semi-Arid Lands." Presented at Khartoum International Workshop on Sand Transport and Desertification in Arid Lands, Khartoum, Sudan.
- Hoag, R.B., Jr., 1985, "An Innovative Technique for Determining Contaminant Pathways in Fractured Bedrock." In: Proceedings of the Sixth national Conference on Management of Uncontrolled Hazardous Waste Sites. US EPA, et al., Washington, D.C.
- Hoag, R.B., Jr., and Cook, G.W., 1983, "The Exploration Geology Approach to Solving Groundwater Source Protection Problems." Presented at the First Conference on Water Quality and the Public Health, Worcester, Massachusetts.
- Hoag, R.B., Jr., and Bisson, R.A., 1981, "Mineral Exploration Techniques Applied to Bedrock Water Discovery." Presented at the 33rd Annual National Water Well Association Conference.
- Hoag, R.B., Jr., 1978, "The Removal of Trace Metals from Acid Mine Waters by Circulation Through the Bedrock." Abstracts with Programs, The Geological Society of America, Vol. 7, No. 7.
- Hoag, R.B., Jr., and Stewart, G.W., 1977, "Preliminary Petrographic and Geophysical Interpretations of the Exploratory Geothermal Drill Hole and Core, Redstone, New Hampshire." Contract No. EY-76-5-02-2720, U.S. Energy Research and Development Administration, open file C00-2720-1 NTIS, Pg. 121.
- Hoag, R.B., Jr., 1976, Mineral Overview Report and Maps of the White Mountain National Forest. Contract No. RQ#12-WM-76T, (open file).

Hoag, R.B., Jr., and Webber, G.R., McGill University, 1976, "Significance of Mineral Exploration of Sulfate Concentrations in Groundwater." Canadian Institute of Mining and Metallurgy Bulletin, Vol. 69, No. 776.

Hoag, R.B., Jr., and Webber, G.R., McGill University, 1976, "Hydrogeochemical Exploration and Sources of Anomalous Water." Journal of Geochemical Exploration, Vol. 5, No. 1.

Hoag, R.B., Jr., 1975, "Periodical Sampling as a Means of Interpretation of Chemical Composition of Groundwaters." Abstracts with Programs, The Geological Society of America, Vol. 7, No. 6, Pg. 763.

Joseph Ingari, Vice President of HydroSource Associates, is a structural geologist and geophysicist. He has over 13 years of experience in the field of groundwater exploration and site investigation. He has served as senior technical advisor, geophysical department manager, special projects officer, and project manager. His responsibilities include operational planning and budgeting, exploration program design, remote sensing interpretation, geologic and brittle feature mapping, geophysical program design, data interpretation and analysis, and drill site selection. Mr. Ingari's other duties include ongoing project quality control and pre-project technical feasibility analysis.

While employed at BCI, Mr. Ingari directed and managed field operations for the company's major bedrock water development projects in Somalia and Sudan, East Africa. He has also traveled extensively throughout Somalia, Ethiopia, Djibouti, Kenya and Zimbabwe conducting a variety of field studies and training sessions. Over the last 13 years, Mr. Ingari has successfully located productive wells in more than 50 major domestic and international water supply projects.

Mr. Ingari has also managed several wellhead protection area delineation and contaminant threats investigations, was primary investigator for BCI fracture fabric analysis of hazardous waste sites in New Hampshire, has conducted geophysical investigations to locate underground fuel storage tanks and other sources of contamination, and has determined groundwater recharge areas using a variety of geophysical techniques. Mr. Ingari is skilled in the acquisition and evaluation of seismic, magnetic, electromagnetic, earth resistivity, gravimetric, and ground penetrating radar data, and in structural mapping techniques, brittle feature analysis, geologic logging, and pumping test conduction.

### **Education**

B.S. Geology curriculum -- University of Massachusetts

### **Professional History**

1991 to Present	Vice President HydroSource Associates, Inc.
1989 - 1991	Senior Technical Advisor and Special Project Officer, BCI Geonetics
1988 - 1989	Geophysics Department Manager, BCI Geonetics
1985 - 1988	Project Manager, BCI Geonetics
1982 - 1985	Seismologist, BCI Geonetics
1978 - 1982	Field Geologist, BCI Geonetics

**Professional Affiliations**

Society of Exploration Geophysicists  
European Society of Exploration Geophysicists  
Geological Society of America  
Association of Engineering Geologists

**Selected Publications**

- Ingari, J.C., 1978, "Brittle Fracture Petrofabric Transverse Across Western Massachusetts and Eastern New York", NRC Report.
- Hoag, R.B., Jr., and Ingari, J.C., 1985, "Modern Approach to Groundwater Exploration in Arid and Semi-Arid Lands." Presented at Khartoum International Workshop on Sand Transport and Desertification in Arid Lands, Khartoum, Sudan.

James Brady is a geoscientist skilled in the analysis of geologically complex terrains. Mr. Brady's areas of expertise include bedrock mapping, downhole video camera mapping and fracture fabric analysis. Mr. Brady is actively involved in mapping the bedrock geology and associated saprolite deposits of the Inner Piedmont Terrain in the Greater Atlanta, Georgia, region. His duties at HydroSource Associates include geologic mapping, well drilling inspection and hydrogeologic field work. Other responsibilities are project management and business development.

Mr. Brady's past geologic experience includes detailed structural and petrologic analysis of a multiply deformed, faulted and metamorphosed terrain located on the Maine/New Hampshire state border. He has conducted a number of smaller studies involving brittle and ductile deformation in eastern Maine, Alabama and New Mexico. Mr. Brady also worked for a Maine-based geotechnical engineering firm. His duties, while working for this firm, included both surficial and bedrock mapping, test pit logging, bedrock core logging, various drilling and well installation operations, and water level monitoring. He is also familiar with the legal permitting of sand and gravel mining.

### **Education**

Master of Science, University of Maine, Orono, ME, 1991. Specialization: Structural and Metamorphic Geology; GPA = 3.6.

Bachelor of Arts, Florida State University, Tallahassee, Florida, 1984.  
Major: Geology; GPA = 3.0.

### **PROFESSIONAL HISTORY**

- |                |  |
|----------------|--|
| 4/91 - Present | HydroSource Associates, Inc., Ashland, NH. Geologist   |
| 5/90 - 4/91    | BCI Geonetics, Inc., Laconia, NH. Geologist  |
| 1/88 - 5/88    | Independent Contractor, Maine Geologic Survey, Augusta, Maine. Carried out X-ray analysis of the Presumscot Fm., directed by Dr. Joseph T. Kelley, Maine State Coastal Geologist (MGS).              |
| August, 1987   | Independent Contractor, Watershed Manipulation Project, University of Maine, Orono, Maine. Conducted bedrock mapping and fracture trace analysis of two adjacent watersheds on Lead Mountain, Maine. |
| July, 1987     | Independent Contractor, U.S. Environmental Protection Agency. Coordinated state-wide geologic classification of over 3,000 radon water samples.  |

1/85 - 12/87

Teaching Assistantship, University of Maine, Orono, Maine. Presented lectures and labs for undergraduate geology courses.

### **Organizations**

Maine Geologic Society  
Geological Society of America

### **Selected Publications**

Brady, J.J., 1988, "A reevaluation of Devonian Stratigraphy and Pre-metamorphic Faulting in the Bethel, Maine, Area", Geological Society of America Abstracts with Programs, Vol. 20, No. 1, Pg. 9.

Brady, J.J., 1991, "Bedrock Geology of the Bethel, Maine, Area", M.S. Thesis.

Brady, J.J., in preparation, "Significance of kyanite as an aluminosilicate phase within the Smalls Falls Formation and its implication of post-Carboniferous retrograde metamorphism in western Maine."

Brady, J.J., in preparation, "Bedrock geology of the Fayetteville, Georgia 7.5' quadrangle", Open File Report, Georgia Geologic Survey, Atlanta, Georgia.

Vernon, J.H., and Brady, J.J., in preparation, "Scientific logging with borehole video camera."

In her 13 years as a geologist, Rosemarie de Mars has worked on numerous water supply and development projects around the country. She combines a detailed knowledge of project operations with several years of field and project experience.

Here responsibilities include all aspects of HSA's technical services. She is familiar with several geophysical exploration instruments and performed a number of surveys in varied terrain. She is also the site geologist during the drilling phase of many projects and supervises the installation of monitoring wells, test and production holes in both overburden materials and bedrock. Other areas of her experience include design of monitoring networks, performance of pumping tests, and analysis of hydrogeologic data. For the past two years, Ms. de Mars has worked on aquifer delineation and completed wellhead protection work for the Connecticut towns of Putnam and Berlin. She also serves as HSA's liaison to state and local regulatory agencies for a number of larger exploration projects.

Besides her technical contributions, Ms. de Mars performs data acquisition and management services for HSA staff. Working through the extensive network of agency contracts and reference sources, she provides the exploration teams with needed types of projects. She uses a number of computerized data bases in her research and has access to college and university collections. Through her efforts, the company now houses an extensive collection of published hydrogeologic data and maps for many regions of the U.S. and overseas.

Ms. de Mars also obtains aerial photographs and satellite imagery for needed HydroSource projects and outside clients. Over the past 5 years she has built up a reference file of private suppliers and government indexes, allowing HSA to identify and provide complete aerial photographic coverage of any location in the country from the earliest photos to the most recent flights.

Ms. de Mars has shared project management duties and field work on a number of overseas assignments. During 1985 and 1986, she was a member of a field team that successfully located and developed groundwater supplies as part of a USAID refugee assistance project in Northwest Somalia. During 1988-1989, she participated in another government funded groundwater exploration project in the Red Sea Province of Sudan. She was responsible for purchase and shipment of field equipment and supplies during these and other international projects.

In addition to her employment at HydroSource Associates, Ms. de Mars serves on her local Conservation Commission, the Lakes Regional Planning Commission (LRPC) and the Lakes Region Conservation Trust (LRCT). For the past five years she has worked with the LRPC and area towns to organize an annual Household Hazardous Waste Collection Day. Her experience within municipal government is valuable to HSA's work in the public sector.

**Technical Experience**

April 1991 - Present	Geologist/Project Manager, HydroSource Associates, Inc. Ashland, New Hampshire
1978 - April 1991	Geologist/Project Manager BCI Geonetics, Inc. Laconia, New Hampshire

**Education**

1978 B.A. Geology, University of Vermont

**Member**

1991 - Present	Lakes Region Conservation Trust, Board of Trustees
1990 - Present	Lakes Region Planning Commission (LRPC), Meredith, NH
1991 - Present	LRPC Executive Committee Treasurer
1986 - Present	Conservation Commission, Town of Sandwich, NH
1986 - Present	National Water Well Association

James Vernon is a geoscientist interested in both scientific research and applications. Areas of expertise include structural geology, wellhead protection (especially in fractured bedrock aquifers, tectonics, field geology, and numerical modeling. Dr. Vernon seeks to integrate these areas of expertise in attempts to understand complex systems and address problems of applied or theoretical interest. Examples include assessment of bedrock and surficial geology at various sites in the Appalachians and Rocky Mountains, field and subsurface assessment of rock fracture for reservoir (hydrologic, petroleum, geothermal) characterization, fault mapping and numerical modeling applied to earthquake studies, and geologic contribution to ecological understanding.

Since his arrival from a post-doctoral fellowship at Los Alamos National Laboratory, Dr. Vernon has participated in EPA-sponsored research to delineate a wellhead protection area and assess groundwater flow through fractured bedrock in New Hampshire. He has also developed research and exploration proposals and managed projects, including fracture trace analysis at a "superfund" site and a multiple-author journal article on wellhead protection in fractured bedrock.

### **Education**

Doctor of Philosophy, Geology, University of Oklahoma, 1987. Specialization: Structural Geology (also Geophysics, Engineering mathematics and mechanics); GPA=4.0

Masters of Arts in Liberal Studies, Wesleyan University, Middletown, Connecticut, 1982. Major: Science; GPA=3.8

Bachelor of Arts, cum laude, Bucknell University, Lewisburg, Pennsylvania, 1974. Double Major: Geology, Mathematics; GPA=3.6

### **Technical Experience and Accomplishments**

4/91 - Present      Geologist, HydroSource Associates, Inc., Ashland, New Hampshire.  
Invited speaker, Georgia Well Show and Exhibition/Georgia Groundwater Association Annual Meeting, Savannah, Georgia, 4/91

4/90 - 4/91      Geologist, BCI Geonetics, Inc., Laconia, New Hampshire.  
Structural geology, hydrogeology (particularly fractured bedrock reservoirs) research and exploration. Project management.

- 3/87 - 3/90                      Post-Doctoral Fellow, Los Alamos National Laboratory  
Numerical modeling (three-dimensional) of geological and geophysical phenomena.  
Field Investigations of faulting, tectonics, and possible seismic hazard near Santa Fe, New Mexico.  
Borehole Televiwer (BHTV) Log interpretation of rock fracture in hydrothermal system; core fracture description; evaluation of BHTV  
Chaired technical session of American Geophysical Union, Fall Meeting, 1988.  
Completed short courses:  
    .                      FORTRAN (Los Alamos)  
    .                      Hazardous Waste Site Characterization (Geol. Soc. Am.)  
    .                      Groundwater-Contaminant Transport Modeling (Princeton)
- 1983, 1985                      Geologist, Amoco Research Center  
Summers                      Performed research and wrote two company reports on use of borehole televiwer log as a fracture detection tool.  
Performed three-dimensional finite element analysis of forced fold structures.  
Performed fracture studies on Nugget Sandstone cores from thrust belt, Wyoming and Utah.
- 8/82 - 2/87                      Research Assistant, University of Oklahoma  
Worked on numerous structural geology research projects under the supervision of Dr. David W. Stearns, including field work in Western United States, 6/84 - 10/84, and clay and sand modeling

### Teaching Experience

Teaching Experience includes adult environmental education (Audubon Ecology Workshop), university geology and meteorology lectures, laboratories, and field trips, independent school (grades 6-10) science and mathematics teaching and program supervision.

### Other

Extensive volunteer service, National Audubon Society. Lifelong interest in environmental problems.

## Publications

- Vernon, J.H., 1984, The borehole televiwer log as a fracturedetection tool, Gage Holland A#1 well: Amoco Production Company Research Report (proprietary).
- Vernon, J.H., 1985, The borehole televiwer log as a fracturedetection tool: Amoco Production Company Research Report (proprietary).
- Neese, D.G., and Vernon, J.H., 1987, Cambrian pisolites as paleo-environment and paleotectonic stress indicators, Rattlesnake Mountain, Wyoming [abs.]: Amer. Assoc. Petroleum Geologists Bull, Vol. 71, Pg. 597.
- Vernon, J.H., 1987, Three-dimensional finite element modeling for geologic implications in forced folding [Ph.D. dissert.]: Norman, Oklahoma, University of Oklahoma, Pg. 252.
- Vernon, J.H., 1988, Effects of several variables on three dimensional finite element models motivated by geologic forced folds [abs.]: EOS, Vol. 69, Pg. 469.
- Vernon, J.H., 1988, Three-dimensional finite element models of crustal block rotations [abs.]: EOS, Vol. 69, Pgs. 1456-1457.
- Vernon, J.H., and Riecker, R.E., 1989, Significant Cenozoic faulting, east margin, Espanola Basin, Rio Grande rift, New Mexico: Geology, Vol. 17, Pg. 230-233.
- Vernon, J.H., in preparation, Effects of several variables on three-dimensional finite element models motivated by geologic forced folds: (to be submitted to Journal of Geophysical Research).
- Vernon, J.H., in preparation, Three-dimensional finite element models of crustal block rotations and implications for Rio Grande rift tectonics (to be submitted to Tectonics).
- Vernon, J.H., and Brady, J.J., in preparation, Scientific logging with borehole video camera.
- Griswold, W.J., Moore, B.A., Vernon, J.H., 1990, Developing wellhead protection area and monitoring strategy for a fractured bedrock aquifer, Dover, NH. Proceedings of the 1990 FOCUS Conference on Eastern Regional Ground Water Issues, Pgs. 131-145.
- Vernon, J.H., Paillet, F.L, Pedler, W., Moore, B.A., and Griswold, W.J., in preparation, Fracture and Flow Assessment for wellhead protection and monitoring: (to be submitted to Ground Water).

Mr. Ives has developed a wide range of the skills required for successful groundwater exploration and hydrogeologic evaluations. As a geologist, he has been responsible for geologic mapping, analysis of aerial photography, and planning and supervising geophysical surveys. Mr. Ives is skilled in the collection and interpretation of magnetic, electromagnetic, and gravimetric data and is experienced in several other geophysical techniques.

His responsibilities as a hydrogeologist include supervising well installations, well logging, collecting soil and water samples, conducting sanitary surveys, and designing and supervising pumping tests.

As a project manager his responsibilities include proposal writing, project planning and budgeting, supervision of field work, report preparation and liaison with clients and regulatory officials.

Mr. Ives has participated in many groundwater projects throughout New England, upper New York State, southern California, Georgia, Virginia and East Africa since joining BCI in 1983. As a result, he has developed a solid understanding of the hydrogeologic condition in these regions from both water supply and groundwater contamination perspectives.

### **Education**

B.A., Geology, Albion College, Albion, Michigan

### **Special Studies**

Remote Sensing - Applications to Hydrogeology, National Water Works Association  
Elementary Surveying, New Hampshire Vocational Technical College  
Introduction to Groundwater Hydrology, University of New Hampshire

### **Professional History**

1991 - Present	Geologist/Project Manager, HydroSource Associates, Inc.
1983 - 1991	Geologist/Project Manager, BCI Geonetics, Inc.

February 19, 1992

Robert A. Bisson  
Exploration Consultant

Dear Bob,

I'm writing to say how pleased I am that the prospects are good for your project on Mega-watersheds in Africa moving ahead. As you know, my experience on that continent has centered on the Kalahari and specifically on Botswana. Water is the governing element for all life there, plant, animal, and human, and it has always been in short and unpredictable supply. Newfound sources of abundant and measurably renewable ground water will bring about fundamental changes in a nation that has always lived in the face of drought.

I hope to document and communicate the project as it gets off the ground and grows, in Botswana and elsewhere. As the project progresses, the potential is great for producing significant articles and films, even a book. I hope to reach a wide public with stories that are human as well as scientific. I would like, whenever appropriate, to present the search for Mega-watersheds in the context of the cultures and geographic settings in which it takes place. From a journalist's and writer's point of view, I feel that your project has the potential to reshape parts of the world as fundamentally as the 'Green Revolution' recast the fate of much of rice-growing Asia.

In addition to rewards for agriculture, industry, and Botswana's growing population, the tapping of newly discovered renewable water reserves may ring a bell of salvation for the nation's protected areas and the animals they preserve. The Botswana Government has long had to struggle with often conflicting demands of conservation and development. Your discoveries may be a key to the resolution of the needs of both.

I've developed a wide network of contacts in Botswana over the course of four years' involvement with the country, which culminated in but did not end with publication of 'Okavango Delta, Old Africa's Last Refuge', in the December 1990 National Geographic. You are welcome to any contacts or assistance I can give you.

I'm excited about the promise of Mega-watersheds, and very much looking forward to working with you and your team as a writer and communicator.

Best wishes,

  
Douglas Lee

## RESUME for Douglas Bennett Lee

### ABSTRACT:

I am a free lance writer with 15 years' experience writing and editing at National Geographic Magazine, where I served on the Senior Editorial Staff as an articles writer until January, 1992.

My work at the magazine has included a year's field time in Botswana, gathering information for a cover article on the Okavango Delta published in the December 1990 NGM. During two years' involvement with this project I supervised the creation of a three-story presentation on Botswana, its history and culture, wilderness and wildlife, which was given more than two thirds of the December issue. My coverage in Botswana included extensive back-country travel, and exposure to virtually all aspects of resource use in the region, from government to local levels.

I have also written frequently about wetlands, wilderness, and resource use in the United States and Canada. My current interests lie in writing and producing books, articles, and films about wilderness, wildlife, human interaction with the natural world, and human use and management of land, water, and other resources.

### FIELD EXPERIENCE:

Extensive coverage of wetlands, wilderness, and human cultures on the U.S. Gulf Coast, in the Alaskan and Canadian Arctic, and in northern Botswana. In Botswana I reported on issues involving the use and management of wildlife, water, land, and other resources from the perspectives of the Botswana Government, local inhabitants, scientists and researchers, industries, cattle ranchers, and commercial users of wildlife and protected areas for tourism and hunting.

OCCUPATION: Free lance writer for print and film.

### ACADEMIC DEGREES:

B.A. Germanic Language and Literature, Princeton University, 1975, Magna cum laude.

Certificate in European Studies, Princeton University, 1975.

College Preparatory, English Honors, American Community School of London, 1971, Magna cum laude.

**PUBLISHED WORK:**

'The Lure of the Gulf Coast', National Geographic Magazine July 1992 (scheduled).

'Montreal, Spirited Heart of French Canada', NGM March 1991.

'Okavango Delta, Old Africa's Last Refuge', NGM December 1990.

'Tragedy in Alaskan Waters', NGM August 1989.

'Oil in the Wilderness--An Arctic Dilemma', NGM December 1988 (NGS Centennial Issue).

'Endangered Earth' map supplement text, NGM December 1988.

'Sharks at 2000 Feet', NGM November 1986.

'Kluane, Canada's Icy Wilderness Park', NGM November 1985.

'The Plain People of Pennsylvania', NGM April 1984.

'Mississippi Delta, The Land of the River', NGM August 1983.

'Slime Mold, The Fungus That Walks', NGM July 1981.

'Hokkaido, Japan's Last Frontier', NGM January 1980.

'Day of the Rice God--Festival in Japan', July 1978.

**Books:**

Co-author and project coordinator: STAGE FOR A NATION--THE NATIONAL THEATRE--150 YEARS (University Press of America, Lanham, Md., 1985).

**Other:**

Author of more than 100 sets of picture captions (legends) and picture texts for articles in NGM.

NGS Centennial Issues Planning Committee, 1986.

Author of Editorial Directions Plan for 'Sea Frontiers' magazine, University of Miami, Miami, Florida, 1986.

**PROFESSIONAL POSITIONS:**

1977-1985: Editorial Staff, legends and articles writer, NGM.

1984-1985: Issue Editor, NGM.

1985-1992: Senior Editorial Staff, NGM.

1985-1987: Assistant Editor, Legends Department, NGM.

1988-1992: Articles writer, NGM.

February 1992

**PETER SHAW THACHER, JR.**

North Lynn St., Suite 200  
Arlington, VA 22209  
276 1800

Home:  
5010 Cathedral Ave., NW  
Washington, DC 2007  
202 686 5647

**Academic:**

Environmental Systems Research Institute June 1991 - July 1991  
Courses Completed: Introduction to Arc/Info  
Database Design  
Cartographic Design  
Introduction to Modelling

Embry Riddle University, School of General Studies January 1988 - May 1991  
Major: Anthropology  
Cumulative GPA: 3.46

**Employment:**

Geographic Information System Consultant October 1991 - Present

Environmental Systems Research Institute May 1991 - Present  
Conservation Program - Voluntary Affiliate

Langley Research Institute for Space Studies, NASA January 1989 - December 1990  
Research Assistant for Dr. Sergei Lebedeff,  
Dr. James Hansen; study of urban heat island  
effect upon global climate model.

**Primary Interest:**

The relationship, management and status of human and natural resources in light of current and projected political and economic conditions.

**Best Available Copy**

Statement:

## Best Available Copy

Geographic information systems and associated technologies are crucial tools for sustainable resource management. Natural resources, when perceived as "rural bank accounts" for developing nations, are often degraded when human land pressure tips traditional balances between man and his environment.

Geographic information systems allow the "bank account" as well as human needs to be indexed, mapped, visualized and managed. When simply explained maps and technical manuals relevant to resource limitations are distributed to rural communities and institutions, rural decision-makers can themselves undertake sustainable resource management.

My work for both ESRI's (Environmental System Research Institute) Conservation Program and Volunteers in Technical Assistance (VITA), is dedicated upon the belief that appropriate dissemination of GIS, the crucial resource management tool, as well as information derived from geographic analysis, is instrumental for natural resource conservation as well as social and economic rural development.

As a consultant for VITA I identify roles for GIS in an organization that specializes in rural enterprise development, technical information dissemination and communication provision.

Two of VITA's project are currently using GIS: the Afghanistan reconstruction project is using GIS to inventory supplies and prioritize road re-construction; and, the Djibouti renewable energy project is using GIS to identify hydro-thermal energy sources. The River Blindness Foundation, at VITA's recommendation, is using a GIS to manage distribution Ivermectizan, a drug that kills microfilariae in humans, in the Jos Plateau State, Nigeria.

With US Sprint and IBM, VITA is developing the concept of communication networks that serve rural informatics franchises for localized distribution of technical manuals and resource maps. The franchises would bring communciatio

and information poor regions on-line to global and national electronic networks for two-way transfers of knowledge, information and services.

Finally VITA is engaged in promoting disaster preparedness, mitigation and prevention strategies in developing countries. These strategies rely upon geographic analysis for risk assessment upon which information dissemination is to be based.

Due to my consulting activities with VITA I work with a wide range of non-governmental organizations in Washington and abroad. I participate in seminars and conferences regarding geographic information systems and remote sensing, technology transfer and characterization, disaster prevention, mitigation and preparedness, and, agricultural technologies and research.

My work with ESRI's Conservation Program is less formal. ESRI is the manufacturer of Arc/Info, the most widely used GIS software. The cost for software, training and hardware can amount to more than fifty thousand dollars, well beyond the budget of many conservation projects.

The mandate of the Conservation Program is to provide software and training to conservation projects worldwide. In addition equipment donations are sought for projects and regional and international technical support is identified for Conservation Program recipients. My voluntary role is to help conservation projects apply for ESRI sponsorship and to coordinate donations and equipment delivery.

The role that Robert Bisson has proposed would be to help in the feasibility study and transfer of proof of concept and to act as an inter-institute liaison so that the review committee is kept informed and access to the United Nation Conference on Environment and Development is enhanced. In addition I would identify GIS roles related to the management of identified water resources.

**Best Available Copy**



**BCI GEONETICS, INC.**

Groundwater Exploration, Development, and Protection

VIA FAX

February 20, 1992

Bob Bisson

~~Bruce Gair~~

clp Porter & Gair

3815 Plaza Drive

Fairfax, VA. 22030

Bisson  
Dear Mr. Gair,

BCI Geonetics, Inc. would be pleased to provide you with services in Africa, including Botswana and Ethiopia. We look forward to the opportunity to be part of your team in Groundwater Exploration and Modelling. We have enclosed information regarding our recent groundwater projects, and resumes of key technical personnel.

Sincerely,

James E. Dougherty  
President - Chairman

JED:cas

**LORNE G. EVERETT**

Registered Professional Hydrologist - AIH #164  
Registered Professional Groundwater Hydrologist - AIH #836  
Certified Groundwater Professional - AGWSE #293

**EDUCATION**

Ph.D., Hydrology, University of Arizona, 1972  
M.S., University of Arizona, 1969  
B.Sc. (Honors), Water Sciences, Lakehead University, 1968  
B.Sc., Chemistry, Lakehead University, 1966

**SPECIAL MANAGEMENT EDUCATION**

General Electric Management Development Institute, Crotonville, New York, Executive Manager Development, 1979

The Wharton School, University of Pennsylvania, Finance and Accounting for the Non-Financial Executive, 1978

General Electric Management Development Institute, Crotonville, New York, Management Practices, 1977

University of California at Davis, Groundwater Management Program, Groundwater Law, 1975

Great Lakes Water Research and Development Laboratory, Ontario, Canada, 1966-1967

Queen's University, Ontario, Canada, articulated in Chartered Accounting, concentration on business management, financial business evaluations, business law, 1962-1963

**REGISTRATIONS**

Registered Professional Hydrologist --AIH #164  
Registered Professional Groundwater Hydrologist - AIH #836  
Certified Groundwater Professional - AGWSE #293  
Nuclear Regulatory Commission -- Isotope Experimental Work, AR12, AEC, 10-24  
Certified Research Diver  
Registered Laboratory Chemist  
Registered Nuclear Soil Moisture and Density Gauges, CPN #9043

**EXPERIENCE**

Metcalf & Eddy (1990-Present): Chief Scientist

Metcalf & Eddy (1989-Present): Vice President

LORNE G. EVERETT

Page 2

University of California at Santa Barbara (1985-Present): Full Research Professor and Director of the Vadose Zone Monitoring Laboratory of the Institute for Coastal Studies

On a part-time basis, Dr. Everett conducts a major research program directed towards soil-gas migration, soil pore-liquid migration, underground tank monitoring system evaluation, hydrocarbon remediation, and sensor installation techniques.

American Society for Testing Materials (1986-Present): Section Chairman D.18.21.02 entitled Vadose Zone Monitoring

Dr. Everett is responsible for developing ASTM National Standards for soil core monitoring, soil pore-liquid monitoring, hydraulic conductivity measurement, matric potential measurement, neutron moderation, soil gas monitoring, air permeability determination, soil moisture measurement, and field screening techniques.

Kaman Sciences (1984-1989): Assistant Vice President

Dr. Everett led a team of hydrogeologists, engineers, and chemists in site characterization, monitoring, and remediation of hazardous and solid waste landfills, refinery and industrial sites, underground storage tank sites, and dense non-aqueous phase liquid investigations. Extensive experience was developed in post-closure monitoring strategies.

Kaman Tempo (1978-1989): Manager, Natural Resources Program.

Dr. Everett has prepared RCRA Part B permits and Hazardous Waste Land Treatment Demonstrations for numerous clients including Tenasco, Genese, Amoco, Hunt Oil, Murphy Oil, Wesco, IMC Carbon, Bekin Oil, Golden Bear Refinery, and General Portland Cement (hazardous waste incinerator). He has conducted turn key monitoring programs at numerous solid waste landfills, hazardous waste disposal sites and underground storage tank leak sites. Dr. Everett has participated as an expert panel chairman and panel member on many occasions. He has testified before the U.S. Congress on different occasions and has been an expert witness for the U.S. Department of Justice, Attorney General of California, etc. Dr. Everett is a specialist and advisor to the EPA Technical Assistance Team for Emergency Response Removal and Prevention. In addition, Dr. Everett is a Special Advisor to the GCA Corporation relative to dioxin monitoring at Superfund sites. Dr. Everett has been selected on a sole-source basis to write guidance manuals and to present training programs for EPA, United States Navy Hazardous Waste Team, California Water Resources Control Board, California Department of Health Services, all 10 EPA Regional Headquarters.

University of California at Davis and Santa Barbara, USC, and other institutions. Dr. Everett is developing and presenting training programs sponsored by the National Water Well Association on the subject of Vadose Zone (Early Alert) Monitoring for Hazardous Waste Sites.

Menaghan & Metz, Attorneys at law, San Diego, California: Expert Witness in successful case for the plaintiff in a major stoddard solvent and TCE/PCE groundwater and vadose zone investigation.

Schramm & Raddue, Santa Barbara, California: Expert Witness in successful case for the plaintiff relative to a major unleaded tank leak from a service station.

Texaco, Inc., College Station, Texas: Expert Witness for the defendant in a successful defense of an unleaded tank leak from a service station.

Los Angeles Fire Department, Los Angeles, California: Principal Investigator to develop a Guidance Document and videos relative to all aspects of underground storage tank site characterization, monitoring, testing, installation, abandonment, and remediation.

U.S. Navy, Mare Island, California: Scientific Advisor to major Naval installation covering inorganic hazardous waste hot spots, leaking underground storage tanks, dense phase organic solvents, and a RCRA landfill sitting on top of a Superfund site.

U.S. Naval Petroleum Reserve, Elk Hills, California: Scientific Advisor to the evaluation and cleanup of over 30 hazardous waste sites at Naval facilities.

Des Moines, Public Works Department, Des Moines, Iowa: Principal Investigator to evaluate groundwater and vadose zone contamination associated with major municipal landfill.

Major oil company: Scientific Advisor to major soil venting and bioremediation investigation covering a refinery spill of over 55,000 barrels. Location: Company Confidential. State: Company Confidential.

U.S. Environmental Protection Agency, Kansas City, Kansas: Co-Principal Investigator to evaluate the U-tube design for underground monitoring systems for soil vapor testing.

U.S. Environmental Protection Agency, Suffolk County, New York: Co-Principal Investigator of underground tank vapor monitoring systems by tracer testing methods.

# TIMOTHY J. THOMPSON

1495 LOMA DR.  
OJAI, CA 93023  
(805) 648-9376

## OBJECTIVE

To obtain a position as a geologist for a company active in the groundwater and/or environmental sciences.

## PROFESSIONAL BACKGROUND

- 3/88 - now: Exploration geologist  
Unocal  
1800 30th St.  
Suite 200  
Bakersfield, CA 93301
- 1/85 - 1/88: Geologist  
Crouch, Bachman & Associates  
Santa Barbara, CA
- 2/79 - 2/80: Mainframe computer programmer/  
operator.  
Alflex Corp  
Long Beach, CA

## ACADEMIC BACKGROUND

- 1/90 - 3/90 Groundwater Hydrogeology  
and Organic Chemistry  
for Hazardous Materials  
Management coursework.  
U.C.S.B. & U.C.L.A. Extension  
G.P.A. 4.0
- 9/85 - 10/87 M.S. Geology  
U.C. Santa Barbara  
G.P.A. 3.8
- 9/82 - 12/84 B.S. Geology  
U.C. Los Angeles  
G.P.A. 3.6
- 9/78 - 6/81 Computer engineering,  
math, and gen. education.  
C.S.U. Long Beach

## COMPUTER EXPERIENCE

MAINFRAME:  
BASIC  
FORTRAN  
Assembly  
COBOL  
EXPRESS  
(@UNOCAL)

P.C. & Macintosh:  
Wordstar  
Word  
Prof. Write  
Lotus  
Excel  
dBase  
MacWrite  
MacDraw/Paint  
MS Works  
Claris CAD  
MORE II

## PERSONAL

AGE: 29

INTERESTS: Hiking, skiing,  
biking, travel, geology, music,  
flying (Private Pilot, 1980;  
~350 hrs.), computers.

MEMBERSHIPS: N.W.W.A. / A.G.W.S.E.,  
Geological Society of America,  
American Assoc. of Petroleum Geol.,  
Rocky Mountain Assoc. of Geol.,  
Coast Geologic Society.

**PROFESSIONAL WORK SUMMARY****Unocal:**

1) Exploration for natural gas in the northern San Joaquin basin. Generated structural and isopachous contour maps integrating seismic and well log interpretations. Currently, I have delineated ten drillable gas prospects (ranging from 50 to 200 Bcf). Land is being leased and seismic shooting is planned on all of these prospects. Initial part of project included self-motivated training in seismic processing, seismic interpretation, and seismic stratigraphy.

2) Computer modeling of seismic response to gas-saturated versus water-saturated sandstones at varying depths, sandstone thicknesses and impinging seismic wavelet type. Wrote detailed report including 7 plates and several figures.

3) Offshore northern California basin analysis and hydrocarbon potential study. Integrated structural, stratigraphic, well log, geochemical, geophysical (seismic and gravity) and paleontologic interpretations into a comprehensive report (including over 20 plates) on the onshore and offshore Point Arena basin.

4) Wellsite geologist on over 10 wells - Supervised mud loggers; picked casing, perforation, and core points; determined and supervised logging programs; analyzed logs for amounts of hydrocarbons versus water, and determined percentages of porosity and permeability.

5) Attended short courses on seismic stratigraphy, Shipley technical writing workshop, Shipley oral presentation workshop, dipmeter interpretation, seismic amplitude vs. offset principles, and log analysis.

**Crouch, Bachman & Associates:**

1) Wrote and edited sections of reports on topics such as California sedimentation and tectonics, basin analysis, oil and gas field development history, and prospect evaluation. Helped write, edit, and compile a detailed review (500+ pp.) of the numerous geologic and seismologic reports written for the Diablo Canyon Nuclear Power Plant. Assisted in review of E.I.R. on proposed Lease Sale 91 (Offshore N. Calif.).

2) Discussed details of both proposed and completed studies with clients.

3) Performed field work, including mapping, measuring sections, and collecting samples for geochemical and paleontologic analyses. Also, assisted in leading field trips.

4) Interpreted and correlated well logs. Drew contour maps, cross-sections, and stratigraphic sections which were included as primary figures in proprietary studies.

5) Supervised technical help (e.g., geologic trainees, computer operators, draftsmen).

6) Literature searches, compilations and reviews.

7) Computer-based chart and graph preparation (using Lotus); data base programming (using dBase).

**ACADEMIC SUMMARY**

See attached thesis abstract and list of university coursework.

**Publications:**

Outer fan lobes of the lower to middle Eocene Juncal Formation, southern San Rafael Mountains, California, in Filewicz, M.V., and Squires, R.L., eds., 1988, Paleogene Stratigraphy, West Coast of North America: Pac. Sect. S.E.P.M., vol. 58, p. 113-127.

Depositional environments and controls of the Juncal Formation, southern San Rafael Mountains, California: Amer. Assoc. Petroleum Geol. Bull., 1987, v. 71, p. 621-622 (Abstract from talk given at AAPG National Convention, Los Angeles).

**Honors and Awards:**

Feb. 1986; March & Oct. 1987: Exxon Geologic Research Grants

June, 1984: Sabins-Chevron Scholarship; June, 1983: J.P. Getty Scholarship

January, 1983 - Dec. 1984: U.C.L.A. Division of Honors.

# STEVEN B BACHMAN

**ADDRESS** 801 Oak Grove Dr.  
Santa Barbara, CA 93108

**PHONE** (805) 969-1528

## EDUCATION

- 1971 BS, Aeronautical Engineering  
University of Washington
- 1974 MS, Geological Sciences  
University of California, Los Angeles
- 1979 Ph.D., Geological Sciences  
University of California, Davis

## EXPERIENCE

- 1966-1969 US Army Officer
- 1974-1979 Exploration Geologist/Geophysicist, Chevron USA
- 1977-1979 Lecturer, Univ. Calif., Davis
- 1979-1983 Asst. Professor, Geological Sciences, Cornell University
- 1983-1984 Research Associate, Scripps Institute of Oceanography
- 1983-1984 Asst. Director, Geological/Geophysical Studies Group,  
NEKTON, Inc., San Diego
- 1984-1990 Director, co-founder of Crouch, Bachman & Assoc., Inc.
- 1990-Present Vice President, BCI Geonetics, Inc.

## SUMMARY OF PROFESSIONAL EXPERIENCE

### Groundwater Development

Groundwater exploration in bedrock and alluvial settings, artificial recharge of groundwater, wellhead protection, groundwater transfers, conjunctive use of water supplies

### Basin Analysis (sedimentation, structure, fluid migration history, reservoirs):

California: onshore and offshore Santa Maria basin, Santa Barbara Channel and nearshore areas, Owens Valley, Los Angeles basin, Santa Monica Mountains-San Fernando, Salinas basin, San Joaquin Valley basin, Eel River basin, central and northern California offshore basins.

Elsewhere: Philippines, Argentina, offshore Mexico, shelf and slope of eastern US.

## PROFESSIONAL ACTIVITIES

Past-President of Pacific Section, SEPM (Society of Sedimentary Geology),

Science advisor and lead instructor, AAPG School on *Sedimentation, Tectonics, and Basin Analysis*, annual week-long school in Banff, Alberta.

Associate Editor, Geol. Soc. of America's *GEOLOGY*, 1983-85.

Technical Program Chairman, Coeditor/convenor of several symposia, including Tectonics and Sedimentation Along the California Margin.