

The Role of Hydrological, and Epidemiological Issues Essential to a Successful Recovery Program in Post-Saddam Iraq

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I Proposal request and outcomes

The University of Pennsylvania Iraq Consortium* proposes to undertake a 24 month field research and analysis project with the objective of determining the hydrological, epidemiological, demographic, and environmental factors essential to a successful recovery program in Iraq. The study will also include an assessment of whether the Al-Huwaiza Marsh in the wetlands of southern Iraq, the only remaining marsh that stands a reasonable chance of being recovered, can be saved from destruction that would produce serious ecological, environmental, human, and economic consequences for Iraq.¹ The Consortium will offer short and long-term recommendations and immediate action guidelines for planners and decision-makers in an order of priority. These results will take the form of a series of issue specific reports together with accompanying data and models organized and designed for ease of use.

The research will also produce eight additional outcomes: 1) Recommendations for basin-wide, integrated management of Iraqi water resources. 2) The creation of a modern national water database, presently lacking, that will significantly improve the planning and management capability of Iraqi planners and managers. 3) A hydrological monitoring program rooted in the baseline information and data that will be gathered against which future development can be planned and measured. In this regard, it should be noted that the IES already possesses one of the largest academic Middle Eastern water database in the country with 10,000 entries constituting some 50,000 documents, including significant data on Iraq gathered in the field on the eve of the Gulf War. 4) An information infrastructure for continuing in-country epidemiological surveillance. This infrastructure will provide the vehicle for collecting, storing, and analyzing population-based, health-related data that will become a durable and lasting asset to researchers, planners, and practitioners with interests in the health of the Iraqi public, as well as members of the Iraqi public health community. As such, the infrastructure will be freely available worldwide. 5) Additionally, in association with the latter two items, a program of analytical and predictive modeling of the key issues that emerge from the study that will provide planners and policy makers with valuable analytical tools essential to sound decision making. 6) A program for training Iraqis in-country and at Penn in the fields under examination with a view to enabling them as soon as possible to handle their recovery problems themselves and to acquire an improved capability for continued indigenous training programs. As will be seen, we would be working at virtually every phase of our project with Iraqi counterparts. We would also expect to

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¹ See T. Naff & G. Hanna, "The Marshes of Southern Iraq: A Hydro-Engineering and Political Profile," and J. Brassington, "Monitoring Marshland Degradation Using Multipectral Remote Sensing Imagery," in E. Nicholson & P. Clark, eds., *The Iraqi Marshlands. A Human and Environmental Study*, London, 2002, 151 – 200.

cooperate with any UN, American or European aid agencies, and NGOs on the ground whose work complements or overlaps ours (see further under item II below). 7) A design plan in outline for rescuing the Huwaiza Marsh if analysis indicates that rescue is feasible. 8) The project will identify and explain the international freshwater legal and diplomatic issues involved in some of the critical water-based recovery efforts and recommend how international law and diplomacy can be most effectively employed wherever necessary (see further under item II below). The process will involve joint work with Iraqi lawyers and diplomats.

Owing to the combined expertise, experience, data, and other resources possessed by the Consortium research organizations it is expected that some initial major findings could be available by the end of the first 12-month phase of the project.

We request \$___ million to implement the proposal beginning in June [??] 2003 (see detailed budget under item IX below)

II Project need

The imminent prospect of a change of regime in Iraq at the hands of the United States and its allies raises the question of how best can a US military government or any other successor regime to Saddam Hussein deal with the problems of rapid recovery and stabilization? Assuming a change of regime, and bearing in mind that water is a vital socio-economic and strategic resource, and that public health and water are intimately linked, then within the context of this proposal, there is a three-part answer that highlights the importance and timeliness of this project (each part is elaborated in other sections below).

First, sufficient quantity, quality, and efficient delivery of water will be essential to the recovery and political and social stabilization of a post-Saddam Iraq, especially if he is removed by means of warfare. Whoever and whatever the governing body, it will not be able to deliver essential social services to the population without sufficient, well-managed water supplies. Iraq's water system will be at the heart of any recovery program — food supply, public health, urban and rural demographic migratory issues (including refugees), the speed and success of economic development (see details under item IV below), and oil production that cannot be carried out without the use of significant quantities of water. The deterioration of Iraq's water system resulting from war damage, lack of qualified manpower and poor management and maintenance, maldistribution, and the UN embargo will make improvement of the water sector and its infrastructure a vital priority for recovery.

Second, this project involves precisely the kind of planning necessary for salvaging Iraq's water resources, for assessing public health needs, and for producing a demographic country profile — all issues that are essential for planning a successful recovery. Our study would assess the hydro-engineering infrastructure of the two river basins and their marsh wetlands in the south and recommend actions in order of priority that take into account economic, epidemiological, demographic, and other social factors.

Third, this project addresses the panoply of deleterious effects on public health always associated with social and environmental upheaval, particularly when warfare or large natural disasters are the cause. It is well established that military conflict, social and economic disturbances, and degradation of environmental resources impact negatively on the physical and emotional well being of the citizenry and create instability. In order to assess accurately those services required to alleviate these effects it is necessary to obtain detailed data about the characteristics of the populace, the environment, and relevant government structures, particularly as they pertain to health. The gathering of these data mandates a large-scale approach across a representative sample of the population, including those who have been displaced or otherwise harmed by the current regime. However, no such approach currently exists. The statistics gathered by the World Health Organization are very useful indicators, but these data depend on reporting structures that can be circumvented by local authorities. Furthermore, health statistics gathered by various non-governmental organizations are not likely to be complete or representative. Our project would examine the specific requirements for an ongoing prospective surveillance system involving the collection of data needed to ascertain disease incidence and prevalence and would, accordingly, design programs for the reduction and control of disease in Iraq. In these endeavors, we would give priority as circumstances allow, to the condition of children — the infant mortality rate in Iraq (over 93/1000, 2002 est.) is among the very highest in the region — and to post-traumatic stress disorder (PTSD). These basic activities are essential to managing the outbreak of any contagion. It should be borne in mind that infectious diseases do not distinguish between native civilians and occupying forces.

This broad answer to the question overlays a multiplicity of constituent facets of this project. For example, recovery in Iraq will require Iraqi hydrologists, civil engineers, and public health specialists in sufficient numbers to achieve the essential tasks of recovery. Adequate, well-trained manpower in several salient areas is presently lacking. Should we be able to go into Iraq as a consequence of some US (and allied) action, this project could contribute toward alleviating that shortage in two ways: first, by working with Iraqi counterparts we could provide essential assistance in establishing the bases for continued recovery work by Iraqis themselves. We could offer guidance for establishing in-country training and arrange for the training of new cadres of Iraqi specialists in special programs at Penn and other cooperating institutions in the US and UK. These university arrangements could become ongoing. Fortunately, we would have relatively good human resources to work with as Iraq had, until the 90s, a fairly good secular educational system that turned out technocrats, scientists, engineers, etc. However, one of the effects of the Gulf War was that access to current journal and other literature, to updated technology and laboratory equipment, and to education abroad were severely curtailed and the education system deteriorated in other ways as well. Consequently, the numbers of new qualified specialists dropped off resulting in serious manpower shortages in key fields. Second, we could also assist rapid recovery by helping in the establishment and organization of databases where needed and in the upgrading of existing databases — for example in the water sector (see below under Item IV). Such cooperation would enable us to learn from one another thereby improving the quality of our reports and recommendations.

Recovery efforts by any successor government must take into account the hydro-politics of the Euphrates and Tigris River basins because significant percentages of Iraq's surface water

resources originate in and pass through the neighboring upper riparian states. This circumstance gives Iraq's surface (and some) ground water supplies a distinct international character that in turn demands that the policies of Baghdad's riparian neighbors — principally Turkey, Syria, and Iran — be taken into account when important water-based recovery activities are undertaken, particularly those involving hydrological infrastructure. This will be necessary in order to avoid potential inter-basin complications (see further under item IV below) that could cause serious delays and raise tensions. This circumstance means that resort to diplomacy that encourages basin-wide cooperation and to international fresh water law to settle disputes will be critical to the success of many remedial efforts. Because some of the key issues to be dealt with by the project fall under the purview of international hydro-politics and international fresh water law, two principle investigators on the project will focus on these particular issues. One is a prominent international law professor who specializes in international legal dimensions of fresh water issues in the Middle East and the other is a hydro-political specialist who has done considerable published work on the inter-riparian politics of the Tigris and Euphrates River basins, with a focus on Iraq. These two team members have collaborated for several years. Their task will be to identify clear or potential areas discord and determine the most appropriate diplomatic and legal strategies for the avoidance of inter-basin tensions and for encouraging cooperation.

There is an auxiliary benefit that could be one of the outcomes of this project. The widespread impression that American actions in Iraq are self-serving and aggressive could be in some degree mitigated by the fact that we, an international academic civilian team, would be going in early with a project that would have important and broad benefits for Iraq's people (and for its neighbors). This impression would be reinforced by our willingness to collaborate closely with Iraqis and with other NGOs that might be on the ground.

III Should there not be a change in regime...

Should there not be a change in regime in the immediate future, we can still achieve in significant measure the primary analytical, feasibility, and reporting objectives of the project. We already possess some basic, validated data on the waters and marshes of Iraq. We can make use of current and new satellite images and the social and demographic data at AMAR and elsewhere. There is public health information on Iraq available from the Friends Service Committee in Philadelphia, from the UN, and from various NGOs here and in Europe that have been working in the Iraqi health sector for some years. AMAR has collected data on Iraqi refugees in Iran, and through Baroness Emma Nicholson, the founder of AMAR and First Vice-Chair of the European Parliament Committee for Foreign Affairs, Human Rights, Common Security, and Defence, we would have access to various relevant European sources. Baroness Nicholson who was the rapporteur for the EP "Report on the Situation in Iraq Ten Years after the Gulf War," has negotiated with the Iranian authorities over the Marsh Arab refugees (see further under VI below). Additionally, we are able to gather some in-country information from Iraq over the Jordanian border. In these circumstances we would re-organize and recalculate the project budget accordingly in consultation with our sponsors.

IV Snapshots of some basic recovery problems targeted by the project

The following examples illustrate some of the inter-connected, complex dimensions of water, public health, and demography that will confront a post-Saddam government and are targeted by this project. We stress that all of these problems are reciprocals of one another and therefore must be engaged holistically and on several salients simultaneously. The complex nature of these problems requires sufficient lead-time for sound planning and implementation programs. It is one of the objectives of this project to assist post-Saddam Iraqi planners and decision-makers to acquire such lead-time in key areas.

Water Quantity: The Euphrates and Tigris Rivers have not flowed in their natural state, i.e. in relative full flow, for decades owing to extensive hydro-engineering projects by all three riparian states (Turkey, Syria, and Iraq) but mainly by Turkey in the fulfillment of its GAP Project on the Euphrates. The Euphrates, over 90% of which rises in Turkey, has a current annual average flow into Iraq that fluctuates between 18 and 20 bcm/yr (billion cubic meters) depending on upstream operations, principally those of Turkey's GAP project.² In Iraq, the Tigris has a total annual average flow of 51.4 bcm/yr., 21.5 bcm/yr is fed from Turkey, 2 bcm/yr is added from Iran (which also contributes 0.8 bcm/yr to Shatt al-Arab), and 27.9 bcm/yr originates in Iraq. Owing to dams and other engineering projects, the 21.5 bcm that reaches Iraq is only 40% of the 64% of the Tigris that rises in eastern Turkey. The Tigris River's level of flow in Iraq can be attributed to two factors: 1) Turkey has not yet significantly extended the GAP project to the Tigris and 2) a consequential part of the flow of the Tigris rises within the border of Iraq. While it would appear that the combined water in both rivers is sufficient to satisfy current need, serious shortage nevertheless exists and the projection is for increasing diminishment of supplies in the foreseeable future owing to maldistribution, poor management, decaying infrastructure and the continued development of GAP. Moreover, half the flow of a watercourse must remain in channel to ensure the vitality of the river, i.e., to cleanse itself of pollutants, ensure a suitable environment for its fish population, and to maintain the health of the basin's ambient ecology.

The Euphrates offers an excellent example. In 1990, agriculture in the Euphrates basin consumed 95% of the river's available supply, the domestic and municipal sectors took 3.5%, and industry used 1%. Euphrates agriculture currently requires about 21 bcm/yr but only about 16 bcm/yr is available. Owing in part to ongoing large rural-to-urban migrations over the last decade, the domestic and municipal sectors' needs have increased by about 6% and industry by 2%. In anticipation of a loss of up to 70% of the Euphrates's flow when GAP is fully implemented, Iraq determined to mitigate the loss by transferring water from the Tigris and a lake-reservoir named Tharthar by means of canals. In 1985-86 two canals, one supplied with water from both the Tigris and Tharthar, and the other exclusively from Tharthar were completed. The quality of Tharthar water is very poor. In the early 1980s another canal

²We have received from a fairly reliable source lately returned from Iraq information that the flow of the Euphrates has dropped this year to 12 – 14 bcm. Until we can verify this information, we will continue to use the 18 – 20 bcm/yr figure.

designed to deliver water from Tharthar back to the Tigris in order to maintain the river's safety was begun but never completed, perhaps because the condition of the Euphrates was considered more urgent and was therefore given priority. The condition of the canals and their operation in the aftermath of the Gulf War is not known, but is likely to be consistent with the general poor status of the water infrastructure. The solution of cross-river canals is very limited because almost three-quarters of Iraq's 24 million inhabitants, who are increasing at 3% per annum, live in the Tigris basin, requiring virtually all of its flow. It should be borne in mind that the combination of population growth rate, recovery programs, and economic development will produce greater demand and place water and human resources under increasing stress.

Water Quality: Prior to the Gulf War, the quality of the Euphrates and Tigris Rivers was considered to be relatively good, usable for a variety of purposes. The pollutant content of the Euphrates ranged between 500 – 600 ppm (parts per million) in the upper and middle sections to 1000 – 1500 ppm in the south. For the Tigris, the figures ranged from 500 – 600 ppm in the northern and central reaches of the river to 1400 ppm in the south. By 2000, the degree of pollution along the entire stretch of both rivers had increased to over 2000 ppm and over 2500 ppm in some parts of the basins. Most of this increase can be attributed to the causes of the deterioration of Iraq's water systems cited under item II above. The embargo has caused a severe shortage of chemicals that are used for water purification, a condition that has contributed to the decline in domestic sector water quality. Aside from the obvious public health and production problems, poor quality contributes to water shortage and maldistribution because unusable water is lost water.

Public Health: Although much of the medical focus in this project is on epidemiology, epidemiological surveillance constitutes the essential means for understanding the needs that must be met in order to improve the health of the Iraqi public as soon as possible — it is the essential first step. Ultimately, the goal of this project, in terms of medical perspective, is, as stated, to lay the basis for the reduction of the incidence and prevalence of disease and to increase the level of general public health in post-regime Iraq. The WHO health statistics on Iraq reveal that it is a country with in marginal or sub-marginal health. For example, child mortality (defined as the number of deaths prior to five years of age, per 1,000) is among the highest in the region, at 111 females and 122 males. Only Afghanistan (249 females/252 males), Somalia (198 females/219 males), Djibouti (165 females/181 males) and Sudan (117 females/124 males) have higher rates of child mortality. Furthermore, most countries in the region have substantially lower rates (between 7 and 30 deaths per 1,000). As a result, there exists in Iraq a very real challenge in terms of reducing child mortality. This can be met only by first identifying the risk factors associated with child mortality in Iraq, which may include poor water supplies, malnutrition, lack of access to medical care, and poor immunization coverage. However, there may be many other risk factors, and these can be identified only through the type of epidemiological surveillance system proposed here. A similar pattern is seen with increased adult mortality and low life expectancy. According to WHO statistics, these two indices are substantially disproportionate when compared to other countries in the region. However, Iraq spends a substantial amount of money on health (573 international dollars spent per capita in 2000 on both public and private health expenditures). Regionally, in terms of dollars, Iraq is outspent only by Cyprus, Qatar, United Arab Emirates, Lebanon, Saudi Arabia, and Bahrain.

Yet, this amount is relatively low, when considered as a fraction of the gross domestic product of Iraq (3.7%), and this puts the country in the lower third of countries in the region with regard to health expenditures. It is not clear where these "health dollars" are going, but given the high mortality rates, it is reasonable to assume that they are not sufficient, and that they are not being spent appropriately.

Agriculture: The agricultural sector is in a state just this side of disastrous. Neglect of proper drainage and irrigation practices, worsened by the migration of farmers to the cities and oil fields and the effects of the Gulf War has led to degradation of the soil. Iraq's agricultural problems began prior to the Gulf War beginning with the government's policy of making agriculture and water matters of military security. Between 1974 and 1984, public investment in the water sector was 15 percent of the agriculture budget. In the decade between 1980 and 1990 when 85 percent of the agricultural budget was placed under military expenditures, that investment dropped to 5 percent, reflecting Saddam Hussein's aggressive policies toward Iran and Kuwait. Soil salinity is generally high owing to poor water quality, water logging, and irregular flows stemming from maldistribution.. There is a chronic shortage of seeds and fertilizer and the latter tends to be regularly misused. Modern agricultural practices are few. Drip irrigation was introduced experimentally only around 1990 but abandoned after the Gulf War. Widespread irrigation is necessary but is highly inefficient and wasteful. Traditional methods predominate and are based on gravity flows. Saddam Hussein, his relatives, and high officers of the military and government own the greater portion of farmland. They have no particular interest in agriculture other than personal avarice, nor do they concern themselves with production costs vs. rate of return for key crops, as evidenced in part by the 100% subsidy of irrigation water. They concentrate on making maximum profits with very little investment. Farmers have virtually no political influence. The consequences have been very low efficiency, very high consumption and pollution of water, very low production of food necessitating very high imports. Life for rural dwellers has deteriorated significantly creating serious instability. During the decade, roughly, between 1985 – 95, the number of Iraqis who devoted themselves to full-time farming dropped to only about 250,000 and agriculture accounted for about 10% of GDP — it has since dropped to about 6% of GDP. There has been a three-decade long rural to urban migration that has created serious social problems in all of Iraq's urban centers, problems that have been held in check --- without serious efforts toward solution --- only by ruthless oppression. For this reason and because of the ruination of the Iraqi economy and the UN embargo, a reverse urban-rural migration has occurred. Now, the number of full-time farmers has increased to about 400,000, but agricultural production remains generally stagnant. Rural public health has declined steadily in the last decade. Social and political stability in Iraq will require swift attention to this problem and water and public health will be key elements in any solution.

Population Factor: Despite widespread problems of health and high infant mortality, Iraq's population grows by about 3% per annum, a doubling time of about 25 years. This rate of growth is unsustainable in relation to Iraq's water and other natural resources. Only oil profits enable the regime to import food and other essential products (under the rules of the embargo) sufficient to meet the needs of the population, at least minimally. However, as population growth outstrips water supplies, especially in light of Turkey's GAP project, the hydro-demographics of

Iraq will play an important part in the success or failure of nation's future economic and social development. Efficiency in all delivery and uses of water, as soon as possible, will become imperative. Literacy in Iraq is, relative to the region as a whole, not bad: about 71% of males over 15 can read and write and about 47 % of females. This gives us and other entities that might become involved in Iraq's recovery, a reasonably good pool of educated Iraq's to work with and train.

Databases: Unlike other ministries, especially security and intelligence, the central databases for water and public health in Iraq are rudimentary, un-integrated and suffer from very poor organization and management. Data collection, verification, collation, and sharing are low-grade and sporadic. As a consequence, planning and decision-making suffer. Nevertheless, even in the face of such handicaps, some talented water managers and public health officials have produced occasional instances of fairly good planning but implementation has been very poor because of a lack of qualified personnel and fear of severe punishments if errors are made. The establishment of national databases in key sectors will be an essential element to the long-term success of recovery plans.

Alternative Sources of Water: Iraq has not developed a policy regarding desalination. There is only one desalination plant in Iraq. It's in Basra and was used by an oil company. Groundwater is Iraq's greatest potential for alternative water development. In the early 1980s Iraq undertook a survey of ground water resources (it's not clear whether the survey was complete) but no further surveys using improved equipment and techniques have been conducted since. Known groundwater supplies could, hypothetically, make up as much as 50% of the anticipated losses from the GAP project. Most of these supplies lie under the western desert far from population centers and the quality varies widely but tends generally to be poor. Exploitation of the groundwater would be expensive and so too would be the cost of the delivered water. Two of the aquifers are shared with Jordan and Saudi Arabia.

The Marshlands: The marshlands of southern Iraq, even in their current reduced and debilitated state, constitute one of the most outstanding and extensive natural wetland ecosystems in Europe and western Asia.³ Between 1990 and 1992 the government intensively drained massive areas of the marshes facilitating military control of this wilderness area and opened it up for exploitation of oil that had been detected beneath the marshes. The ecological and environmental importance of these wetlands make them integral to whatever efforts are made to redeem Iraq's water system. Our study will enable us to determine not only the feasibility of rescuing Al-Huwaiza marsh, but also whether the oil fields beneath the wetlands can be exploited without destroying them or harming their environment.

Hydro-politics --- Water and Iraq's Foreign Relations: Water is a very important factor in Iraq's relations with key regional actors, namely, Turkey, Iran, and Syria through which the Euphrates flows enroute to Iraq. It will be recalled that over 90% of the Euphrates rises in Turkey as does about 64% of the Tigris. Turkey, Syria, and Iraq created a Tripartite Commission for dealing

³ M.I. Evans, "The Ecosystem," in E. Nicholson & P. Clark, eds., *The Iraqi Marshlands. A Human and Environmental Study*, London, 2002, 200 - 219; E. Maltby, "An environmental and ecological study of the marshlands of southern Iraq," AMAR Appeal, London, 1994.

with the problems anticipated by the GAP project. From its first meeting in 1983 until the Gulf War, the Commission met only periodically with no results. None of the commissioners was given sufficient authority to negotiate an agreement. Discussions were confined to technical matters. Turkey has said it will guarantee a flow of 500 cubic meters per second (cumecs)) to its downstream neighbors who insist that they have a right to and need of at least 750 – 850 cumecs. Without a sustainable water sharing agreement among the riparian states of both the Tigris and Euphrates basins the development plans of Syria and Iraq will be subject to uncertainty. In such circumstances, a potentially serious element of instability and of conflict will remain. Iraq's relations with Jordan and Saudi Arabia will also be impacted by how they distribute the waters of their shared aquifers, especially given the steadily increasing water needs of all three parties. The issue of water and Iraq's relations with its riparian neighbors will be a basic part of this study.

V Research and procedural methods

Procedures There will be two US Co-Directors, one a water specialist, the other a public health specialist and one Iraqi Director/Government Liaison at the project headquarters in Iraq. An administrative staff at Penn and in Iraq will assist the Co-Directors and PIs (see further under VIII below).

We recognize that such a multi-faceted project requires close coordination and cross-tabulation of surveys and data among its units if a unified package of results is to be created. Moreover, the separate databases created will, in the end, need to be integrated. Toward these ends, we shall begin this project by assembling designated key members of the research team in a workshop to be held perhaps as early as May.

The purpose of the workshop will be to produce a comprehensive, detailed working plan that covers organization, administration, coordination, priorities, assignment of tasks and resources, methods, execution including cross-tabulations and data sharing, and a time-line with the aim of ensuring that each unit member understands clearly what is expected and when. The first two steps in implementation will be 1) to identify and begin the collection and, as far as possible, the assessment of needed data and information not already in our possession. It is a given that data collection and treatment is a continuous component of this project from its inception to its conclusion. 2) It will be necessary for the Principle Investigators (PIs) of each unit or activity to travel to Iraq as early as possible to assess working conditions and specific needs for their assignments, to confer with Iraqi authorities in relevant agencies, recruit local personnel, and to plan and implement accordingly. All PIs will be expected to spend whatever time in the field their tasks require. At all events, they must undertake at least six extended trips to Iraq over the 24 months of the project.

In order to ensure that the work of each unit is coordinated and integrated and that each is aware of what the others are doing, the principal investigators will report at specified times to the Co-Directors who will then integrate, summarize, and distribute the aggregated reports to the PIs. Moreover, The PIs will periodically confer with one another in meetings convened by the Co-Directors to review outstanding issues.

We emphasize that throughout this endeavor, we will work with Iraqi authorities in relevant agencies, especially in the water establishment where we already have contacts.

Research methods The research methods deployed in this project must be commensurate with the complexities and varied nature of the project. The methods, as defined by discipline, will encompass empirical analysis, surveys, interviews, statistical analysis, application and analysis of satellite imagery, and modeling, all as appropriate singly or in combination. We offer two brief, summarized examples of our approaches — epidemiological and hydrological.

Our basic approach in the epidemiological research will be to develop a population-based survey instrument, translated into Arabic, on health status, health perception, sanitation practices, and beliefs and attitudes pertaining to water accessibility and use. The design of instrument will be such that it can be administered prospectively or over a period of time as a series of repeated measurements with a view to determining changes in the dimensions measured by the instrument. Initially, the instrument will be used to collect a baseline of public health-related data in the most cost-effective and accurate way possible. As much as possible, we will incorporate existing survey instrumentation that has been validated previously, thus obviating the need to conduct extensive validation procedures prior to data collection. In addition, this strategy will help us to focus our survey development efforts on creating and validating dialect-sensitive instruments that will be useful in the Iraqi population and its subgroups. Assuming we will be working in the field, the instrument will be pre-tested on the ground and revised accordingly. Because experience has shown that in the Middle East teachers tend to be trusted and respected and are therefore more effective in administering the instrument, Iraqi teachers will be trained to perform the task.

Our intended instrument will be based in part on a health survey that was administered in 1997 and 2000 under the auspices of the World Health Organization and AMAR to Iraqi marshland refugees in a camp in Iran (Nicholson and Clark 2002). This survey captured data about family health, diarrheal disease, and household sanitation practices, in addition to assessing the status of environmental sanitary conditions by direct observation. It was administered to a random sample of refugee heads-of-household, identified through files in camp health centers operated by AMAR and by random residential block sampling. Questions from this survey included items such as demographics (age, gender, arm circumference, weight, birthweight), immunization status of children and women of childbearing age, breast feeding practices, clinical evidence of malnutrition, and practices in treating diarrhea within the family. We propose to enrich this survey instrument by adding a well-known, validated health measurement scale, the WHOQoL-BREF, a quality of life instrument developed by the World Health Organization The WHOQoL Group, 1994). This 26-item instrument addresses four domains, physical health, psychological well-being, social supports and relationships, and environment. This instrument has been translated into Arabic for Saudi Arabia and Egypt; we propose translating it into dialects appropriate to the target Iraqi population. In addition, we will include a cognitive screening instrument that we will create for this project. To reduce development time and cost, we will look to existing cognitive status instruments as models for the one that we will create. (See Appendix B for fuller details.)

Regarding the hydrological sector, we will of necessity have to work on several fronts simultaneously. However, our first task will be to review existing data for the past five years to establish a baseline from which to work forward. We will at the same time collect and verify current flow data including level and fluctuations (i.e., stages), with a view, eventually, to establishing monthly collections of such data. This will be accomplished in cooperation with the Iraqi water ministry through measuring instruments placed selectively at about 100 points or more in the main streams of the two river systems as well as in some canals, lakes, and at key dams. These instruments will be in addition to those already in place. These essential data activities will continue during all other phases of the project. We will then proceed to examine the condition and adequacy of the water supply and treatment systems, that is, the most pressing problems of water for drinking, sanitation and other public health purposes. We will focus first on large urban population centers particularly those where the national government functions in order to identify the most urgent problems of social and health need. Water quality and pressure in the supply system will be examined including status of the technology for cleansing and delivery. (We expect to use government laboratories and computer system to test quality). A related requirement will be to undertake a cross-sectional survey of representative households of the user population and calculate real need in relation to demand for drinking water, sanitation, and public health. In rural areas, in addition to matters of household water use and sanitation, we will conduct some surveys of irrigation systems, canals, and soil quality with a view to assessing the need for land reclamation and technological upgrading. In all of our endeavors, we will determine manpower requirements for improvement and self-sufficiency.

VI Team capability

We begin this project with a sixty-five-page analysis (with tables and water balances) of the two river systems that comprehends hydrology and engineering infrastructure, organization of the water sector, and agricultural data based on in-country data obtained from the principal hydro-engineering investigator who is a Fellow of the IES. He is an American trained Iraqi hydrological engineer with many years' experience in Iraq's water establishment where he held a central position. He is thoroughly familiar with the hydrology and engineering infrastructures of both basins and with the flow and quality data. He managed to come to the US on the eve of the Gulf War, bringing with him considerable documentation and first-hand knowledge of Iraq's water establishment. He and the former Director of Penn's Middle East Research Institute and the IES Middle East Water Database (the hydro-political specialist on Iraq referred to under item II above) are the co-authors of the paper. They recently co-authored and published another paper on Iraq's river systems with a focus on the marshlands in the southern reaches of the basins.

The Penn Iraq Consortium contains all the necessary professional expertise required. It offers the scientific, medical, engineering, hydrological, and social scientific resources of a world class research university and of those institutions with which there are cooperative agreements.

As indicated, we already possess perhaps the largest academically based Middle Eastern water database in the US. This database (which includes relevant maps) is backed by the library system of the University of Pennsylvania and the adjacent research libraries on the East Coast and comparable sources in the UK. Additionally, through the Wharton School GIS lab and the

Graduate School of Fine Arts GIS facility, the University of Pennsylvania has considerable data management/analysis and GIS display capabilities that will be at the disposal of the project. We have connections to the US Environmental Protection Agency (EPA) and US Geological Service (USGS) and AMAR has access to the British Geological Service (BGS).

The Consortium members are international as will be seen from the accompanying vitas. Through our British partner we can tap into a wide web of European organizations, such as the World Conservation Union (Geneva) with which it has collaborated. Mention has already been made of the assets that AMAR's Chair, Baroness Nicholson brings to the project. Two AMAR-related members of our team provide particular skills in key areas: one is a satellite imagery specialist who has been focussing on Iraq's water system for the past two years. Consequently, we have a collection of relevant satellite images of the Tigris and Euphrates systems. The other member has been working during the same period on the demographic dimensions of the issues. Our legal specialist is considered to be perhaps the most productive, experienced and internationally reputable American lawyer working on international fresh water issues in the Middle East. He is the rapporteur of the International Law Association Committee for Revision of the Helsinki Rules that are guidelines for the legal behavior of actors on international fresh waterways and for the legal settlement of international riparian disputes.

A list of research fellows and their vitas who have agreed to participate in the project is found in Appendix A. Some will devote full-time and others part-time to this endeavor, some will participate from the beginning others will enter at points when they are needed.

VII Project components

- Hydro-Engineering
- Epidemiology
- Modelling
- Databasing
- Training
- Freshwater law
- Hydro-politics/diplomacy
- Basin management
- Huwaiza recovery design plan
- Reports and recommendations

VIII Personnel Positions (full and part-time — see budget for details)

US

Administration

- 2 Co-Directors
- Associate Director/Project Coordinator
- Project Administrator

2 secretaries

Research

4 Principal investigators
 6 Post-doctoral research fellows
 6 research assistants
 1 database administrator/coordinator
 2 database assistants
 1 Arabic programmer
 1 Project Research/Planning consultant

Iraq

Administration

Director/government liaison
 2 Secretaries
 4 Odd-jobbers

Research

6 Senior researchers (with professional qualifications and experience)
 8 Junior researchers
 6 Hydro-engineering technicians & surveyors
 8 Translators
 10 Survey interviewers (teachers)
 1 International law/diplomatic specialist

IX Time-line/phases of the project

X Evaluation of the project

Evaluation of this Study will be made in three parts: at the eight, sixteenth, and twenty second month. The primary function of the evaluators will be to assist the project in the achievement of its objectives and finally to assess how well it has done so. The assessments will be made by an international Oversight Committee of experts in relevant disciplines. The Oversight Committee will be expected to meet, two days for each of the evaluations at the University of Pennsylvania.

XI Budget (2 years)*

Item	Cost (\$)
US	
Initial planning workshop (20 participants, three days)	25,000

[Chris: please note the increased figures for the Hydro-engineering and Epidemiology PIs. This is on the basis of conferring with people in those fields.]

Personnel

2 Co-Directors	150,000
Associate Director/Project Coordinator	120,000
PI Hydro-Engineering	170,000
PI Epidemiology	170,000
PI International Fresh Water Law (1/2.t)	75,000
PI Integrated basin management (1/2.t.)	75,000
Research Consultant (retainer @ \$25,000/yr)	50,000
6 Post Doc Res Fellows (@ 60,000/yr ea.)	720,000
6 Research Assistants (@ \$12/hr x 20hrs/wk x 80wks	115,200
1 Administrator	90,000
1 Secretary	70,000
1 Secretary (1/2.t.) (@\$12/hr x 20hrs/wk x 24mos.)	23,040
2 Database ass'ts (1/2.t.) @\$12/hr x 20hrs/wk x 80 wks	38,400
2 Arabic programmers @ \$20/hr x 120 hrs ea.	4,800
 3 Proj. Evaluations (4 x \$2000 ea. x 3 evaluations)	 24,000

Travel & Expenses **[Chris: the travel & expenses should be re-calculated on the bases of 6 trips by the PIs to Iraq travel & per diem for 14 days ea trip; 1 annual trip/yr by the Co-directors for 7 days ea; 6 trips by Post Doc Fellows, 30 days ea. — they can be combined in various ways for shorter or longer periods but must add up to 180 days over 2 yrs. We can reduce or delete the European travel if necessary. Also, on advice, the space rental should be calculated at \$1500/mo rather than 1200]**

Eur.: 3 pers. @ 200p/d x 3 days/trip x 3 trips –	5,400
Airfare @ 800 x3 x 3	7,200
 Iraq 6 RFs 4 trips, 4 wks ea. @ 350/d (incls. 150 research exps.	 63,000
Airfare@ 1200 ea x 6 x 4	28,800

Evaluations: 3 pers @ 200/d x 2 days x3	5,400	
Airfare: 600 ea. x 3 x 3	<u>5,200</u>	
	115,000	115,000

Communications & supplies		10,000
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[Chris: The equipment figures will have to be recalculated in conformity with the changes we discussed re. Number of laptops, desktops, software, etc.]

Equipment (computers & software)		
6 field laptops		12,000
2 desktops		4,000
Software		5,000
Space @ 1200/mo x 24		28,800

Iraq

Administration

Director/liaison with governing authorities	\$50,000
Admin. Assistant @ \$8/hr x 40 hrs x 104 wks	33,280
2 Secretaries @ \$5/hr x 30 hrs/wk x 80 wks	24,000
4 Odd-jobbers @ \$3/hr x 20 hrs/wk x50 wks	12,000

Research

6 Senior researchers @ \$20,000/yr x2 yrs	240,000
8 Junior researchers @ \$6/hr x 30 hrs/wk x 80 wks	115,200
6 Technicians & surveyors with hydro-engineering qualifications @ \$6/hr x 30 hrs/wk x 80 wks	86,400
8 Translators @ \$8/hr x 20 hrs/wk x 180 wks	102,400
10 Survey interviewers @ \$8/hr x20 hrs/wk x30 wks	48,000
1 International law/diplomatic specialist	20,000

Office Space \$300/mo x 24 mos.	7,200
Equipment (3 desktop computers, 3 laptop)	6,000

[Chris: you'll have to recalculate the communications cost on the basis of information that you have about satellite phones. Please emend the note below on communications in accordance with your research on the matter]

Communication** and supplies	5,000
Office furnishings	3,000
Accommodations for US researchers @ 12,000/yr***	48,000
Transportation (car & driver) @ \$30/day****	21,600

[Benefits and overhead will have to be recalculated in accordance with the changes made above]

Benefits

Part-time @ 15%	60,156
Full-time @ 30%	<u>354,000</u>
Total	1,844,996

Overhead @25%	<u>461,249</u>
Grand Total	\$2,306,245

[Chris: note that I have deleted the sentence about the US military providing cars. This item has been included under the Iraqi budget with its own separate notation.] * One item of importance is not included in this budget. The cost of formal training at Penn and associated institutions of Iraqi personnel cannot be estimated until the specific training requirements, including qualifications of candidates and needed level of skills, are determined. This cannot be accomplished until after we are in the field. This should be treated as a separate but related project. However, we will do as much training as possible in the field as we work with our Iraqi counterparts.

**Given the nature of our project, good communication between Iraq and the US is essential to its success. Internet communications in Iraq are inadequate and cellular phone service exists, restrictively, only in certain northern parts — namely in some Kurdish-held areas — of the country. Therefore, we must rely on satellite telephone service. Fortunately, there are several satellite telephone service providers that offer coverage in Iraq at a cost of about \$600 per phone and \$100 for 400 minutes of airtime per month. Importantly, the phones are capable of transmitting data to and from laptop computers in the field.

***Consultations with Iraqi colleagues indicate that the best and most cost effective arrangement would be to rent furnished houses rather than use hotels. The cost figure above includes maintenance and cleaning.

****Consultation with Iraqi colleagues indicates that the cost of purchasing 2 adequate used cars and employing a car and driver for two years would be the same and the preferable choice.

Appendices