REBUILDING AFGHANISTAN'S AGRICULTURAL MARKETS PROGRAM (RAMP)

REHABILITATION NEEDS ASSESSMENT FOR THE MIDDLE HELMAND IRRIGATED AGRICULTURE SYSTEM

20 April, 2004

DAI Development Inc.

Executive Summary

Historical Background: The Middle and Lower Helmand Valley lands have historically suffered from cyclical (25 to 30 year) droughts and intensive flooding during its past history. To alleviate these problems the Kajakai Dam on the Helmand River and the Boghra Canal and its Shamalan branch that serve the Upper Boghra, Nad-i-Ali, Marja and Shamalan, and later the Darweshan Canal that serves the Darweshan area were constructed, which were called the Helmand Valley Project lands. Agricultural production during the first phases of development suffered from lack of drainage and salinity. However, after the establishment of Helmand and Arghandab Valley Authority (HAVA) more efficient operation and maintenance of irrigation and drainage systems, water management and agricultural research and extension services to farmers gradually helped agricultural production in the Helmand Valley Project to grow and reach its peak in the early seventies. Due to the invasion of Afghanistan by Soviet forces and the ensuing 23 years of warfare, the Helmand Valley Project and its infrastructure has rapidly deteriorated and is in serious need of rehabilitation.

The Assignment: Development Alternatives, Inc., (DAI) was contracted by USAID's Rebuilding Afghanistan's Agricultural Markets Program (RAMP) on 18 January 2004 to conduct an inventory and irrigation system rehabilitation needs assessment for the Middle Helmand Irrigated Agriculture System (MHIAS) in Helmand Province. A team of engineers and an agricultural specialist including representatives of the Ministry of Irrigation and Environment from HAVA was mobilized and conducted their field work from January 19 to March 5, 2004 in Helmand.

The findings of the Team show that: 1) All downstream areas of the project and canal systems that have silted up suffer from water deficiency and low agricultural productivity. 2) In most areas that drainage systems are silted up, water logging and accumulation of salt on the farmland have resulted in low crop yields. 3) The Helmand Valley Authority has lost most of its trained staff and authority and is in need of reorganization.

The Assessment Report: The report documents the findings of the team, the inventory of all irrigation, drainage and road systems, the present condition of these systems, the needs, costs and recommendations for rehabilitation. Each facility was visited by the team members who documented its condition, made recommendations for its repair and determined its geographical position and cost for rehabilitation.

To Summarize: The total area of land currently irrigated in the MHIAS is approximately 94,300 hectares.

The total cost of recommended rehabilitations was estimated at about Twenty Seven Million dollars. The Implementation of Rehabilitation is recommended to be scheduled for a three year period. The Benefit-Cost Analysis for the whole project shows a ratio of 3.4 to 1, for a period of three years.

The report is organized into seven sections describing in detail the field data, methods used for estimating costs and rehabilitation measures. Priorities were established on the basis of criticality of rehabilitation impacts and optimization of crop yields and returns by the farmers. The methods for the estimation of costs and benefits of rehabilitation are also described. The

last section of the report discusses the environmental impacts, schedules for implementation, necessary funding and cash flow requirements of the recommended rehabilitation measures.

Recommendations about institutional reorganization of HAVA and the organization of the Water Users Associations in regards to the operation and maintenance of irrigation, drainage systems, and farm roads are made. Specific recommendations about the removal of illegal pumps and other issues related to the need for further studies in relation to drain water reuse in regards to the salinity and leaching of irrigated farmlands, underground water geological investigations as well as, the need for integrated water resource management studies are made in the last part of this report.

Attachments: The five Attachments at the end of the Report include: Detailed Volume and Cost tables, Album of Maps, Agricultural Production and Income Tables, Methods of Road Rehabilitation Costs and lastly an Album of Photographs to illustrate the current condition of facilities that are recommended for rehabilitation.

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1. Introduction

On 18 January 2004, USAID's Rebuilding Afghanistan's Agricultural Markets Program (RAMP) contracted Development Alternatives, Inc., (DAI) to conduct an inventory and irrigation system rehabilitation needs assessment for the Middle Helmand Irrigated Agriculture System (MHIAS) in Helmand Province. DAI's assessment team mobilized to Lashkar Gah on the same day and completed its fieldwork on 5 March 2004.

This report documents the team's findings and presents inventories, cost estimates and recommendations for rehabilitating irrigation, drainage and road infrastructure in the 5 major MHIAS sub-systems – Upper Boghra, Shamalan, Nad-i-Ali, Marja and Darweshan. It also describes significant irrigation and drainage issues in parts of the region outside the 5 main subsystems and gives recommendations for addressing those issues.

The report is comprised of seven sections in the main report and four attachments.

Section 1, the introduction, provides contractual background, outlines the structure and contents of the report, introduces the members of the DAI assessment team, and acknowledges significant contributions from others who were not formally members of the team.
Section 2 outlines the geographic and technical scope and objectives of the MHIAS needs assessment.
Section 3 describes the irrigation, drainage and road networks in each subsystem of the MHIAS, and summarizes our assessment of the condition of the infrastructure within those networks. The section presents technical descriptions and cost estimates for five main types of work – cleaning sediment out of canals and drains, repairing eroded banks, repairing concrete structures, repairing steel structures, and rehabilitating roads.
Section 4 discusses issues related to irrigated agriculture in parts of the MHIAS outside the five main subsystems. These areas are Nad-i-Ali – Boghra, Marja – Boghra, Sistani, Sheen Gazak and Trikhnawar.
Section 5 describes the methods we used for costing and prioritizing rehabilitation measures.
Section 6 presents recommendations for carrying out the rehabilitation measures described in Section 3. We present these recommendations in three categories – high priority, medium priority and low priority.
Section 7 describes the impacts we expect the measures we recommend to have, and the benefits we estimate the measures will bring to the residents of the five subsystems of the MHIAS.

Attachment 1 contains detailed volume and cost tables for all the rehabilitation needs we identified in our assessment. For each of the five subsystems we present five tables, one for each category of work – 1) cleaning, 2) bank repair, 3) concrete work, 4) steel work and 5) road rehabilitation. Separate tables give the volume and cost estimates for major rehabilitation work to the Boghra and Darweshan diversions (Table 6) and for roads that are not associated with individual subsystems (Table 7).
Attachment 2 is an album of maps showing the routes of canals and drains that need cleaning, the locations of structures that need repairing, re-building or replacing, and the routes of roads that need resurfacing and re-grading.
Attachment 3 presents agricultural production and income tables compiled by DAI's senior agriculturalist. The data in these tables forms the basis of the benefit-cost analysis presented in Section 7.
Attachment 4 is an album of photographs that illustrate the current condition of the canals, drains, water control structures and roads in the MHIAS.

The DAI team that has been carrying out irrigation system rehabilitation activities under both RAMP and another USAID program – Assisting Afghanistan to Revitalize Irrigated Agriculture (AARIA) –

conducted the surveys, analyzed the data and prepared the maps presented in this report. Team members from our Kabul office and our regional office in Lashkar Gah contributed to the assessment under the leadership of AARIA Chief of Party, Engineer Tawab Assifi. Mr. Eric Viala, a DAI irrigation engineer, worked with the assessment team in Helmand from 18 – 29 February, and he assisted in collecting data and in the writing of this report.

We would like to thank Mr. Dawari, President of the Helmand Arghandab Valley Authority (HAVA), Mr. Obaidullah, HAVA's Director of Operations and Maintenance, and other members of the HAVA and Helmand Construction Unit staff for their help and support. Their knowledge of past and current conditions in the MHIAS made the collection of the information provided in this report possible. We are also grateful to staff at the U.S. Embassy for providing satellite images which we used to estimate the extent of irrigated areas and update maps of irrigation, drainage and road networks.

2. Scope and Objectives

2.1. Geographical Scope

The Helmand River and its tributaries drain the southern half of Afghanistan. The fertile alluvial soils along these rivers have been irrigated by canal diversion for several thousand years. Irrigation has thus existed for a long time all along the course of the Helmand River, from its upper reaches in the Hindu Kush to the Seistan depression on the border between Afghanistan and Iran.

Traditionally, irrigated agriculture in Afghanistan has suffered severely from droughts that can last for several years. It was after one of these droughts during World War II that the Government of Afghanistan decided to create two major reservoirs by building the Kajakai Dam on the Helmand River and the Arghandab (Dahla) Dam on the Arghandab River. These multipurpose dams were constructed to store water from rainfall, melting snow and floodwaters for year-round irrigation, to alleviate periods of drought, and to reduce the intensity of floods, thereby reducing damage to farmland and traditional irrigation systems downstream. The Helmand and Arghandab Valley Authority (HAVA) was established with various departments (Agriculture, Engineering and Planning, Construction and Operation and Maintenance) to manage the entire system, carry out maintenance works and provide extension services to the farmers.

The present inventory and rehabilitation needs assessment focuses solely on the Middle Helmand Irrigated Agriculture System (MHIAS), that is, the area brought under irrigation after the construction of the Kajakai dam and reservoir in the 1950s and 1960s, and of the Boghra, Shamalan and Darweshan Canals. The five main sub-systems of the MHIAS are Upper Boghra, Shamalan, Nad-i-Ali, Marja and Darweshan (see Map 1 in Attachment 2). Together these five sub-systems irrigate approximately 78,000 hectares of land. Two more areas extending across approximately 8,800 hectares outside the main subsystems are irrigated directly from the Boghra Canal. We refer to these two areas as Nad-i-Ali – Boghra and Marja – Boghra. Other areas discussed in this report include Sistani to the west of Marja, Sheen Gazak to the south of Marja and Trikhnawar to the south of Nad-i-Ali, all of which are irrigated informally either from the Boghra Canal or from drain water from the major subsystems. These three informal areas together extend across approximately 7,500 hectares of land. **Thus the total area of land currently irrigated in the MHIAS is approximately 94,300 hectares[1].** This is the bulk of the land irrigated by water from the Helmand River, and it is one of the most intensively farmed and productive areas in Afghanistan. In the 1970s the MHIAS was both the main breadbasket of Afghanistan and a major supplier of produce for export to Pakistan and other counties.

The Kajakai reservoir and the Saraj Canal, although both important parts of the Helmand irrigation system, are not included in this assessment.

2.2. Technical Scope

The following is the Scope of Work as presented to DAI by Chemonics. It is extracted directly from the agreement under which Chemonics sub-contracted DAI to conduct the MHIAS needs assessment.

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[1] We estimated this area from interpretations of recent medium-resolution satellite imagery, checked against official figures from government agencies in Helmand Province and ground-truthed in the field by our assessment team. Ninety-four thousand three hundred hectares is, we believe, the most accurate estimate available of the area currently under irrigation in the MHIAS.

The Subcontractor shall conduct an assessment of demands for repair and rehab of public infrastructure (roads, irrigation and drainage) in Helmand Province. The assessment will be conducted within the global perimeter of the Middle Helmand Irrigated Agriculture System (MHIAS). That is:

- The entire length of Boghra Canal, its intake and the areas irrigated by this canal in Marja and Nad-i-Ali, as well as the associated drainage systems.
- The Boghra canal implies also the Shamalan Canal, the S-10 lateral
- The New Shamalan Canal Intake and the part connecting to the Shamalan Canal.
- The Darweshan Canal and all areas irrigated by this canal as well as the associated drainage systems.

The work in Lashkargah shall start not more than one week after signing by both parties of this subcontract.

Specific tasks to be completed include:

1. Prepare detailed inventory of all the irrigation infrastructure and roads in the Helmand system (Nadi-i-Ali, Marja, Shamalan and Darweshan areas). The inventory will describe all primary, secondary and tertiary roads, canal and drains, intakes and diversions, weirs, turnouts and other irritation structures. All major structures be geo-referenced with GPS coordinates and located on maps.
2. Assess all irrigation infrastructure and roads described in the inventory to determine whether they are in a) good working order, b) poor condition but repairable, or c) completely destroyed and in need of replacement. Assess the condition of all the canals and drains described in the inventory to determine what rehabilitation measures will be necessary to return them to full operating capacity.
3. Prescribe rehabilitation measures to fix problems identified above, and estimate the costs of carrying out those measures;
4. Define environmental limiting factors that constrain rehabilitation and indicate about environmental impact of rehabilitation activities.
5. Prepare a report to document the findings and recommendations of the engineering survey.
   a) In coordination with Chemonics (RAMP), discuss with HAVA presidency the need for rehabilitation of different components of the MHIAS (road, drainage and irrigation infrastructure).
   b) For different identified items establish the methodology of rehabilitation; the cost of rehab/repair; and the priority. For different categories and methodology of repair/rehab establish units of measurement and construction prices of the same units.
   c) Pay special attention to those areas of canals and drains that supposedly have been mined and indicate solutions for clearing and their costs.
   d) Define quarries for rock to be blasted. Investigate and locate the quarries that could be used to supply rock for the sites 1), 2) and 3) as described below. The cost of blasting excavation, loading and transport to each site. 1) One quarry has to serve for material to be deposited in Helmand River at the Bogra Intake in order to repair the rivers cross weir. The quarry's capacity should be over 30,000 m3 of quality rock that can be blasted into pieces between 0.5 and 1.5 m3 each. When pieces are loaded on dump trucks and later dumped in the river they should not disintegrate. 2) Another quarry should have a similar capacity for repair of the Helmand River bank and construction of groins in order to re-establish Shamalan Canal where it has been breached by the river. It is understood that UNOPS is currently designing river bank protection works in several locations for the protection of the Shamalan Canal. The Sub-contractor shall coordinate with UNOPS Engineer and HAVA so as not to have any duplication of work by all involved in Shamalan Canal river bank protection works. 3) Much smaller quantities of rock of smaller size are required to fill erosion and scouring trenches and holes associated with S 10 Lateral and Canal works and banks, distributed all over the system.(It is recognized that sound rock is not present nearby and that use has to be made of formations of

Attachment 1 – Volume and Cost Tables

Table A1 – Upper Boghra Cleaning……………………………………………………………………..
Table A2 – Upper Boghra Bank Repair…………………………………………………………………
Table A3 – Upper Boghra Concrete Work……………………………………………………………..
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Table B1 – Shamalan Cleaning…………………………………………………………………………
Table B2 – Shamalan Bank Repair……………………………………………………………………..
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Table C1 – Nad-i-Ali Cleaning…………………………………………………………………………..
Table C2 – Nad-i-Ali Bank Repair………………………………………………………………………
Table C3 – Nad-i-Ali Concrete Work…………………………………………………………………..
Table C4 – Nad-i-Ali Steel Work………………………………………………………………………..
Table C5 - Nad-i-Ali Roads………………………………………………………………………………

Table D1 – Marja Cleaning………………………………………………………………………………
Table D2 – Marja Bank Repair………………………………………………………………………….
Table D3 – Marja Concrete Work……………………………………………………………………….
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Table E2 – Darweshan Bank Repair……………………………………………………………………
Table E3 – Darweshan Concrete Work…………………………………………………………………
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Table F – Regional Roads ………………………………………………………………………………

Table G – Boghra Canal and Darweshan Canal Diversion Structures ……………………………

selected, well cemented conglomerate in formations of conglomerate which usually are poorly cemented.)

e) Define costs and the time required for the production of blasted rock according to location, distance of transport to destination and size.

f) Define costs of canal and drain cleaning under different working conditions (running or dry canals); with different canal sizes and with different excavation methods (mainly manual or mainly mechanized). Silt and sediment excavated from canals has to be carried across canal banks and canal bank roads and be deposited on the off-side. Small irrigation distribution ditches when present on the off-side of the canal banks have to be left in operational condition and any sizable growth of trees along the canal banks has to be respected.

   It is to be indicated how removal of green matter is going to be accounted for and how volumes of silt and sediment will be measured.

   It is understood that "on farm" canals and drains will be repaired by farmers themselves.

g) Propose itemized cost of repair of canal structures, that is: repair and patching of reinforced concrete; repair of steel by welding and patching; repair of gates by replacement (cast iron gates, (galvanized) steel gates and Armco type gates) and replacement of gate sealing rubbers. For replacement gates and sealing rubbers a list of dealers and manufacturers will be provided by the Subcontractor. If dealers and manufacturers could not be found locally and may require additional time for search in neighboring countries, the additional time needed for this purpose should be requested from Chemonics in a Change Order for the approval of an extension of time in the sub-contract.

h) Provide copies of detailed maps of canals and drains on electronic format. Use can be made of maps available with HAVA, of satellite images which will be made available and other supporting information.

i) During the collection of data, the subcontractor shall coordinate with the Chemonics-RAMP Chief Engineer or his designee. Upon completion of the data collection phase of the assessment, the Chief Engineer and HAVA president or their designees will review the collected information. In the event that inconsistencies are noted, the Subcontractor may be requested by Chemonics to verify the information, and if necessary revise and resubmit the information prior to completion of the sub-contract.

j) Quality of work and work to be proposed shall be according normally accepted standards of good workmanship, relevant Afghani standards and internationally recognized and relevant standards like those of USDA-NRCS, USDI-BR, ASTM, ACI and AASHO.

3. Assessment of Rehabilitation Needs in the Five MHIAS Subsystems

This section describes the nature of the rehabilitation work needed in the MHIAS and presents our estimates of what the costs will be to carry out that work. Rehabilitation needs range from major engineering works on large structures such as the Boghra and Darweshan diversions, to resurfacing, grading and providing proper drainage for key roads such as the one that links Lashkar Gah to the Kandahar highway, to cleaning out silt from canals and drains, to repairing or replacing small parts on water control structures. Some of the rehabilitation measures we describe will benefit the people living in individual subsystems; some will benefit people throughout the MHIAS.

Tables 1 and 2 summarize the costs of carrying out the rehabilitation measures DAI identified in its assessment[2]. Table 1 presents the cost estimates for the three major rehabilitation projects on the regional roads and the Boghra and Darweshan diversion structures. Table 2 presents aggregate cost estimates for the different categories of rehabilitation work for each of the five MHIAS subsystems. **We estimate the total cost for rehabilitating the irrigation, drainage and road networks in the MHIAS will be $26,020,000.**

Name of Rehabilitation Activity	Rehabilitation Requirement	Estimated Cost
Regional Roads	Resurface and grade 183km of roads and provide proper drainage. Re-build 2 bridges and 21 culverts.	2,624,000
Boghra Canal Diversion Structure	Build 800m long dike requiring 14,400m³ earth excavation and 43,200 m³ gabions	2,178,000
Darweshan Canal Diversion Structure	Build 1,100m long dike requiring 11,000m³ earth excavation and 44,000 m³ gabions	2,208,000
Total		**7,010,000**

Table 1 - Cost Estimates for Major Rehabilitation Measures

	Estimated Cost ($)					
Subsystem	**Cleaning**	**Bank Repair**	**Concrete Work**	**Steel Work**	**Roads**	**Totals**
Upper Boghra	840,000	1,486,000	109,000	10,000	810,000	**3,255,000**
Shamalan	1,953,000	2,117,000	61,000	38,000	1,890,000	**6,059,000**
Nad-i-Ali	317,000	926,000	12,000	18,000	1,354,000	**2,627,000**
Marja	977,000	424,000	56,000	9,000	1,127,000	**2,593,000**
Darweshan	1,231,000	2,065,000	24,000	25,000	1,131,000	**4,476,000**
Totals	**5,318,000**	**7,018,000**	**262,000**	**100,000**	**6,312,000**	**19,010,000**

Table 2 - Cost Estimates for Subsystem-Specific Rehabilitation Measures

We have structured Section 3 to highlight the rehabilitation measures that will have the broadest impact, presenting our assessment and cost estimates for rehabilitating regional roads and re-building

[2] Minor discrepancies between volume and cost figures presented in the main report and those presented in the tables in Attachment 2 are due to rounding.

diversion structures at the Boghra and Darweshan Canal intakes in separate sections. We describe subsystem-specific rehabilitation requirements and present cost estimates for meeting those requirements in sections dedicated to each of the five MHIAS subsystems individually.

Section 3.1 summarizes our assessment of the condition of the most important roads in the MHIAS and our estimates of the costs to rehabilitate them. These regionally important roads link the five subsystems to each other, to the markets of Lashkar Gah and Girishk, and to the main highway to Kandahar. They are not associated with individual subsystems, but because they carry the most traffic, rehabilitating them will bring the most benefits to the largest number of people.

Section 3.2 describes the urgent requirements for protecting the Boghra Canal diversion and intake from being eroded by the Helmand River. It also includes an estimate of the cost of carrying out the work and an explanation of how we calculated those costs. Even though the Boghra Canal diversion and intake are located in the Upper Boghra subsystem, protecting them will benefit four of the five subsystems in the MHIAS – Upper Boghra, Shamalan, Nad-i-Ali and Marja. For that reason we have presented our needs assessment and cost estimate for this regionally important rehabilitation initiative separate from our needs assessment and cost estimates for measures that will only impact the Upper Boghra subsystem itself.

Though only directly beneficial to the Darweshan subsystem, building a protection dike for the Darweshan diversion and intake will be another major engineering effort. We therefore describe the technical requirements and present the cost estimate for this activity in a separate section - Section 3.7.1.

We describe all the other work needed to rehabilitate irrigation, drainage and road networks in the MHIAS by subsystem, with one section each devoted to measures specific to Upper Boghra (3.3), Shamalan (3.4), Nad-i-Ali (3.5), Marja (3.6) and Darweshan (3.7). For each of the subsystems we present needs assessments for two types of networks – irrigation and drainage networks and road networks. For the irrigation and drainage networks we describe rehabilitation needs and present cost estimates for four different types of work – cleaning and re-shaping canal and drain channels; repairing eroded canal banks; repairing or rebuilding concrete structures; and repairing or replacing steel structures. The final section under each subsystem summarizes requirements and cost estimates for rehabilitating subsystem-specific roads. The volume and cost tables in Attachment 1 give the details behind the summaries presented in Section 3.

The maps in Attachment 2 show the sections of the silted up canals and drains and eroded banks, the locations of the damaged concrete and steel structures and the sections of defective roads referred to in the text in Section 3 and the tables in Attachment 2. Every rehabilitation site is identified on the maps and in the tables by a unique Point ID number. Point ID numbers prefixed with the letter "A" identify the locations of concrete structures; numbers prefixed with the letter "B" show the locations of steel structures; numbers prefixed with the letter "C" show the beginning and end points of canal and drain sections that need cleaning; and numbers prefixed with the letter "D" identify the locations of sections of eroded canal banks. Point IDs for road sections are strictly numeric – they do not have a prefix letter[3].

3.1. Regional Roads

[3] In some cases we have assigned more than one Point ID number to an individual site in the tables and on the maps. For example, the Boghra intake is identified by 8 Point IDs (B1-B8) on Map 5 and in Table A4. Where a site has more than one Point ID it means either that more than one type of work is needed at that point on a particular canal or drain, or that repairs are needed on both the left and right banks at that one site. Refer to the tables in Attachment 1 to determine the nature and cost of the different types of work.

For the road networks we present cost estimates for rehabilitation based on the length and width of each section of road, the structures that need repairing along each section, and the distance over which material for resurfacing must be transported to the site. We identified three main classes of roads – roads that run cross-country and are not associated with a specific canal or drain (desert roads); roads that run alongside a primary canal (canal roads) and roads that run alongside lateral canals and drains (lateral and drain roads). Map 2 shows the three classes of roads in the MHIAS. Most of the roads we assessed are associated with individual subsystems, and we present needs assessments for these roads in the sections for the respective subsystems.

Table 3 lists the roads that are not associated with individual subsystems but that are vitally important to the MHIAS region as a whole. These roads either run between subsystems, or they link irrigated areas within the MHIAS to the settlements and markets of Lashkar Gah and Girishk, or to the main Girishk-Kandahar highway.

Section ID	Description	Length (km)	Estimated Rehabilitation Cost ($)
10	Lashkar Gah to the Girishk-Kandahar road	45.0	1,152,000
11	Lashkar Gah to Girishk	31.1	358,200
15	Lashkar Gah to Marja	26.9	318,500
12	Marja to Darweshan	34.3	391,800
3	Boghra Canal road from Nad-i-Ali to Marja	19.3	150,200
17	Nad-i-Ali to the Lashkar Gah-Marja road	5.5	54,100
14	Chah Anjir to the Lashkar Gah – Marja road	11.4	155,600
78	Shamalan connector road	9.7	44,000
Totals		**183.2**	**2,624,400**

Table 3 - Estimated Rehabilitation Costs for Regional Roads in the MHIAS

Map 3 in Attachment 2 shows the routes of the roads listed above, and Table F in Attachment 1 gives details of the rehabilitation requirements and cost estimates.

The total length of the eight sections of regional roads is 183km. Along those sections we identified 1 suspension bridge, 1 concrete slab bridge and 21 culverts that need re-building. **We estimate it will cost $2,624,400 to resurface and grade the roads, provide proper drainage, and carry out the necessary repairs to the bridges and culverts.**

3.2. Diversion Structure for the Boghra Canal Intake

[***Tawab to write]
The primary diversion and intake for the Boghra Canal is identified as Point C1 on Map 4 in Attachment 2. Table G in Attachment 1 describes the volume of work and gives details of the cost estimate for carrying out the work. **We estimate it will cost $2,178,000 to build the diversion structure for the Boghra intake.**

3.3. Upper Boghra

We estimate the total cost of rehabilitating the irrigation, drainage and road networks in the Upper Boghra subsystem will be $4,736,000

Volume and cost estimates for rehabilitation work in Upper Boghra are presented in Tables A1 through A5 in Attachment 1. Map 1 in Attachment 2 shows the extent of the Upper Boghra subsystem. Map 4 shows the routes of the canals and drains and the sections of those canals and drains that need cleaning. Map 5 shows the locations of concrete and steel structures that need rehabilitating, and sections of eroded banks that need repairing. Map 6 shows the routes of the roads we have identified for resurfacing, grading and structural repairs.

The Upper Boghra sub-system is comprised of all the land irrigated by the upper sections of the Boghra Canal, from its intake on the Helmand River as far as the Shamalan Canal intake at Station 31+580. The command area of the Upper Boghra is approximately 9,500 hectares, home to some 4,600 families or 27,600 people. The irrigated land is bounded by the canal to the north and the Helmand River to the south. Table 4 lists the canals and drains DAI surveyed in Upper Boghra for this needs assessment.

Main Canals	Drains
Boghra Canal (31.58km)	Adam Khan Drain
	Girishk Bazar Drain
	Girishk Drain
	Babaji Drain 1
	Babaji Drain 2
	Babaji Drain 2, Spur 1
	Babaji Drain 2, Spur 2
	Babaji Malgir Drain
	Spillway 10+317

Table 4 - Canal and Drains for Rehabilitating in Upper Boghra

3.3.1. Irrigation and Drainage Network Rehabilitation Needs

The most important irrigation structures in the Upper Boghra sub-system are the primary diversion and intake on the Helmand River, the 31.58km length of the upper section of the Boghra Canal and the structures that control the flow of water in and from the main canal. In terms of rehabilitation needs for this subsystem, the main requirements are for structural repairs to the Boghra Canal's primary diversion and intake, cleaning silt and vegetation out of canals and drains, repairing eroded sections of canal banks, repairing or rebuilding concrete structures, and repairing or replacing gates and associated lift mechanisms.

Cleaning – The Upper Boghra Canal and the drains in the Upper Boghra subsystem are clogged with silt and vegetation. The largest volumes of silt are in the uppermost section of the main canal between its intake on the Helmand River at Point C1 to Point C2 (Map 4). This 4.5km section of canal is 16 meters wide and the silt deposits average 1.5 meters deep. The volume of silt that must be removed is therefore 108,000m³. Downstream from Point C2 the canal narrows to 14 meters wide and the depth of silt deposited on its bed averages only about 1 meter. The total accumulation for the 31km section from Point C2 down to Point C7 is approximately 435,000m³. The total cost of de-silting the upper 35.8km of the Boghra Canal and returning it to its design carrying capacity will be approximately $543,000. This cost estimate is based on using heavy equipment as the most efficient and cost-effective method of cleaning out wide and deep sections of canal.

The drains in the Upper Boghra subsystem also need cleaning. The 6 drains, 2 spurs and 1 spillway listed in Table 4 total some 24km in length and are currently clogged with more than 182,000m^3 of silt. The drains and spurs are an average of only 5 meters wide and 4.5 meters deep. Manual laborers could clean them out generating approximately 98,000 labor days of work at a cost of $246,000. The spillway however is 20 meters wide and 9 meters deep, and cleaning it with heavy equipment would be more efficient and cost effective. This would cost approximately $52,000.

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We estimate the cost of cleaning the canals and drains in the Upper Boghra subsystem will be $841,000.

Bank Repairs – The banks of the Upper Boghra Canal are eroded in many places. Erosion is particularly severe immediately downstream of drops and other water control structures. We identified 36 sections of canal bank that need repairing with back-fill and, for particularly vulnerable sections downstream of control structures, with riprap. These sections are identified on Map 5 as Points D1 to 36. Volume and cost details are given in Table A2. The most seriously eroded sections are downstream of D17 (left bank) and D18 (right bank) where 1,500 meters of canal bank needs repairing. Other major sections of erosion are downstream of Points D5, D6, D15, D16 and D34.

Spillway 10+317 is an important flood control structure that is intended to prevent the Boghra Canal over-filling. Seven hundred meters of the right bank (D442) and 100 meters of the left bank (D443) downstream from its junction with the canal are severely eroded and need filling and riprapping.

In total approximately 8km of bank need repairing on the upper sections of the Boghra Canal and on Spillway 10+317. **We estimate the cost of carrying out these repairs will be $1,486,000.**

Concrete Work – Repairs to concrete structures are needed at the 6 sites identified on Map 5 as Points A1 to A7. A1 is a weir that has been eroded and needs re-building. A2 and A3 is a wash culvert that carries flood waters under the canal, A4, A5 and A6 are flumes that carry water in the Boghra Canal across low-lying ground, and A7 is a siphon that carries water in the Boghra Canal under the Hapachaq Wash. **We estimate the cost of re-building these six structures will be $109,000.**

Steel Work – Repairs to steel gates are needed at 5 sites along the Upper Boghra Canal in addition to the repairs needed to the gates at the primary diversion and intake described above. The 5 sites are identified on Map 5 by Point IDs B9 through B16. The gates at these 5 locations all need some form of repair, in most cases requiring replacement parts such as cabling, steel rods, rubber washers and iron netting. The Shamalan intake gate at B15/16 needs a complete new lift mechanism. **We estimate the cost of carrying out the repairs to these steel structures will be $5,000.**

3.3.2. Road Network Rehabilitation Needs

Map 6 shows the sections of road in the Upper Boghra subsystem that need rehabilitating and Table A5 describes the nature of the work and presents an estimate of the costs of re-surfacing and grading the roads and carrying out necessary structural repairs. The sections that need rehabilitating include the 30km of class CA road that runs along the northern bank of the Boghra Canal (Section 1) and 3 sections of class DD road that run cross-country for another 30km. The structures that need repairing on these sections of road include 3 causeways and 8 culverts. **We estimate the cost of rehabilitating these roads will be $810,000.**

3.4. Shamalan

We estimate the total cost of rehabilitating the irrigation, drainage and road networks in the Shamalan subsystem will be $6,058,600*.**

Volume and cost estimates for rehabilitation work in Shamalan are presented in Tables B1 through B5 in Attachment 1. Map 1 in Attachment 2 shows the extent of the Shamalan subsystem. Map 7 shows the routes of the canals and drains and the sections of those canals and drains that need cleaning. Map 8 shows the locations of concrete and steel structures that need rehabilitating, and sections of eroded banks that need repairing. Map 9 shows the routes of the roads we have identified for resurfacing, grading and structural repairs.

The Shamalan subsystem irrigates approximately 23,500 hectares of land. Table 5 lists the canals, laterals and drains DAI has identified for rehabilitation in the Shamalan subsystem.

Main Canals	Lateral Canals	Drains
Old Shamalan Canal	Lateral Canal 28	Drain E
New Shamalan Canal	Lateral Canal 42	Basharan Drain
S10 Lateral	Lateral Canal 48	Drain C
		Drain K
		Drain F
		Drain F1
		Spur F1
		Spur F2
		Mangalzai Drain
		Drain B
		Drain B, Spur
		Drain B, Spur 2
		Drain D
		Drain H
		Drain H, Spur
		Surkh Duzak Drain
		Spillway 3
		Drain A
		Chai Anjier Drain
		Washair Drain
		Washair Drain, Spur

Table 5 - Canals and Drains for Rehabilitating in Shamalan

3.4.1. Irrigation and Drainage Network Rehabilitation Needs

The Shamalan subsystem's main arteries are the Old Shamalan Canal, the New Shamalan Canal and the S10 Lateral Canal. The Old Shamalan Canal is the primary canal. It draws water from Station 31+580 on the Boghra Canal and runs south for some 64km. The S10 Lateral was built in the mid-1970s to irrigate land to the west of the land irrigated by the Old Shamalan Canal. It branches off the Old Shamalan Canal at Station 10+317. In 1996 the Helmand River breached the banks of the Old Shamalan Canal along 2 sections, so the New Shamalan Canal was built south of the breaches to draw water from the river and continue irrigating land in the middle and lower sections of the subsystem.

The current situation is that all the water carried from the Old Shamalan intake on the Boghra Canal is now diverted into the S10 Lateral Canal. There is no water in the Old Shamalan Canal between the S10 Lateral branch and the Point at which the New Shamalan Canal joins it at Station 25. All of the land between these two Points is currently being irrigated by water from the S10 Lateral Canal.

As in Upper Boghra, silted-up canals, eroded canal banks, and damaged or destroyed concrete and steel structures are significant problems in Shamalan. But poor drainage is a bigger problem that has, over the past 25 years, progressively depleted the productivity of the soils in the area through water-logging and salinization. Many of the drains in Shamalan are almost completely filled with sediment, and cleaning them out should be a top priority.

Cleaning – Table 6 summarizes the requirements for cleaning out the canals and drains in Shamalan. Details of these volumes and cost estimates are given in Table B1 in Attachment 1.

Canal or Drain	Length (m)	Volume of Silt (m^3)	Estimated Cost ($)
Old Shamalan Canal	64,320	360,000	360,000
S10 Lateral Canal	37,410	290,300	545,600
Drain E	9,910	66,900	66,900
Basharan Drain	1,750	6,300	14,100
Drain C	6,790	33,200	33,200
Drain K	12,090	84,500	84,500
Drain F1	2,900	37,100	92,800
Drain F	13,220	100,900	100,900
Mangalzai Drain	6,900	33,600	33,600
Spur 2 of Drain B	5,900	13,500	13,500
Spur of Drain F	1,200	3,600	6,800
Drain D	4,940	13,000	24,500
Drains 1, 2 and 3	3,630	14,500	27,200
Spur of Drain B	3,460	16,200	30,500
Drain H	3,810	15,700	29,500
Spur of Drain H	580	2,600	4,900
Surkh Duzak Drain	14,620	74,800	140,600
Spillway 3	1,840	16,600	31,100
Drain A	20,620	109,500	109,500
Drain B	9,970	71,600	71,600
Chai Anjier Drain	3,800	14,700	27,600
Washair Drain	2,830	38,000	71,400
Spur of Washair Drain	1,680	17,400	32,700
Totals	**234,170**	**1,434,500**	**1,953,000**

Table 6 - Volumes and Cost Estimates for Cleaning the Canals and Drains in the Shamalan Subsystem

For the cleaning work on the larger and more important channels we estimated the cost on the basis of using heavy equipment. These include the Old Shamalan Canal and Drains A, B, C, E, F and K. For cleaning the smaller channels we estimated the cost on the basis of using manual labor. **We estimate the cost of cleaning the canals and drains in the Shamalan subsystem will be $1,953,000.**

Bank Repairs – Bank erosion in the Shamalan subsystem is only a problem in the main canals which frequently carry large volumes of water at high velocity. The problem is particularly acute downstream of water control structures which constrict flow, thereby increasing the velocity and erosive power of the water in the canal. The problem has been exacerbated in recent years by over-filling of the S10 Lateral and New Shamalan Canals to compensate for the reduced capacity of the Old Shamalan Canal since it was breached by the Helmand River in 1996. Putting more water in these two canals than they were originally designed to carry again increases the velocity and erosive powers of the water. As shown on Map 8, examples of the most severe sections of erosion are at Points D133, D153, and D154 on the Old Shamalan Canal, Points D217, D232 and D 274 on the S10 Lateral Canal, and along numerous sections of the New Shamalan Canal. Table 7 presents the estimated costs of repairing eroded sections of canal bank in the Shamalan subsystem.

Name of Canal	Length of Eroded Sections (m)	Estimated Cost ($)
Old Shamalan Canal	5,000	745,500
S10 Lateral Canal	5,900	462,900
New Shamalan Canal	3,500	908,600
Totals	**14,400**	**2,117,000**

Table 7 - Summary of Cost Estimates for Repairing Eroded Banks in the Shamalan Subsystem

Table B2 in Attachment 2 gives detailed volume and cost estimates for repairing all the eroded sections of the Old Shamalan, S10 Lateral and New Shamalan Canals. **We estimate the cost of carrying out these repairs will be $2,117,000.**

Concrete Work – The concrete structures that need repairing or re-building in Shamalan are on the Old Shamalan Canal and the S10 Lateral Canal. The types of structures that need rehabilitating include drop structure walls, bridge piers, bridge slabs and flumes. The most serious damage is to structures at Points A23 (drop structure), A24 (bridge slab), A30 (bridge) and A34 (bridge slab) on Map 8 in Attachment 2. Volume and cost estimates for repairs to concrete structures at 33 sites are given in Table B3 in Attachment 1.**We estimate the cost of rehabilitating these structures will be $60,800.**

Steel Work – Steel structures on the 3 main canals and on lateral canals 28, 42 and 48 in Shamalan need repairing. Map 8 in Attachment 2 shows the locations of the structures on these 6 canals, and Table B4 in Attachment 1 gives cost estimates for repairing them. The nature of the work that needs to be done on gates and other steel structures is wide-ranging and includes replacing wheels, bushings and rubber seals, replacing lifting mechanisms, installing cables, building frames and in some cases installing complete new gate structures. Most of the steel structures are small and repairs will be inexpensive relative to the costs of the cleaning and bank repair work. **We estimate the cost of rehabilitating the steel structures in Shamalan will be $37,900.**

3.4.2. Road Network Rehabilitation Needs

Map 9 in Attachment 2 shows the sections of road in the Shamalan subsystem that need rehabilitating. Table B5 in Attachment 1 describes the nature of the work and presents an estimate of the costs of rehabilitating each section of road and repairing structures along those sections. The roads that run along the lengths of the Old Shamalan Canal and the S10 Lateral Canal are the most important roads in the subsystem. These are identified as Sections 6, 7 and 8 on Map 9. The combined length of these 3 roads is 94km and we estimate the cost of resurfacing and grading them and repairing the culverts and causeways on them will be $996,500. This accounts for more than 50% of the total cost we estimate for rehabilitating the roads in Shamalan.

The other roads in the system are associated with lateral canals and drains, or they are cross-country desert roads (Sections 16 and 19 on Map 9). The combined length of these secondary roads is 149km. To resurface and grade them and to repair the culverts, foot bridges and other structures on them will cost approximately $893,400.

We estimate the cost of rehabilitating the roads and associated structures in Shamalan will be $1,889,900.

3.5. Nad-i-Ali

We estimate the total cost for rehabilitating the irrigation, drainage and road networks in the Nad-i-Ali subsystem will be $2,627,000*.**

Volume and cost estimates for rehabilitation work in Nad-i-Ali are presented in Tables C1 through C5 in Attachment 1. Map 1 in Attachment 2 shows the extent of the Nad-i-Ali subsystem. Map 10 shows the routes of the canals and drains and the sections of those canals and drains that need cleaning. Map 11 shows the locations of concrete and steel structures that need rehabilitating, and sections of eroded banks that need repairing. Map 12 shows the routes of the roads we have identified for resurfacing, grading and structural repairs in the Nad-i-Ali subsystem.

The Nad-i-Ali subsystem draws water from the Boghra Canal between Station 40+000 (Point C8 on Map 10) and Station 56+000 (Point C11). The subsystem irrigates approximately 12,400 hectares of land and supports approximately 6,400 families or 38,400 people. Most of the canals and drains in Nad-i-Ali are in relatively good condition. The farmers have been cleaning most of the lateral canals on a regular basis and DAI cleaned out all the drains except for Drains I and J in 2003. The smaller tertiary canals or sub-laterals are also in relatively good condition because the farmers and *mirabs* have regularly maintained them. Table 8 lists the canals and drains that still need cleaning and structural repair work.

Main Canals	Lateral Canals	Drains
Boghra Canal (31+580 to 58+000)	Lateral 40	Drain I
	Lateral 43	Drain J
	Lateral 44	
	Lateral 56	

Table 8 - Canals and Drains for Rehabilitating in Nad-i-Ali

3.5.1. Irrigation and Drainage Network Rehabilitation Needs

The main requirements for rehabilitation in Nad-i-Ali are cleaning the Boghra Canal and Drains I and J, and repairing eroded banks, concrete and steel structures on the Boghra Canal and the 4 lateral canals listed in Table 8

Cleaning – Table 9 summarizes the requirements for cleaning out the canals and drains in Nad-i-Ali. Details of these volumes and costs are given in Table C1 in Attachment 1.

Canal or Drain	Length (m)	Volume of Silt (m^3)	Estimated Cost ($)
Boghra Canal	24,320	259,800	259,800
Drain I	3,160	22,100	41,600
Drain J	1,800	8,100	15,200
Totals	**29,280**	**290,000**	**316,600**

Table 9 - Volume and Cost Estimates for Cleaning the Canals and Drains in the Nad-i-Ali Subsystem

The cost estimate for cleaning the Nad-i-Ali section of the Boghra Canal is based on the use of heavy equipment such as draglines. This is the most efficient and cost effective method because these sections of the Boghra Canal are wide (8-12 meters) and deep (average 7 meters). The cost estimate for cleaning the narrower and shallower Drains I and J are based on the use of manual labor. **We estimate the cost of cleaning the canal and drains in the Nad-i-Ali subsystem will be $316,000.**

Bank Repairs – Numerous sections of the banks of the Boghra Canal and Lateral Canals 40, 43, 44 and 56 in Nad-i-Ali are eroded. Again, erosion is particularly severe downstream of water drops and other control structures, particularly on the Boghra Canal itself. Table 10 presents estimated costs for repairing eroded banks on the sections of the Boghra Canal and lateral canals in Nad-i-Ali.

Name of Canal	Length of Eroded Sections (m)	Estimated Cost ($)
Boghra Canal	4,400	723,100
Lateral Canal #40	700	78,200
Lateral Canal #43	500	29,500
Lateral Canal #44	800	82,400
Lateral Canal #56	150	12,800
Totals	**6,550**	**926,000**

Table 10 - Summary of Cost Estimates for Repairing Eroded Banks in the Nad-i-Ali Subsystem

The most severely eroded sections are downstream of drop structures at Points D47, D48 and D64 on Map 11 in Attachment 2. Table C2 in Attachment 1 gives detailed volume and cost estimates for repairing all the eroded sections of the canal banks in Nad-i-Ali. **We estimate the cost of repairing those sections will be $926,000.**

Concrete Work – The concrete structures that need repairing on the sections of the Boghra Canal and the lateral canals in Nad-i-Ali include bridges, drop structures and protection walls. The repairs will be relatively inexpensive but they are important for efficient water control and management. The single most expensive requirement is to repair a drop shoot protection wall at Point A82 on Lateral Canal #40 (Map 11). Volume and cost estimates for repairs to concrete structures at 34 sites in Nad-i-Ali are given in Table C3 in Attachment 1. **We estimate the cost of rehabilitating these structures will be $11,500.**

Steel Work – In Nad-i-Ali, only the Boghra Canal and Lateral Canal #40 have steel structures that need repairing. Most of the work that needs doing is to repair spillway, siphon and turnout gates on the Boghra Canal. The gate at Point B20 on Map 11 needs a new lifting mechanism, and the gates at Points B21, B24 and B25 are missing and need replacing. Repairs to the other 10 gates that need work are relatively minor and include replacing cables, connector clips, grease fittings and shafts. Table C4 in Attachment 1 describes the nature of the repairs needed at each site and gives cost estimates for carrying out those repairs. **We estimate the cost of rehabilitating the steel structures in Nad-i-Ali will be 18,400.**

3.5.2. Road Network Rehabilitation Needs

Map 12 in Attachment 2 shows the sections of roads in the Nad-i-Ali subsystem that need rehabilitating. Table C5 in Attachment 1 describes the nature of the work required and presents an estimate of the costs of rehabilitating each section of road and repairing culverts and footbridges on them. The most important roads in Nad-i-Ali are the roads that run along the north bank of the

Boghra Canal (Section 2 on Map 12), connect the Boghra Canal road to the Lashkar Gah – Marja road (Section 13), and run alongside Lateral Canals #43 (Section 29), #44 (Section 28) and #56 (Section 27). The combined length of these 5 sections of road is 88km and we estimate the cost of resurfacing and grading them and repairing the structures on them will be $855,300. This represents 63% of the total estimated cost for rehabilitating all the roads in Nad-i-Ali. The other roads in the subsystem follow lateral canals and drains for a total length of 80km. To repair these roads and culverts and footbridges associated with them would cost approximately $499,200.

We estimate the total cost of rehabilitating the roads and the structures associated with them in Nad-i-Ali will be $1,354,500.

3.6. Marja

We estimate the total cost for rehabilitating the irrigation, drainage and road networks in the Marja subsystem will be $2,593,000*.**

Volume and cost estimates for rehabilitation work in Marja are presented in Tables D1 through D5 in Attachment 1. Map 1 in Attachment 2 shows the extent of the Marja subsystem. Map 13 shows the routes of the canals and drains and the sections of those canals and drains that need cleaning. Map 14 shows the locations of concrete and steel structures that need rehabilitating, and sections of eroded banks that need repairing. Map 15 shows the routes of the roads we have identified for resurfacing, grading and structural repairs in the Marja subsystem.

The Marja subsystem irrigates approximately 14,700 hectares of land. Some 14,300 families or 85,800 people live there. Marja is one of the least productive areas in the MHIAS because it has relatively poor soils and it has suffered most severely from water shortages in recent years because of drought and because Marja is at the tail end of the Boghra Canal. Table 11 lists the canals and drains DAI has identified for rehabilitation in the Marja subsystem.

Main Canals	Lateral Canals	Drains
Boghra Canal (58+000 to 91+000)	Lateral 70	Drain A
	Lateral 14	Drain B
		Drain C
		Drain D
		Drain E
		Drain G
		Drain G Spur
		Drain H
		Drain I
		Drain L
		Drain M
		Drain V
		Drain W
		Drain W Spur

Table 11 - Canals and Drains for Rehabilitating in Marja

3.6.1. Irrigation and Drainage Network Rehabilitation Needs

The Marja subsystem draws its water from the Boghra Canal, starting at Station 70+000 (Point D82 on Map 14). At Station 75+000 the Boghra Canal divides into the Sistani Branch and the West Boghra Branch Canals. Lateral Canals off the West Branch, including Lateral Canal #14

(Point D385 on Map 14), also deliver water to Marja. The sections of the main Boghra Canal and West Branch of the Boghra Canal that serve Marja are silted up and need cleaning. The sections of drains listed in Table 11 also need cleaning. The lateral canals, on the other hand, have been regularly cleaned by the farmers and *mirabs* and do not need additional cleaning at this time. All three canals have eroded banks that need to be repaired, but only the Boghra Canal, its West Branch and Lateral Canal #70 have damaged concrete structures, and only the Boghra Canal and its West Branch have steel structures that need work.

Cleaning – The Marja drainage network is comprised of many more drains than those listed in Table 11 but DAI cleaned 44% of the network in 2003. The drains listed in Table 11 are only those that remain to be cleaned. Table 12 is a complete inventory of the drains in Marja, and it indicates which sections of drain DAI has already cleaned and which remain to be done.

Drain	Total Length (m)	Length Cleaned by DAI in 2003 (m)	Length Remaining to be Cleaned (m)	Estimated Cost ($)
A	16,400	0	16,400	187,900
B	12,000	10,180	1,820	11,000
C	17,450	0	17,450	83,100
D	10,500	3,080	7,420	55,700
E	11,460	0	11,460	86,000
F	10,500	10,500	0	0
G	12,000	8,880	3,120	20,700
G Spur	830	0	830	3,700
H	3,800	0	3,800	37,300
I	3,270	0	3,270	36,900
J	1,800	1,800	0	0
K	1,800	1,800	0	0
L	2,050	0	2,050	23,100
M	11,000	5,300	5,700	51,300
N	4,300	4,300	0	0
O	3,600	3,600	0	0
P	3,300	3,300	0	0
Q	1,200	1,200	0	0
R	2,600	2,600	0	0
T	1,800	1,800	0	0
U	6,000	6,000	0	0
V	1,850	0	1,850	26,100
W	3,410	0	3,410	38,500
W Spur	2,320	0	2,320	31,200
Totals	**145,240**	**64,340**	**80,900**	**692,500**

Table 12 - Inventory and Cleaning Status of Drains in Marja

The Boghra Canal and its Western Branch also needs cleaning along the sections that feed the Marja subsystem. We estimate the 31km section between Points C12 and C13 on Map 19 and between C13 and C15 on Map 13 will cost $284,800 to clean.

We estimate the cost of cleaning the Boghra Canal, its western branch and the remaining drains in Marja will be $977,300.

Bank Repairs – Erosion is a problem on the Marja sections of the Boghra Canal and on Lateral Canals #14 and #70. Again erosion is most severe downstream of water drops and other water

control structures. Table 13 summarizes the lengths of eroded sections and the estimated costs for repairing those sections on the 3 canals.

Name of Canal	Length of Eroded Sections (m)	Estimated Cost ($)
Boghra Canal	1,800	273,300
Lateral Canal #14	120	14,500
Lateral Canal #70	700	136,000
Totals	**2,620**	**423,800**

Table 13 - Summary of Cost Estimates for Repairing Eroded Banks in the Marja Subsystem

Two of the most severely eroded sections of canal bank in Marja are downstream of the intake for Lateral Canal #70 (Point D349 and D350 on Map 14) and downstream of a drop structure on the Western Branch of the Boghra Canal (Points D87 and D88)[4]. Table D2 in Attachment 1 gives detailed volume and cost estimates for repairing all the eroded sections of canal banks in the Marja subsystem. **We estimate the cost of repairing all the eroded sections of canal banks in Marja will be $423,800.**

Concrete Work – Concrete structures at 17 sites in the Marja subsystem need repairing or re-building. The damaged structures include a siphon and 3 water drops on the Boghra Canal and its Western Branch, and several water drops, bridges and turnouts on Lateral Canal #70. The drop structures at Points A11 and A12 on the Western Branch of the Boghra Canal and the drop structure, turnout and bridge at Point A69 on Lateral Canal #70 are particularly severely damaged. Repairing these structures will account for 76% of the total estimated cost for repairing all damaged concrete structures in Marja. Table D3 in Attachment 1 gives cost estimates for all concrete repair work in Marja. **We estimate the total cost of carrying out these repairs will be $56,100.**

Steel Work – Most of the steel structures in Marja are operable and only a few need repairing or replacing. All the damaged gates are on the Marja sections of the Boghra Canal. The most severe damage is to the spillway gates at Point B27 and the gate at Point B30, both on Map 14. New gates need to be installed at these sites and the gate at Point B30 needs repairs to its frame and a new lifting mechanism. Table D4 describes the nature of the steel work needed in Marja and gives cost estimates for carrying out that work. **We estimate the cost of rehabilitating the steel structures in Marja will be $9,200.**

3.6.2. Road Network Rehabilitation Needs

Map 15 in Attachment 2 shows the sections of road in the Marja subsystem that need rehabilitating. Table D5 in Attachment 1 describes the nature of the work needed and presents estimates of the costs of rehabilitating each section of road and repairing the structures along those sections. The most important roads in Marja run along the Western Branch of the Boghra Canal (Section 4 on Map 15), along Drain F (Section 23) and along Drain A (Section 26). The combined length of these sections of road is 46km. Resurfacing and grading these sections and repairing the structures on them will cost approximately $400,700. Rehabilitating the remaining 126km of lateral and drain roads in the subsystem will cost an additional $726,100. **We estimate the total cost of rehabilitating the roads and associated structures in Marja will be $1,126,800.**

[4] These two sites each have two Point ID numbers because both the left and right banks have been eroded and need repairing. This explains why many other sites have two Point ID numbers on the maps.

3.7. Darweshan

We estimate the total cost for rehabilitating the irrigation, drainage and road networks in the Darweshan subsystem will be $6,975,300*.**

Volume and cost estimates for rehabilitation work in Darweshan are presented in Tables E1 through E5 in Attachment 1. Map 1 in Attachment 2 shows the extent of the Shamalan subsystem. Map 16 shows the routes of the canals and drains and the sections of those canals and drains that need cleaning. Map 17 shows the locations of concrete and steel structures that need rehabilitating, and sections of eroded banks that need repairing. Map 18 shows the routes of the roads we have identified for resurfacing, grading and structural repairs.

Darweshan is the only subsystem in the MHIAS that does not draw water from the Boghra Canal. It has its own diversion and intake on the left bank of the Helmand River approximately 8km north of the Hazarjoft Bridge (Point C16 on Map 16). The Darweshan Canal and its lateral canals irrigate approximately 17,700 hectares of land. Approximately 14,700 families or 61,200 people live in its command area. Table 14 lists the canals, laterals and drains DAI has identified for rehabilitation in the Darweshan subsystem.

Main Canals	Lateral Canals	Drains
Darweshan Canal	Lateral Canal #6	Outlet Drain A
	Lateral Canal #7	Drain A Spur 1
	Lateral Canal #8	Drain A Spur 2
	Lateral Canal #9	Drain A Spur 3
	Lateral Canal #11	Drain A Spur 4
	Lateral Canal #12	Drain A Spur 5
	Lateral Canal #13	Drain A Spur 6
	Lateral Canal #14	Drain A Spur 7
	Lateral Canal #15	Drain A Spur 8
	Lateral Canal #16	Drain A Spur 9
	Lateral Canal #17	Drain A Spur 10
	Lateral Canal #18	Drain A Spur 11
		Drain A Spur 12
		Drain A Spur 13
		Drain A Spur 14
		Drain A Spur 15
		Drain A Spur 16
		Drain A Spur 17
		Drain A Spur 18
		Drain A Spur 19
		Drain A Spur 20
		Drain A Spur 21
		Drain A Spur 22
		Drain A Spur 23
		Drain A Spur 24
		Drain B
		Drain B, Spur
		Drain C (Zanjier Drain)
		Drain D

Table 14 - Canals and Drains for Rehabilitating in Darweshan

The rehabilitation needs of the Darweshan subsystem include urgent reconstruction work to protect the primary diversion weir and intake structures from river erosion, cleaning sediment out of the main canal, main drains and spurs, filling in eroded sections of banks on the main canal, re-building a drop structure which has been totally destroyed at Station 32+250, and repairing or replacing steel gates and associated lifting mechanisms on the main canal and the lateral canals.

3.7.1. Diversion Structure for the Darweshan Canal Intake

The most urgent rehabilitation need in Darweshan is to build a diversion structure to protect the primary intake and upper sections of the canal's banks against river erosion. Table G in Attachment 1 describes the volume of work and gives details of the cost estimate for carrying out the work The Darweshan intake is located at Point C16 on Map 16 in Attachment 2.

A 50-meter section of the right bank of the diversion dike, extending from the sheet piling and concrete weir, has been breached. A major flood in the future could permanently divert the Helmand River towards the right bank and away from the intake. A second channel has already opened up on the right side of the river and this is already reducing the amount of water flowing into the Darweshan Canal. The HAVA Operations and Maintenance Department has taken the temporary measure of laying sand bags along the top of the diversion weir to raise the water in the river to the level needed for it to flow into the Darweshan intake. Erosion caused by the river is another problem that needs to be addressed near the intake. The canal bank is currently protected by gabions recently installed by MCI.

We estimate it will cost $2,208,000 to build the protection dike for the Darweshan diversion and intake.

3.7.2. Irrigation and Drainage Network Rehabilitation Needs

This section describes other work required to rehabilitate Darweshan's irrigation and drainage network in addition to the work described above for the protection dike.

Cleaning – Table 15 summarizes the cleaning requirements for the entire subsystem.
The bulk of the cleaning work required in Darweshan is on the main Darweshan Canal, Drain A and the numerous spurs of Drain A.

Canal or Drain	Length (m)	Volume of Silt (m^3)	Estimated Cost ($)
Darweshan Canal	51,200	250,700	250,700
Spur 1 Drain A	5,000	30,000	56,400
Drain A	32,800	262,400	262,400
Spur 1 Drain B	3,800	22,600	42,400
Drain C (Zanjier)	10,300	82,400	82,400
Drain D	13,100	77,700	77,700
Lateral Canal #6	3,200	10,800	20,200
Spurs of Drain A	37,400	197,400	371,000
Drain B	6,300	50,200	50,200
Spur Drain B	2,200	17,500	17,500
Totals	**165,300**	**1,001,700**	**1,230,900**

Table 15 - Volumes and Cost Estimates for Cleaning the Canals and Drains in the Darweshan Subsystem

Table E1 in Attachment 1 presents details of these volumes and cost estimates, and the various canal and drain sections for cleaning are shown on Map 16 in Attachment 2. Cost estimates for cleaning deep and wide sections of the main canal, Drain A, Drain B, Drain C and Drain D are based on the use of draglines. For the shallower and narrower spurs we estimate the cost on the basis of using manual labor. **We estimate the total cost of cleaning the canals and drains in Darweshan will be $1,230,900.**

Bank Repairs – Erosion is only a serious problem on the banks of the main Darweshan Canal. Again the most severe erosion occurs immediately downstream of drop structures and other water control structures. Examples of the most severe sections of erosion are at Points D91, D92, D111, and D112 on Map 17 in Attachment 2. The total length of eroded banks on the Darweshan Canal is approximately 4km and we estimate the total volume of fill, filter and riprap material needed to repair those sections will be 308,000m³. Table E2 in Attachment 1 gives full volume and cost estimates for all eroded sections of bank in the Darweshan subsystem. **We estimate the cost of repairing all these sections will be $2,064,600.**

Concrete Work – There are few concrete structures in the Darweshan subsystem. The only requirement for major repair is to the drop structure at Station 32+250 (Point A14 on Map 17. The drop structure is completely destroyed and needs re-building. **We estimate the cost of rebuilding the structure will be $24,300.**

Steel Work – Steel gates, lifting mechanisms and fences need repairing at 12 sites on the Darweshan Canal (see Map 17 in Attachment 2). Most of the steel structures that need repairing are at turnouts from the main canal to the lateral canals in the subsystem. The most common requirements are for new gates and gate frames, lifting mechanisms or parts for lifting mechanisms, cabling, steel grating and fencing. Table E4 in Attachment 1 describes the work that needs to be done at the 12 sites, and it gives cost estimates for carrying out the work at each site. **We estimate the cost of rehabilitating the steel structures in Darweshan will be $24,800.**

3.7.3. Road Network Rehabilitation Needs

Map 18 in Attachment 2 shows the sections of roads in the Darweshan subsystem that need rehabilitating. Table E5 in Attachment 1 describes the nature of the work required and presents cost estimates for rehabilitating each section of road and repairing the structures associated with those sections. The road network in Darweshan is not particularly well developed, but improving a few key routes would greatly increase mobility within the subsystem and access to sources of inputs and markets outside it.

The road that runs for 52km along the length of the Darweshan Canal is the main transportation route in the subsystem. It is identified as Section 5 on Map 18. Not only is this road important for moving people and goods around within the subsystem, but it also links Darweshan to roads to the Shamalan and Marja subsystems, and to the regional roads that lead to the markets of Lashkar Gah and Girishk. We estimate it will cost $591,700 to resurface and grade this key road.

The road identified as Section 54 on Map 18 is another key artery in the Darweshan subsystem. This road runs along the entire 35km length of Drain A, and it is the principal route by which people living in eastern parts of the subsystem gain access to markets within Darweshan and beyond. We estimate it will cost $230,200 to rehabilitate this road.

The cost of rehabilitating Section 5 and Section 54 represents approximately 73% of the total cost we estimate for road rehabilitation in Darweshan.

We estimate the cost of rehabilitating the roads and associated structures in the Darweshan subsystem will be $1,130,700.

4. Other Irrigated Areas in the MHIAS

In several places the area irrigated and farmed in the mid-Helmand region has expanded beyond the area for which the system was originally designed and built. These "out-of-project" areas include Nad-i-Ali Boghra, Marja Boghra, Sistani, Sheen Gazak and Trikhnawar. Together these five expansion zones occupy an area of some 16,300 hectares of land. Most of the farmers on this land take water either directly from the Boghra and Shamalan Canals or use drain water from the Marja, Nad-i-Ali and Shamalan subsystems. Though agriculture here is not as intensive as it is on the land served by the five formal sub-systems, it does have significant implications for irrigation and drainage. Most important among these are additional demands on the region's limited water resources, degradation of soil quality through the recycling of drain water, and the growing of illicit crops.

Whilst DAI did not formally survey irrigation infrastructure in the expansion areas as part of this assessment, in the following sections we present some general observations and describe important water management issues. The detailed hydrological, agricultural and soil and water quality studies needed to recommend courses of action to address the issues were beyond the scope of this needs assessment.

Nad-i-Ali Boghra – Approximately 1,287 hectares of poorer quality land to the south of the Boghra Canal, from the Old Shamalan Canal intake to the beginning of Nad-i-Ali Area, was not included in the land development of the Helmand Valley Project at the beginning. However, several turnout structures from the Boghra Canal were provided for irrigation and agricultural development at a later time. Gradually, this area has been settled by farmers and is currently being cultivated. It is necessary to survey this area for irrigation improvement and drainage and farm road construction. Lack of drains will cause water logging and salinity of the soils and result in the abandonment of these lands in the future.

Marja Boghra – Approximately 7,500 hectares of poorer quality land to the south of the Boghra Canal, from the end of Nad-i-Ali to the beginning of Marja subsystem, was not included in the land development of the Helmand Valley Project at the beginning. As in Nad-i-Ali Boghra, HAVA has, over the years, provided several turnout structures from the Boghra Canal for irrigation and agricultural development. The Marja Boghra area has also been settled by farmers and is currently being cultivated quite intensively. Lack of drains will exacerbate problems of water-logging and salinization of the soils which are already serious on these marginal lands. Declining soil productivity caused by poor drainage will eventually force farmers to abandon this area. Again, detailed hydrological, soils and agricultural studies are needed before specific measures to improve irrigation, drainage and farm road networks in Marja Boghra can be made.

Sistani – The Sistani Lateral Canal takes off from the end of Boghra Canal at Station 71+650 to serve an area of about 2,500 hectares. This area was also not included as part of the original development plans for the MHIAS. The drainage from Sistani flows into the Sistani depression which is located on the upper terrace lands of the Margo Desert. It has no outlet into the lower Helmand Valley. Over the years the Sistani area has been settled by farmers and it is now being cultivated quite intensively. It is necessary to survey the area for irrigation improvement and drainage and farm road construction. Lack of drains will cause water logging and salinity of the soils and result in the abandonment of these lands in the future.

Sheen Gazak – About 3,000 hectares of land in the Sheen Gazak area takes water from the end of the Boghra Canal and from outlet drains from the Marja subsystem. Excess water in Sheen Gazak eventually drains onto Helmand River Valley lands at the toe of the Margo Desert, close to upper end of the Darweshan subsystem.

Trikhnawar – Trikhnawar is a large swath of poor quality desert terrace land to the south of the Marja and Nad-i-Ali road. Approximately 2,000 hectares of land is irrigated drain water from the Nad-i-Ali subsystem. The remaining area up to the northern edge of the Shamalan Valley that has been sparsely occupied by squatters who have built large compounds is irrigated from excess Nad-i-Ali irrigation and drainage water and water from drilled wells. Although this area will eventually be abandoned due to water logging and salinity, the immediate negative impact has been the movement of saline subsurface drainage waters to the lower Shamalan Valley agricultural lands. It is necessary to make a detailed survey of the area to find a solution to this problem before it further aggravates the situation.

Pumps – The out of project public desert lands mostly to the right (north) and some to the left (south) of the Boghra Canal from the town of Girishk to the end of Marja are illegally irrigated by pumps that lift water from the canal, and in some cases by drilled wells. The downstream areas in the Boghra Irrigation system, such as Marja have been experiencing shortage of water supply during these years. **It is recommended that all these pumps be removed and stealing of water from canals shall in no case be allowed**. In most of these areas squatters have built mud walls around a large piece of public land that they have usurped during the war years with the help of gun-lords, and are planting illicit drugs. The use of underground water by drilled wells has been observed to draw down the underground water and increase seepage loss from the canal. Public Authorities and HAVA should not allow this practice to continue. The organization of Mirab and water users associations and institutional strengthening of operation and maintenance functions, will help in improving operation and management of the canals and irrigation systems and the supply of adequate irrigation water to all areas under the command of canals.

The major issues that need to be addressed in the areas described above are their effect on the limited supply of water available to the MHIAS, progressive soil degradation from water-logging and salinization caused by poor drainage, the effects of increasing numbers of drilled wells on groundwater levels, and the growing of illicit crops. These issues must all be studied in detail by before practical measures can be taken.

5. Methodologies for Prioritization and Costing

This section describes the methodology we used for analyzing the data we collected for the MHIAS needs assessment. Section 5.1 describes and discusses the basis on which we prioritized rehabilitation measures, as presented in Section 6. Sections 5.2 and 5.3 describe the methods we used for making cost estimates for rehabilitating the irrigation and drainage networks and the road networks respectively.

5.1. Prioritization Methodology

The method by which we have prioritized rehabilitation measures for this assessment is based on the following principles and objectives:

- Attainment and sustenance of maximum agricultural production and returns on all farmlands in the MHIAS.
- Criticality of the infrastructure to accomplish this objective.
- Achievement and sustenance of irrigation system for full capacity and functionality.
- Achievement and sustenance of drainage system for full capacity and functionality.
- Enhancement of systems capability towards the accomplishment of these objectives.
- Realization of maximum returns to the farmers by easy access to agricultural markets and industries by the rehabilitation of roads, construction of necessary en-route and on-farm storages facilities, and provision of equipment, machinery, power and agricultural extension services.

Recommendations for high, medium and low priority measures to repair and rehabilitate the systems are made with a view towards meeting the above objectives. The order of high, medium and low priority is based on the degree to which we consider measures critical for bringing benefits to the farmers and communities living in the MHIAS. The measures we have recommended should be given high priority will bring the biggest benefits to the most people in the shortest period of time. Those measures include:

- Re-building the Boghra and Darweshan diversion structures;
- Cleaning out main drains and canals that have excessive silting;
- Repairing key water control and management facilities and eroded banks associated with them;
- Rehabilitating the road from Lashkargah to the Kandahar-Herat Highway.
- Removal of pumps that take water from irrigation canals.

We have classified as medium priority those measures we do not consider immediately critical and that can afford a bit more time. They include rehabilitating all the other roads in the MHIAS, and measures that influence system capacity and functionality to a relatively lesser degree. Measures that are not immediately critical, such as repairing canal banks and breaks, or cracks in concrete structures, we consider low priorities. They can be done after high and medium priority items are completed. All of the measures we have assessed for this report should be done within a period of not more than three years.

Discussion:

<u>Criticality</u>: The criticality of the Boghra Canal Darweshan Canal diversions is such that if these structures were to fail, irrigation water could not be delivered to the canal systems and to all the farmland under their command. At present the Helmand River has breached the Boghra Canal Diversion structure and has formed a new channel through the diversion barrage away from the canal intake, resulting in silt being deposited in front of the concrete weir and the canal intake. A similar situation has happened at the Darweshan Canal diversion structure. The Upper Boghra, Shamalan,

Nad-i-Ali and Marja subsystems are all served by the Boghra Canal, and thus rely on its diversion and intake structures functioning properly. Similarly, the entire Darweshan subsystem depends on water being diverted from the Helmand River into the Darweshan Canal in the right quantities at the right times. Clearly properly designed and constructed diversion structures are needed as a high priority for the Boghra and Darweshan Canals and for the MHIAS as a whole.

Also, some special cases that need immediate attention are considered as critical, such as:
1) Reconstructing two drop structures, one on the Shamalan Canal and the other on the Darweshan Canal that are totally destroyed. 2) Repairing severely eroded banks below the intake of the S10.7 Lateral Canal (currently being done by DAI); 3) Repairing sections of the banks of the Old Shamalan Canal that either have been or are under imminent threat of being washed out by the Helmand River (currently assigned to UNOPS).

Irrigation System Capacity: The Boghra Canal has silted-up very badly in its Nad-i-Ali and Marja sections. This has reduced the conveyance capacity of the canal and has resulted in insufficient irrigation water deliveries to these subsystems. Our baseline agricultural crop yield survey shows a trend of reduced crop production from upstream to midstream, and then to downstream areas of the irrigation systems. The Marja subsystem suffers most as it is at the tail end of the Boghra Canal. We therefore recommend rehabilitation measures in Marja be given high priority.

Drainage System Capacity: Most of drains suffer from silt, vegetation growth and clogged channels. This situation has severely affected the farmland that used to benefit from full discharge capacity and functionality of the drains. The soils in the Shamalan and Darweshan subsystems show signs of salinity, and low crop yields reported in our baseline agricultural production survey confirms this problem. We have, therefore, recommended that drain cleaning in Darweshan and Shamalan be given high priority.

Enhancement of systems capability: The operability and management of the water system to deliver irrigation water to all areas equitably requires the rehabilitation of water control facilities, gates and lifting and control mechanisms in canals and irrigation systems. Removal of water pumps that take water from the canals. Without this operators will not be able to accomplish their functions and responsibilities.

5.2. Costing Methodology for Irrigation and Drainage Works

This section describes the methodology we used to estimate costs for rehabilitating the irrigation and drainage networks in the MHIAS. Our presentation of the methodology is consistent with the structure of Section 3 of the report, and with the structure of Tables 1 - 4 in Attachment 1, with a separate subsection devoted to each of the four types of work – cleaning, bank repair, concrete work and steel work. Text in "quotation marks" refers to the column headings in the tables.

Cleaning – The following describes the methodology for the cost estimates presented in Tables A1, B1, C1, D1 and E1 in Attachment 1.

- The first two columns in the tables, "From Point" and "To Point", give the Point ID numbers of the beginning and end point of each section of canal or drain that needs cleaning.

- "From Meters" and "To Meters" give the stationing of the beginning and end points of each section. The units are meters, measured from the intake of the canal (Station 0+000) or from the start of the drain.

- "Subsystem Name" gives the name of the subsystem to which the section of canal or drain belongs, and "Canal/Drain Name" gives the name of the canal or drain of which the section is a part.

- The next four columns give the dimensions of the section of canal or drain and the average depth of the silt to be removed. The "Depth of Canal or Drain" was used to help in determining which method of cleaning – manual labor or machine – would be most appropriate. All units are meters.

- "Volume of Silt" is calculated as "Length to be Cleaned" x "Width to be Cleaned" x "Thickness of Silt Deposit". The units are cubic meters.

- The canals and drains will be cleaned either by machine (rented draglines) or by manual labor, depending on the width and depth of the section of canal or drain and the amount of silt to be removed. Entries appear either in the "Cleaning by Manual Labor" column (labor days) or in the "Cleaning by Machines" column (cubic meters) depending on this determination. Entries in the "Cleaning by Manual Labor" column reflect productivity of 1.33 cubic meters of silt removed per laborer per day, an estimate based on DAI's experience in cleaning canals and drains with manual labor Helmand.

- "Costs for Manual Labor" are based on a wage rate of $2.50 per labor day. The factors we considered in determining that $2.50 per labor day is a reasonable year-round average to use for the purposes of budgeting include: the rate we are currently paying manual laborers in Helmand ($2.00 per day); suggestions that UNOPS and other NGOs and contractors in the region are intending to offer laborers $3.00 per day for similar work; and seasonal variations in the demand for labor which tend to push up rates when farmers are busy during the cropping season.

- For wide, deep canals and for particularly large volumes of silt, we estimate the cost of cleaning on the basis of using draglines. The "Cost for Use of Machines" column reflects the rate of US$1.00 per cubic meter for dragline work, slightly higher than the current rate of 90 cents per cubic meter at which DAI is renting draglines from the Helmand Construction Unit.

- The "Total Cost" column gives the total cost we estimate for cleaning each section of canal or drain. The units are US Dollars.

Bank repairs – The following describes the methodology for the cost estimates presented in A2, B2, C2, D2, and E2 in Attachment 1.

- The first three columns in the tables, "Point ID", "DD Lat" and "DD long" give the Point ID numbers (see maps) and the latitude and longitude coordinates of each section of the canal bank that needs repairing.

- "Subsystem Name" gives the name of the subsystem to which the canal or drain belongs, and "Canal/Drain Name" gives the name of the canal or drain of which the section is a part.

- The next three columns give the dimensions, "Length", "Average Width" and "Average Depth" of the eroded area that needs repair. All units are meters.

- "Total Volume Eroded" is the product of these dimensions – Length" x "Average Width" x "Average Depth" – which yields the total volume of the eroded area in cubic meters.

- This "Total Volume" figure is then used to calculate the "Volume of Filter Material" and the "Volume of Backfill Material" (both expressed in cubic meters) needed to repair each section of eroded or damaged bank. Entries only appear in the "Volume of Filter Material" column for sections of canal downstream of water control structures that are particularly vulnerable to erosion.

- The next two columns refer to "riprap", a term used for large stones or concrete blocks put in place to protect fill material on the banks and beds of particularly vulnerable sections of canal. The riprap required is determined on the basis of the surface area of the section of bank or bed that needs extra protection. Units for riprap are square meters.

- The next four columns calculate the costs required to effect these repairs. "Filter Material", a mixture of locally available sand and gravel, and "Backfill Material", locally available desert soil, are both calculated at $6.50 per cubic meter for material and labor. The cost of riprap is estimated at $20.00 per square meter. This includes the transportation cost to get the stones or concrete blocks to the repair site and the labor required to put them in place.

- The "Total Cost" column gives the total cost we estimate for repairing each section of the bank of the canal or drain. The units are US Dollars.

Concrete Work – the following describes the methodology for the cost estimates presented in Tables A3, B3, C3, D3 and E3 in Attachment 1

- The first three columns in the tables, "Point ID", "DD Latitude" and "DD Longitude" give the Point ID numbers (see maps) and the latitude and longitude coordinates of each site requiring structural concrete repair work.

- "Subsystem Name" gives the name of the subsystem to which the canal or drain belongs, and "Canal / Drain Name" gives the name of the canal or drain of which the section is a part.

- The next column, "Description of Repair or Replacement Work" is self explanatory.

- The "Volume of Repair or Replacement Needed" column provides the dimensions in length, width and depth or the volume of concrete (cubic meters) required to repair or replace the structure in question.
  Note: Occasional references in these tables are made to MK plans (for example Point ID A7 "Should be designed per MK plans"). MK refers to Morrison Knudsen, the US engineering company that did much of the original construction work for the MHIAS in the 1960's.

- In those instances where excavation is required to remove the remnants of the existing structure or remove earth for new foundations this information is provided in the columns "Excav Concrete" or Excav Earth". The measurements are in cubic meters.

- The right column, "Estimated Cost", reflects the engineering estimates made on site in the field and include not only the cost of the volume of concrete required but also the innumerable variables that accompany each individual site such as the relative ease or difficulty of access to materials, labor and other inputs.

Steel Work - The following describes the methodology for the cost estimates presented in Tables A4, B4, C4, D4, and E4 in Attachment 1.

- The first two columns in these tables, "Point ID" and "Station Number" identify the location of the steel structure that requires repair or replacement. The Station number is identified in kilometers and meters from the intake of the Canal or Drain in question. For example, in Table A4, ID point number B12 is located 15 kilometers + 500 meters from the intake of the Boghra Canal.

- "Subsystem Name" gives the name of the subsystem to which the canal or drain belongs, and "Canal / Drain Name" gives the name of the canal or drain of which the section is a part.

- The "Types of Structure" column defines whether the structure that needs repairing is related to an intake, spillway, turnout, or gate.

- The next column, "Parts to be Changed or Repaired" is self explanatory.

- All costs are estimates based on prices quoted to our field engineers locally for the specific part required in the Lashkar Gah bazaar. Many are common place items given the extent of the irrigation system on which the city's economy depends. Where not available locally the costs are estimated based on importing the item from Pakistan.

5.3. Costing Methodology for Road Works

The following describes the methodology for the cost estimates presented in Tables A5, B5, C5, D5 and E5 in Attachment 1. We present the costing methodology for roads in three sections. The first section is a table that gives the productivity and rental rates for road building equipment (Table 16); the second section explains how we estimated the cost per kilometer to rehabilitate twelve different classes of road; and the third section shows how we estimated the costs of rehabilitating structures associated with roads, such as culverts, road and foot bridges and causeways.

TABLE 16 - ROAD BUILDING EQUIPMENT RENTAL RATES AND PRODUCTIVITY

Equipment	Rent/Month* $	Rent/Day $
Bulldozer	21,000	808
Grader	19,219	739
Compactor	15,280	588
Roller	11,357	437
Water Tank		80

****OUTPUTS:**

Dozer:

Output/day Linear m	Road width m	Cost/Linear m $
165	16	4.897
250	12	3.232
300	10	2.693
375	8	2.155
500	6	1.616
750	4	1.077

Grader:

Output/day Linear m	Road width m	Cost/Linear m $
250	16	2.956
375	12	1.97
450	10	1.642
563	8	1.313
750	6	0.985
1,125	4	0.657

Compactor:

Output/day Linear m	Road width m	Cost/Linear m $
250	16	2.352
375	12	1.568
450	10	1.307
563	8	1.044
750	6	0.784
1,125	4	0.523

Roller:

Output/day Linear m	Road width m	Cost/Linear m $
250	16	1.748
375	12	1.165
450	10	0.971
563	8	0.776
750	6	0.583
1,125	4	0.388

Watering:

Output/day Linear m	Road width m	Cost/Linear m $
250	16	0.336
375	12	0.224
450	10	0.187
562.5	8	0.149
750	6	0.112
1,125	4	0.075

* Rates per month for equipments rental are taken from CADG office in Helmand

** Outputs for building a 0.30 meter high embankment road of 12 meter width with the type of equipment mentioned are taken from the CADG office. For other widths rates are determined by proportion.

For the purposes of estimating the cost of rehabilitating the roads we sub-divided each of the three main categories of roads into sub-categories. The sub-categories are based on the width of different sections of road, design specifications for rehabilitating them and the unit costs of carrying out the work. Table 17 describes the basic characteristics of the roads in each of the 12 sub-categories.

Category	Sub-Category	Average Width	Notes
Desert Roads	DA	16m	Resurfacing material available on site; depth 50cm
	DB	12m	Resurfacing material available on site; depth 30cm
	DC	10m	Resurfacing material available on site; depth 30cm
	DD	6m	Resurfacing material available on site; depth 30cm
Canal Roads	CA	12m	Transport resurfacing material up to 1km; depth 30cm
	CB	10m	Transport resurfacing material up to 1km; depth 30cm
	CC	8m	Transport resurfacing material up to 1km; depth 30cm
	CD	10m	Transport resurfacing material up to 5km; depth 30cm
	CE	8m	Transport resurfacing material up to 5km; depth 30cm
Lateral and Drain Roads	LDA	8m	Transport resurfacing material up to 5km; depth 30cm
	LDB	6m	Transport resurfacing material up to 5km; depth 30cm
	LDC	4m	Transport resurfacing material up to 5km; depth 30cm

Table 17 – Definitions of Road

The sub-category codes defined in Table *** are listed in the legends of Maps 3, 6, 9 12 15 and 18 in **Attachment 2.**

The estimated rehabilitation costs for each of the twelve sub-categories of roads are in **Attachment 4.**

6. Recommendations and Priorities

This section groups the rehabilitation measures described earlier in this report into high, medium and low priority packages. The total estimated cost for the three packages is $26,019,000, the same total as that for all the rehabilitation measures costed in the tables in Attachment 1. The total is broken down as $8,907,000 for recommendations we consider to be high priorities, $6,715,000 for medium priorities, and $10,397,000 for low priorities.

6.1. High Priority Recommendations

We have organized the High Priority Recommendations in this assessment into three irrigation-related activities and one for road rehabilitation.

Irrigation system rehabilitation	
Diversion repairs	
H-1 Boghra Diversion	$2,178,000
H-2 Darweshan Diversion	$2,208,000
Conveyance	
H-3 Boghra Canal cleaning (2 sections)	$ 544,656
H-4 Water management - steel structural work	$ 100,260
H-5 Concrete drop structures	$ 24,300
Canal failures*	
Drainage rehabilitation	
H-6 Marja Drains	$ 692,349
H-7 Shamalan Drains	$1,047,400
H-8 Darweshan Drains	$ 960,000
Road rehabilitation	
H-9 Lashkar Gah access road to Kandahar-Herat road	$1,152,000
Total	$8,906,965

* Repairs of two canal failures, the S-10 Lateral and the Shamalan are high priority with work in progress currently underway by DAI and UNOPS respectively.)

High Priority Irrigation System Rehabilitation Measures

Overview: In the Middle Helmand Irrigated Agriculture System (MHIAS) crop production is totally dependent on the delivery of adequate supplies of irrigation water to the farms. We therefore recommend that high priority be given to the rehabilitation of facilities for the diversion of sufficient amounts of water from the Helmand River to the canals; and conveyance, control and delivery of adequate water by the irrigations systems to the farmland, when needed, in all areas of the project.

Diversions: The issue. The diversions of the Boghra and Darweshan Canals from the Helmand River. In both cases the river has breached the diversion dam and meandered into a new channel away from the intake of the canal. This condition worsens with time. Flooding deposits more silt in front of the intake structures and further deepens the breaches in the dams. This eventually results in the failure of the diversions to deliver water into the canals. Taking measures to prevent water supply to the Boghra and Darweshan Canals from being cut off is critical. If nothing is done the canals could be cut off during the next flood season. Our recommendation for work totaling approximately $4.4 million on these two diversions follows:

Recommendation (H-1) - Boghra Diversion Repair

Work Schedule and Funding: We recommend that the repair of the diversion dam be started in July and completed before the next flood season begins during March 2005. The work should proceed in 3 phases. 1. Approval of funds for the project. 2. Authorization of funds, $200,000 (9%) and hiring of a design consultant. 3. Approval of plans, go ahead for construction and authorization of funds for construction. For this purpose, a qualified consultant should be retained. The consultant should prepare plans and specifications for construction and help in advertising for bids, award of contract and inspection of construction.
Cost Estimate: DAI's assessment team, while recognizing that more detailed study by experienced river engineers is necessary, made a preliminary design and cost estimate for repairing the Boghra Canal Diversion structure. We estimate it will cost $2,178,000 to repair and extend the dike by building an 800-meter long rock filled gabion overflow weir structure. We designed the structure to withstand the erosive powers of the Helmand River during floods.

Recommendation (H-2) - Darweshan Diversion Repair

Work Schedule and Funding: We recommend that the repair of the diversion dam be started in July and completed before the next flood season begins during March 2005. The work should proceed in 3 phases. 1. Approval of funds for the project. 2. Authorization of funds, $200,000 (9%) and hiring of a design consultant. 3. Approval of plans, go ahead for construction and authorization of funds for construction. For this purpose, a qualified consultant should be retained. The consultant should prepare plans and specifications for construction and help in advertising for bids, award of contract and inspection of construction.
Cost Estimate: DAI's assessment team, while recognizing that more detailed study by experienced river engineers is necessary, made a preliminary design and cost estimate for repairing the Darweshan Canal diversion structure. We estimate it will cost approximately $2,208,000 to repair and extend the dike by building a 1,100-meter long rock filled wall structure and repair the sheet piling structure.

Diversions: Background / Historical Notes

Boghra Canal Diversion: Designed and constructed by the Morrison Knudsen Company early in the 1950s, the Boghra Canal diversion is located about 6 kilometers upstream from the town of Girishk. At its intake the canal has a capacity of 2,700 cubic feet per second (cfs) or 77 cubic meters per second (cms). The diversion has four sluice gates followed by a 180-meter concrete weir which was designed to lift irrigation water into the canal. The concrete weir is extended by an 800-meter long dike (barrage) made of large rocks (minimum 1.4-meter diameter), that were quarried from the adjacent hills. The rock dike is terminated with a dirt fuse section close to the opposite left side hills bordering the Helmand River. During normal times the required water is diverted into the gated canal intake. The remaining water flows through the sluice gates and over the concrete weir back into the river. During high water level and floods in the river the water passes over the rock dike which was made to resist the erosive power of the river. However, during high flood discharges in the 1960s a section of the rock dike was breached by flood waters. This was soon after repaired, in kind, by the then Helmand Valley Authority Operations and Maintenance Department. A section of the dike was again breached by the 1991 (100 year) flood in the Helmand River. Gabion repairs were made upstream from the original dike in a different location. The gabion structure was washed out by subsequent floods in the river.

2) Darweshan Canal Diversion: Designed and constructed by the Morrison Knudsen Company in late 1950s, the Darweshan Canal diversion is located on the Helmand River about 15 kilometers downstream from the end of Shamalan Canal, and about 10 kilometer upstream from the town of Hazarjuft. At its intake the canal has a capacity of 1,000 cfs (28 cms). The diversion has four sluice gates followed by a 175-meter double row sheet piling weir capped with concrete which was designed to lift irrigation water into the Darweshan Canal. The concrete-capped weir is extended by a 160-meter long single sheet piling barrier in the Helmand River. During normal times the required water is diverted into the gated canal intake. The remaining water flows through the sluice gates and over the concrete weir into the river. When the water level in the river is high the water passes over the sheet piling section, which was made to resist the erosive power of the river. However, during high flood discharges such as the 100 year flood in 1991, the Helmand River destroyed the extension weirs and bypassed that section by creating a new river course. We recommend the dike be repaired either with gabions or with sheet piling similar to the original design.

Conveyance – the issue: Canal conveyance capacity throughout the MHIAS area has been adversely affected by silting, and consequent loss of 60 – 70% of its design capacity. Canal failures due to forced excess capacity, and erosion by the river have compounded the problems along with improper water management. These issues are dealt with below.

Recommendation (H-3) - Cleaning 2 Sections of the Boghra Canal

Work Schedule and Funding:
The order of cleaning of Boghra Canal is recommended first from downstream Marja section then proceed to midstream Nad-i-Ali sections of the canal as follows:
Marja section from station 60+080 to 91+000, the length is 39.920 kilometers, and the volume of silt to be cleaned is 284,820 m3.
Cost Estimate is about $284,820.
Nad-i-Ali section from station 35+760 to 60+080, the length is 24.32 kilometers, and the volume of silt to be cleaned is 259,836 m3.
Cost Estimate is about $259,836.
The work schedule should be for the winter canal shutdown period.

(Note: The cleaning of upstream sections of the Boghra Canal from station 35+760 to station 0+000 at the intake is included under medium priority recommendations.)

(Note: Canal failure due to overcapacity erosion. . Due to putting more than the design capacity water into the S 10.7 Lateral of Shamalan Canal at Station 10+700, the banks of the canal below the intake structure eroded severely. The continuance of this condition has put this lateral at the risk of washout and failure. DAI is currently carrying out emergency repairs to the banks of the S10 Lateral under a RAMP job order.

(Note: Canal failure due to erosion by the river: Several sections of the Shamalan Canal Banks above Lashkar Gah were completely cut off by the Helmand River. The breaches of the Main Shamalan Canal by the river at these locations has forced the people responsible for the operation of the system to put more than capacity water into the S10 Lateral Canal. Severe erosion of the canal at several locations, especially below its intake is cause for its eminent failure. Also, this lateral together with the new Shamalan shunt at Lashkargah do not have sufficient capacity to convey adequate irrigation water to the lower Shamalan Canal farmlands. (Shamalan Canal river bank protection works are currently being carried out by UNOPS)

Recommendation (H-4) - Water Management and Steel Work Repair

Work Schedule and Funding Water control and drop structures, canal and turnout gates and lifting mechanisms are needed for the management and delivery of water equitably to all farmland, especially to the downstream areas like Marja at all times of the year. Repair of canal and turnout gates and control mechanisms from the canal intake to the end, are recommended as high priority items, as described below: Most of the work in this item does not have to wait for the shut off period and can be done even when there is water in the canal. The repair work is recommended to begin at the head works or the Intake of the Canals and proceed downstream. However, if the repair of some gates or lifting mechanisms is critical for the operation of the system those items should be done first.

Cost Estimates: We estimate the steel work for the Upper Boghra, Nad-i-Ali, Marja, Shamalan, and Darweshan subsystems will total $100,260.

Recommendation (H-5) – Repair of Concrete Drop Structures

Work Schedule and Funding: Two drop structures, one in Shamalan Canal Station 27+000 and the other at Darweshan Canal Station 32+250 that were totally destroyed during the war years. These two drops are very important, and their reconstruction is considered as high priority.

As indicated in Table E3, the estimated cost to rehabilitate the drop structure at Station 32+250 on the Darweshan Canal is $24,300. The cost of the Shamalan Canal Drop structure at station 27+000 was not evaluated as the survey team had information that this work is already in the scope of work of UNOPS.

Reconstruction of these two drop structures should be included in the high priority items budget and the scope of work of the contractor that will be awarded the contract for rehabilitation of concrete structures in MHIAS. It is recommended that the work for the reconstruction of these two structures be scheduled for the next canal shut off period in December 2004.

Cost Estimate: $24,300.

Drainage system rehabilitation.

Overview: In Middle Helmand Irrigated Agriculture System (MHIAS), in conjunction with the delivery of sufficient water to the farmland, de-silting and cleaning of drainage system is imperative for the achievement of high crop yields. Deep percolation of irrigation water into the soil matrix accumulates on the underlain low permeability soils or conglomerate barrier. As the underground water continues to rise, capillarity fringe will cause water logging on the ground surface and high salinity due to evaporation. This condition greatly reduces the growth of plants and is cause for very low crop yields on the farmland. Construction of pedestrian and animal crossings, designed not to dam up the flow of drain water, at locations that are needed by the communities is recommended to be included in the scope of work of the drain cleaning projects.

Recommendation (H-6) - Complete Cleaning Marja Drains

High priority was earlier given to the cleaning of drains in Nad-i-Ali and Marja. The Nad-i-Ali drains that were completed by DAI/AARIA in 2003, and the Marja drains were approximately 50% completed under DAI/AARIA program in late 2003. DAI started work to complete the balance on 2 March, 2004 under a RAMP job order.

Cost Estimate: We estimate completing cleaning of the Marja drains will cost $629,350.

Recommendation (H-7) – Cleaning the Shamalan Drains

Work, Schedule and Funding. Drain cleaning work can be done all year around and does not have to wait for canal shut off period. Drains are recommended to be cleaned from the lower end upwards. Spur drains should be cleaned after main collector drains are cleaned.

The Shamalan Drains (see report Section 3.3.1, pages 10 and 11) have a total length of 132,440 meters and a volume of 784,200 m3 of silt.

Cost Estimate: Based on the use of draglines we estimate it will cost $1,047,400 to clean the Shamalan drains.

Recommendation (H-8) – Cleaning the Darweshan Drains

Work, Schedule and Funding. Drain cleaning work can be done all year around and does not have to wait for canal shut off period. Drains are recommended to be cleaned from the lower end upwards. Spur drains should be cleaned after main collector drains are cleaned.

The Darweshan Drains (see report Section 3.6.1, page 19) have a total length of 110,900 m, and a volume of 1,001,700 m3 of silt. Using draglines the

Cost Estimate: We estimate it will cost $960,000 to clean the drains in Darweshan, based on the use of draglines.

High Priority Road Rehabilitation

Recommendation (H-9) – Repair the Lashkar Gah Access Road

Work Schedule and Funding: The road from the town of Lashkargah to Kandahar – Heart highway is a critical access road connecting all farm areas such as, Chah-i-Anjeer, Nad-i-Ali, Marja, Shamalan and Darweshan areas to important markets west, southwest, south and east of Afghanistan as well as export markets in Pakistan and Iran. This road at present is a very poor condition and in need of rehabilitation. We are recommending the rehabilitation of this road as high priority item. The benefit gained from repairing this road would be a reduction in the current travel time of cars and trucks by half with the intent of vastly improving access of agricultural product to market.

Cost Estimate: We have estimated the rehabilitation cost of 45 kilometers of a 16 meter wide, compacted and gravel-surfaced all year road at approximately $1,152,000.

6.2. Medium Priority Recommendations

The items that are included in our Medium Priority Recommendations are those that are not included in the high priority list, are not immediately critical, and can afford a bit more time. While items in this category influence capacity and functionality of the systems, they do so to a lesser degree than items in our high priority list. Again, we have organized these priorities into three irrigation-related activities and one for road rehabilitation.

Irrigation system rehabilitation	
M-1 Bank repairs and riprap on four canals	$1,244,827
M-2 Cleaning canals	$1,699,163
M-3 Cleaning drains and laterals	$ 374,448
Repairing Roads	
M-4 Rehabilitating 8 different rural roads	$3,396,550
Total	$6,714,988

Medium Priority Irrigation System Rehabilitation Measures Overview:

Riprap is put on the bottom and sides of the canals to protect them against erosion and canal washout by the force of water generated by high velocities below the control and drop structures in the canals. To lay Riprap in the canal requires that the canal be dried. This can be done during the 40 day winter shut off period, beginning in December. Since, this is a short period for the amount of work that needs to done, therefore, the contractors need to plan ahead and store riprap, gravel filter and backfill material close to the work site during the year.

Recommendation M-1 – Repairing canal banks

Four canals require repair to eroded banks below control or drop structures that require riprap:

They are the Boghra Canal, erosion volume 31,957 m3, estimated cost for riprap	$ 414,500,.
the Shamalan Canal, erosion volume 28,480 m3, estimated cost for riprap	$ 410,179,
the Shamalan S10.7 Lateral, erosion volume 10,600 m3, estimated cost for riprap	$ 214,483,
and the Darweshan Canal, erosion volume 22,256 m3, estimated cost for riprap	$ 205,665.
Total cost	$1,244,827

Recommendation M-2 – Cleaning the main canals

The Upper Boghra Canal, cleaning length 35,760 m, volume 542,868 m3, cost	$ 542,868
The Shamalan Canal, cleaning length 64,320 m, volume 360,000 m3, cost	$ 360,000
The S10.7 Lateral, cleaning length 37.410 m, volume 290,300 m3, cost	$ 545,600
The Darweshan Canal, cleaning length 51,150 m, volume 250,695 m3, cost	$ 250,695
Total cost	$1,699,163

Note: Cleaning of Shamalan canal, S10.7 Lateral and Darweshan canal. Cleaning of canals can best be done during the 40 day winter shut down period. Cleaning with water in the canal is not recommended, as machine operators can not see below the surface of the water. With drain cleaning the situation is different, as cleaning is done from downstream going upstream. The cleaning of the lower sections of the drain helps the water surface to drop down in the drain channel, making the cleaning easier and more efficient as it proceeds upstream.

Recommendation M-3 – Cleaning the drains

Cleaning of Upper Boghra Drains can be done all year around and do not have to wait for the 40 day winter canal shut down period.
The Upper Boghra Drains, length 23,900, volume 182,414 m3, estimated cost $ 297,441.

Cleaning of Nad-i-Ali Drains I and J can only be done only after these drains are de-mined. These drains were mined during the war years, and could not be cleaned when all the other drains were cleaned in this area

The Nad-i-Ali Drains, length 4,960 m, volume 30200 m3, estimated cost	$ 56,800
The Darweshan Lateral, length 3,240 m, volume 10,750 m3, estimated cost (*)	$ 20,207
Total cost	$ 374,448

(*) The cost of cleaning this lateral may not need to be funded. As, the cleaning of Darweshan Lateral Canal #6 can be scheduled and funded by the area farmers or manual labor hired from the nearby communities. The shutting off of the lateral can be done with the help of Mirabs and the consent of the water users.

Rehabilitation of roads:

Overview: One of the main objectives of rehabilitation of irrigation and drainage systems is the attainment and sustenance of high crop yields and returns by the farmers. These objectives will be realized with the implementation made in our assessment of the needs for rehabilitation. As high agricultural production and production values are necessary to sustain high yields and returns to the farmers, the farmers need to find easy and speedy access to the markets for selling their produce with higher prices to make more money. Our agricultural baseline survey presented in Table 1 – 25 in Attachment 3 shows that farmers receive an appreciable share of their income from perishable produce such as melons and water melons. On the other hand they do not make much money by planting items such as wheat and barley. This tells two things: First, Farmers can not get their produce to other markets in the country to get better prices. Second, they could make more money if they could get their melons and water melons faster to other markets in the country and outside the country. This is why rehabilitation of inter area roads and connection and access to roads and markets outside the area can help the farmers to get more money for their produce and be able to sustain a higher level of income for a higher standard of living. Therefore, we are recommending the following roads for rehabilitation in this priority category:

Recommendation M-4 – Rehabilitating the following roads

Description of Work, Cost and Schedule	Length (km)	Cost ($)
1. Lashkargah to Nad-i-Ali to Marja road (15 map)		
2. Boghra Canal road (1,2,3 map)		
3. Old Shamalan Canal road south of Lashkargah (6,9 map)		
4. S10.7 Lateral Canal road (7)		
5. Darweshan Canal road (5)		
6. Boghra – Chah-i-Anjir – Nad-i-Ali road (13 map)		
7. Marja Darweshan road (39)		
8. Lashkargah to Girishk road (11)		
Total =	294 (km)	$3,396,550

6.3. Low Priority Recommendations

Overview: Items that are included in low priority are those that are not included in the high and medium priority list, are not as critical and can afford a bit more time. Items in this category influence capacity and functionality of the systems to a lesser degree than items in the high and medium priority. Examples are:

All canal bank erosion repairs that do not need riprapping and were not included in High and Medium Priority categories. $ 5,772,991

All canal reinforced concrete structure repairs, except major work on Boghra and Darweshan diversions, and two destroyed Darweshan

and Shamalan canal drop structures.	$ 236,849
All roads except those listed in High and Medium Priority categories.	$ 4,387,580
Total:	**$10,397,420**

Recommendation (L-1) – Repair all the Remaining Canals

Description of Work, Cost and Schedule	Length (m)	Volume (m^3)	Cost ($)
Boghra Canal including Marja and Nad-i-Ali Shamalan Canal, Old, New and S10.7 Lateral and Darweshan Canal. Erosion repairs:	30,882m	836,027m^3	$5,772,991

Recommendation L-2 – Complete the remaining concrete work

All reinforced concrete structure repairs except major work included in High Priority and Medium Priorities.	$ 236,849

Recommendation L -3 – Rehabilitate the remaining roads

All roads except those included in High and Medium Priorities.	Total = 625,000	$ 4,387,580

7. Impacts and Benefits

7.1 Rehabilitation Impacts:

The order of high, medium and low priority in this assessment is based on the range of the degree of criticality and attributable benefits to the farmers and communities living in the area. Recommendations for the repair and rehabilitation of the systems are considered with a view to keeping the above objectives in mind. Those that need immediate work like diversion structures and desilting of canals and drains that have excessive silting, repair of water control and management facilities, and some special cases or situations that require immediate attention for the rehabilitation of irrigation, drainage and road facilities, are given high priority.

The degree of impact is directly proportional to the degree of priority given to rehabilitations that are recommended in this assessment. All recommendations for rehabilitation have high impact for achievement of sustained high agricultural production, high yields and returns to the farmers in the project area. Priorities are to differentiate between the urgency and longer time requirement of rehabilitations recommended. The following are examples of high impact items. Examples of medium and low priority items can be seen in the discussion and list of priorities and need not be repeated here.

High Impact Items:

Rehabilitating the Boghra Canal and the Darweshan Canal diversion structures will benefit all parts of the MHIAS. The Upper Boghra, Nad-i-Ali, Marja and Shamalan subsystems will benefit from the new Boghra Canal diversion structure, and the Darweshan subsystem will benefit from the new Darweshan Canal diversion structure.

Reconstructing two drop structures, one on the Shamalan Canal and the other on the Darweshan Canal, repairing severe erosion below the intake of the Shamalan S10 Lateral Canal (currently being done by DAI), and repairing and protecting the banks of the Old Shamalan Canal from river erosion (currently assigned to UNOPS), will bring significant benefits to downstream areas.

Rehabilitation to Improve Irrigation System Capacity: Silting-up of the Boghra Canal, particularly near Nad-i-Ali and Marja, has reduced the conveyance capacity of the canal and resulted in insufficient irrigation water deliveries to these subsystems. Our baseline agricultural production and income survey shows a trend of reduced crop production from upstream to midstream, and then to downstream areas of the irrigation systems.

Cleaning drains of silt and vegetation and will greatly improves drainage system capacity. This will improve full discharge capacity and functionality of the drains. Reduced water logging and salinity in the farmlands of the Shamalan and Darweshan subsystems will be a direct benefit from this work. Our baseline agricultural production and income survey confirms the problem of salinity and reduced agricultural yields in these areas.

Rehabilitating water control facilities, gates and lifting and control mechanisms in canals and irrigation systems will enhance systems capability for better operability, management and control of the water system to deliver irrigation water to all areas more efficiently and equitably.

Operation and Maintenance Capability: To fully benefit from the rehabilitation measures we recommend, the institutions responsible for the implementation of government policies and project objectives will have to be established and/or improved. We recommend steps be taken to empower groups of farmers and water users to take responsibility for the sustainable operation and maintenance of the rehabilitated infrastructure. This will be a major step towards promoting sustainable irrigation and farming practices in the MHIAS.

Rehabilitating Access and Market Roads: Rehabilitating regional, inter-area and in-project roads will help in the attainment and sustenance of high crop yields and returns to the farmers. As high agricultural production and production values are necessary to sustain high yields and returns to the farmers, the farmers need to find easy and speedy access to the markets for selling their produce with higher prices to make more money. As the agricultural production and income tables in Attachment 3 show, farmers receive an appreciable share of their income from perishable produce such as melons and water melons. On the other hand they do not make much money by planting crops such as wheat and barley. This tells us two things: First, farmers are unable to get their produce to other markets in the country to get better prices. Second, they could make more money if their melons and water melons could be transported to other markets both in Afghanistan and in other countries.

Therefore, rehabilitating inter-area roads and connection and access to roads and markets outside the MHIAS will bring significant benefits to farmers in the region in the form of higher returns for their produce, higher incomes and higher standards of living.

See Map 20 – The MHIAS Road Classification in relation to Population and Hectares in an area, and location of Local Markets and Regional Markets.

7.2 Environmental Impacts

This assessment has identified needs for rehabilitating existing canals, drains, irrigation and drainage and road systems. We have not assessed the need to build any new infrastructure. There are no negative environmental impacts due to these recommendations. Improving irrigation and drainage systems will improve agriculture and ground cover. Almost all of the recommendations in this assessment report will have a positive impact on the environment. For Example:

Cleaning drains will benefit land by reducing salt accumulation in the soil. Salt is deleterious to plant and vegetation growth and generally reduces the productivity of the land. By supplying more water to the land farmers will plant more trees and contribute to the improvement of the environment.

Cleaning drain channels will increase the flow capacity of the drains. The concentration of salt levels in drain waters has reduced since the construction of the MHIAS about 40 years ago. The declining salt concentration has less negative impact than 40 years ago. The surface drainage waters from the pre-project deserts all drained into the lower valley basins. The construction of the MHIAS may have changed the balance of salt that has drained from the project drainage system in the past 40 years of project's life. However, the negative impact has been reduced through these years of the project to a degree that the present salt concentrations in drain waters are low enough that some people use the drain water for irrigation of crops on the desert lands.

The silt that is cleaned from the canals and drains is deposited on the side berms of the channel. Farmers and land owners later use this silt and spread on their farms as fertilizer which is better than chemical fertilizers. This method also has positive impact on the environment as the silt is then wetted by irrigation and does not turn into dust if let alone on the surface of side roads.

The Boghra Canal and Darweshan Canal Diversion structure rehabilitation will be the rebuilding of the old diversions that once existed. The rehabilitation work on these structures will keep the river channel in its previous course and will not allow it to meander into the side valley farms and erode the cultivated farmland and wash down the farmland silt and ground cover to the lower reaches of the river and cause further problems downstream. Therefore, this work will have a positive impact on the environment.

7.3 Rehabilitation Benefits:

Agricultural Production and Income Tables in the Appendix show that there is relation between income and the availability of water and drainage to the farmlands. As an area is located further downstream in a canal and irrigation system the yields and farm incomes are lower. This can be seen in net farm incomes in Marja which is located downstream in the Boghra Canal system. Lower yields can also be observed on land located further downstream on a canal. Examples are downstream areas in Shamalan and Darweshan canals. Also, agricultural lands that have their drains silted and clogged show signs of water logging and salinity and low crop yields. Nad-i-Ali area crop production was low until the drains in that area were cleaned by DAI/USAID in 2002. Currently, low crop production in Shamalan, Marja and Darweshan are because of salinity in those areas. Satellite aerial photos clearly show the salinity of some farmland in these areas. Rehabilitation of canals, irrigation and drainage systems directly benefit the related farmlands. Certain items such as the rehabilitation of Boghra and Darweshan canal diversions benefit all sections under the command of these canals.

Cost Allocations:

Table 18 at the end of this section shows the proportion of rehabilitation costs attributed to each of the five MHIAS subsystems. Costs for cleaning canals and drains and for repairing canal banks, concrete structures and steel structures are shown in the columns and directly charged to the area that benefit from these rehabilitations. Regional allocation of costs for items that benefit all the area under the command of that facility is distributed in percentages of the total cost. These items are main canal and its diversion, and regional roads. The percentage distribution of each category is assumed in relation to the 5 subsystems that benefit from the category in question.

7.4 Project Benefit to Cost Ratios:

The benefit-cost ratios shown in Table 18 are based on the net income per hectare of each area shown in the agricultural production and income tables in Attachment 3.

The highest income surveyed is shown for the Upper Boghra subsystem. Upper Boghra is a narrow strip of river valley land that runs parallel to the Helmand River and enjoys good natural drainage through alluvial soils that are underlain by gravel and sand layers. As this subsystem is served by the upstream reaches of the Boghra Canal it receives abundant water throughout the growing season. Close proximity to the town of Girishk is another advantage Upper Boghra enjoys, giving its farmers good access to local markets and to regional markets via the Kandahar-Herat Highway. The increase in net income that would be attributed to this area by re-building the Boghra Canal diversion structure, by carrying out the other rehabilitation measures identified for Upper Boghra in this report, and by improving operational and agricultural extension services, is estimated to be about 15%. This would raise the average income in Upper Boghra to approximately $748 per hectare per year.

We consider that the other subsystems in the MHIAS could also raise their annual per hectare incomes to $748 if the irrigation, drainage and road networks are rehabilitated and they too are provided with adequate supplies of water and improved access to markets. Using this figure as the attainable target, we subtracted the 2002/2003 net income for each of the other subsystems from $748 to determine the benefit each subsystem stands to gain from the recommended rehabilitation measures. Assuming no benefits will accrue in the first year whilst the rehabilitation work is being done, we multiplied the annual benefit by 2 and took the resulting figures to represent a reasonable estimate of the per hectare increases in net income each system would enjoy in the three years following commencement of the work. Multiplying these per hectare figures by the number of hectares served by each subsystem gives the total increase in net income attributable to the rehabilitation measures we have identified.

We calculated the benefit-cost ratios shown in Table 18 by dividing the total increase in net income over three years (Rehab Benefit 3 Yrs) by the amount of rehabilitation costs allocated to each subsystem (Allocated Costs).

The benefit-cost ratio for the Upper Boghra subsystem is 0.84. This relatively low ratio is understandable because the upper reaches of the Boghra Canal do not stand to benefit as much from the rehabilitation work as do the subsystems downstream. Conditions in Upper Boghra are already relatively favorable for irrigated agriculture so rehabilitating the MHIAS will have less of an impact here. The benefit-cost ratios for the other subsystems are all more than 1, with Marja standing to gain most because it is starting from the lowest base. Farmers in Marja actually lost an average of $76 per hectare in 2002-2003, but with a reliable supply of water and good drainage we consider that Marja can be just as productive as Upper Boghra in the future.

Comparing the total increase in income over the first three years ($88,539,690) with the total cost of rehabilitating the entire MHIAS ($26,019,687) gives a system-wide benefit-cost ratio of 3.4. The life of most of the measures we recommend is more than 3 years, which will make the benefit cost ratio even more favorable. However for the purposes of this assessment we consider it appropriate to be cautious and conservative in our estimates. One reason for this approach is that we have not taken recurring costs for operation and maintenance into account as we would have done for an internal rate of return analysis. These will certainly offset some of the increases in income we expect rehabilitating the MHIAS will bring, but still we feel the benefits will significantly outweigh the costs, even over the long term.

Cost Allocations

	SUB - SYSTEM SPECIFIC REHABILITATION COSTS								REGIONAL ALLOCATION OF COSTS						TOTAL OF SUBSYSTEM & ALLOCATED COSTS
	Canals Cleaning	Drains Cleaning	Bank Repairs	Concrete Work	Steel Work	Road Repairs	Diversion Structure	SUB TOTAL	Regional Roads $2,624,589	(%)	Boghra Diversion Structure $2,178,000	(%)	Boghra Main Canal $3,755,767	(%)	
Upper Boghra	$0	$297,491	$0	$0	$0	$809,653	$0	$1,107,144	$524,918	20%	$217,800	10%	$375,577	10%	$2,225,439
Shamalan	$905,559	$1,047,620	$2,117,014	$60,757	$34,470	$1,889,919	$0	$6,055,339	$524,918	20%	$435,600	20%	$751,153	20%	$7,767,011
Nad-i-Ali	$0	$56,843	$202,885	$10,380	$800	$1,354,466	$0	$1,625,374	$524,918	20%	$435,600	20%	$751,153	20%	$3,337,046
Marja	$0	$692,349	$150,560	$20,399	$0	$1,126,812	$0	$1,990,120	$524,918	20%	$1,089,000	50%	$1,877,884	50%	$5,481,923
Darweshan	$250,695	$980,249	$2,064,600	$24,300	$24,820	$1,130,686	$2,208,000	$6,683,350	$524,918	20%	$0	0%	$0	0%	$7,208,268
Total	$1,156,254	$3,074,552	$4,535,060	$115,836	$60,090	$6,311,536	$2,208,000	$17,461,328	$2,624,589	100%	$2,178,000	100%	$3,755,767	100%	$26,019,687
	$4,230,806														

Benefit to Cost Ratios

	2002-2003 Net Income US$ / ha	Project Net Income Increase US$ p/ha, p/yr.	Cultivation Area (ha)	Rehab Benefit p/yr.	Rehab Benefit 3 Yrs (x2)	Allocated costs US$	Benefit Cost Ratio
Upper Boghra	641.59	106.4	8,768	$933,003	$1,866,006	$2,225,439	0.84
Shamalan	49.01	699.0	20,000	$12,580,000	$25,160,000	$7,767,011	3.24
Nad-i-Ali	313.80	434.2	16,539	$7,181,234	$14,362,468	$3,337,046	4.30
Marja	-76.20	824.2	19,089	$15,733,154	$31,466,308	$5,481,923	5.74
Darweshan	173.04	575.0	13,640	$7,842,454	$15,684,908	$7,208,268	2.18
Total			78,036	$44,269,845	$88,539,690	$26,019,687	3.40

Table 18 – Cost Allocations and Benefit-Cost Ratios for Rehabilitation Measures in the Five MHIAS Subsystems

RECO

8. General Recommendations

8.1 Implementation of Rehabilitation and Schedules

The following are recommendations for the implementation of rehabilitation and schedules:

- Approval of Funds no later than May 2004, for rehabilitation and its management for the phases preceding, during and a brief period after rehabilitation works. See, Tables of Rehabilitation Work Schedule, Costs and Funding Cash-flow Diagram, at the end of this section.

- Contract a qualified firm no later than June 2004, for the management of rehabilitation and authorize for contracting and expenditures for the following work:

  First Year Work:

- Begin investigation, design, preparation of plans, specifications and contract documents no later than July 2004, for:
  - Boghra Canal Intake Diversion Structure
  - Darweshan Canal Intake Diversion Structure

- Advertise for Bids (August 2004) and Award contract (October 2004) to qualified international or local contractor for the rehab of above diversions.
  - Inspection of quality and quantity of rehabilitation work on the two diversions. Construction to be scheduled for completion before next flooding season of Helmand River.

- Advertise for Bids and Award contract to qualified international and local contractors for the rehab of items scheduled for the first year. Inspection of quality and quantity of rehabilitation of contracted work for the following:
  - Canal Cleaning
  - Drain Cleaning
  - Water control gates and steel structures
  - Regional Roads

  Second Year Work:

- Begin investigation, design, preparation of plans, specifications and contract documents no later than July 2005, for:
  - Shamalan Canal Shunt Intake and Diversion Structure

- Advertise for Bids and Award contract to qualified international and local contractors for the rehab of items scheduled for the second year. Inspection of quality and quantity of rehabilitation of contracted work for the following:
  - Shamalan Canal Shunt Intake and Diversion Structure
  - Canal Cleaning
  - Drain Cleaning

- Bank Erosion Repairs
- Rehabilitation of Roads

Third Year Work:

- Advertise for Bids and Award contract to qualified international and local contractors for the rehab of items scheduled for the third year. Inspection of quality and quantity of rehabilitation of contracted work for the following:
    - Bank Erosion Repairs
    - Concrete Structure Repairs
    - Rehabilitation of Roads

See - Tables for Rehabilitation Work Schedule, Costs and Funding Cash-flow Diagram,

8.2 Suggested Schedule of Obligated Amounts

The following two tables reflect the recommended Rehabilitation Schedule and the annual and cumulative amounts to be obligated in order to fund the work. If the work schedule is accepted as presented, amounts equal to $10.8 million, $9.5 million and $12.2 million would need to be obligated in the third quarter of 2004, 2005, and 2006 respectively. Management costs are estimated at 20% of the rehabilitation costs for illustrative purposes only.

Helmand Needs Assessment

REHAB IMPLEMENTATION

		HIGH PRIORITY First Year Cost	MEDIUM PRIORITY Second Year Cost	LOWER PRIORITY Third Year Cost	TOTAL COST
Diversion Repairs					
	Upper Boghra	$2,178,000	$0	$0	$2,178,000
	Darweshan	$2,208,000	$0	$0	$2,208,000
	Shamalan Shunt		$1,000,000	$0	$1,000,000
sub-total		$4,386,000	$1,000,000	$0	$5,386,000
Water Conveyance					
Canal Cleaning	Upper Boghra	$0	$542,868	$0	$542,868
	Shamalan	$0	$905,600	$0	$905,600
	Nad-i-Ali	$259,836	$0	$0	$259,836
	Marja	$284,820	$0	$0	$284,820
	Darweshan	$0	$250,695	$0	$250,695
Drain Cleaning	Upper Boghra	$0	$297,441	$0	$297,441
	Shamalan	$1,047,400	$0	$0	$1,047,400
	Nad-i-Ali	$0	$56,800	$0	$56,800
	Marja	$692,349	$0	$0	$692,349
	Darweshan	$960,000	$20,207	$0	$980,207
Bank Erosion Repairs	Upper Boghra	$0	$414,500	$1,071,914	$1,486,414
	Shamalan	$0	$410,179	$1,706,835	$2,117,014
	Nad-i-Ali	$0	$214,483	$711,477	$925,960
	Marja	$0		$423,829	$423,829
	Darweshan	$0	$205,665	$1,858,935	$2,064,600
Steel Structures	Upper Boghra	$10,060	$0	$0	$10,060
	Shamalan	$37,870	$0	$0	$37,870
	Nad-i-Ali	$18,350	$0	$0	$18,350
	Marja	$9,160	$0	$0	$9,160
	Darweshan	$24,820	$0	$0	$24,820
Concrete Repairs	Upper Boghra	$0	$0	$108,514	$108,514
	Shamalan	$0	$0	$60,757	$60,757
	Nad-i-Ali	$0	$0	$11,505	$11,505
	Marja	$0	$0	$56,074	$56,074
	Darweshan	$24,300	$0	$0	$24,300
Sub-total		$3,368,965	$3,318,438	$6,009,840	$12,697,243
Road Rehabilitation					
	Lashkar Gah Regional Road	$1,152,000	$0	$0	$1,152,000
	Upper Boghra	$0	$844,976	$300,544	$1,145,520
	Shamalan	$0	$1,089,973	$1,135,813	$2,225,786
	Nad-i-Ali	$0	$663,139	$1,027,195	$1,690,334
	Marja	$0	$0	$1,255,937	$1,255,937
	Darweshan	$0	$798,463	$668,089	$1,466,552
Sub-total		$1,152,000	$3,396,551	$4,387,578	$8,936,129
TOTAL		$8,906,965	$7,714,989	$10,397,418	$27,019,372

Helmand Needs Assessment

HIGH PRIORITY

REHAB IMPLEMENTATION SCHEDULE AND COSTS

Description		First Year Schedule				Costs
Approve budget May '04	Hire Engineer June '04	Bid	Award	Rehabilitation Begin	Rehabilitation Complete	
Diversion Rehabilitation						
Upper Boghra		Jun-04	Aug-04	Oct-04	Nov-Dec 04	$2,178,000
Darweshan		Jun-04	Aug-04	Oct-04	Nov-Dec 04	$2,208,000
Total Costs Diversion Rehabilitation						$4,386,000

Water Conveyance		Bid	Award	Rehabilitation Begin	Rehabilitation Completed	
Canal	Upper Boghra	-	-	-	-	$0
Cleaning	Shamalan	-	-	-	-	$0
	Nad-i-Ali	Aug '04	Oct '04	Nov '04	Jan '05	$259,836
	Marja	Aug '04	Oct '04	Nov '04	Jan '05	$284,820
	Darweshan	-	-	-	-	$0
Total						$544,656
Drain	Upper Boghra	-	-	-	-	$0
Cleaning	Shamalan	Aug '04	Oct '04	Oct '04	Oct '05	$1,047,400
	Nad-i-Ali	-	-	-	-	$0
	Marja	-	-	Apr '04	Jul '04	$692,349
	Darweshan	Aug '04	Oct '04	Oct '04	Oct '05	$960,000
Total						$2,699,749
Steel	Upper Boghra	Aug '04	Oct '04	Oct '04	Oct '05	$10,060
Structures	Shamalan	Aug '04	Oct '04	Oct '04	Oct '05	$37,870
	Nad-i-Ali	Aug '04	Oct '04	Oct '04	Oct '05	$18,350
	Marja	Aug '04	Oct '04	Oct '04	Oct '05	$9,160
	Darweshan	Aug '04	Oct '04	Oct '04	Oct '05	$24,820
Total						$100,260
Total Costs Water Conveyance						$3,368,965

Regional Road Rehabilitation					
Lashkar Gah to Kandahar	Sept '04	Oct '04	Oct '04	Oct '05	$1,152,000
Total Costs Regional Road Rehabilitation					$1,152,000
Total					$8,906,965

Helmand Needs Assessment

MEDIUM PRIORITY | **REHAB IMPLEMENTATION SCHEDULE AND COSTS**

Description		Second Year Schedule				Costs
Approve Budget May '05	Hire Engineer Jun '05	Bid	Award	Rehabilitation Begin	Rehabilitation Complete	
Diversion Rehabilitation						
Shamalan Shunt at Lashkar Gah		Jun '05	Aug '05	Oct '05	Nov-Dec '05	$1,000,000
Total Cost Diversion Rehabilitation						$1,000,000
Water Conveyance						
Canal	Upper Boghra	Aug '05	Oct '05	Nov '05	Jan '06	$542,868
Cleaning	Shamalan	Aug '05	Oct '05	Nov '05	Jan ;06	$905,600
	Nad-i-Ali	-	-	-	-	$0
	Marja	-	-	-	-	$0
	Darweshan	Aug '05	Oct '05	Nov '05	Jan '06	$250,695
Total						$1,699,163
Drain	Upper Boghra	Aug '05	Oct '05	Oct '05	Oct '06	$297,441
Cleaning	Shamalan	-	-	-	-	$0
	Nad-i-Ali	Aug '05	Oct '05	Oct '05	Oct '06	$56,800
	Marja	-	-	-	-	$0
	Darweshan	Aug '05	Oct '05	Oct '05	Oct '06	$20,207
Total						$374,448
Bank	Upper Boghra	Aug '05	Oct '05	Nov '05	Jan '06	$414,500
Erosion	Shamalan	Aug '05	Oct '05	Nov '05	Jan '06	$410,179
Repairs	Nad-i-Ali	Aug '05	Oct '05	Nov '05	Jan '06	$214,483
	Marja	-	-	-	-	$0
	Darweshan	Aug '05	Oct '05	Nov '05	Jan '06	$205,665
Total						$1,244,827
Total Costs Water Conveyance						$3,318,438
Road Rehabilitation						
	Upper Boghra	Sept '05	Oct '05	Oct '05	Oct '06	$844,976
	Shamalan	Sept '05	Oct '05	Oct '05	Oct '06	$1,089,973
	Nad-i-Ali	Sept '05	Oct '05	Oct '05	Oct '06	$663,139
	Marja	-	-	-	-	$0
	Darweshan	Sept '05	Oct '05	Oct '05	Oct '06	$798,463
Total Costs Road Rehabilitation						$3,396,551
TOTAL						$7,714,989

Helmand Needs Assessment

LOWER PRIORITY

REHAB IMPLEMENTATION SCHEDULE AND COSTS

Description		Third Year Schedule				Costs
Approve Budget May '06		Bid	Award	Rehabilitation Begin	Rehabilitation Complete	
Water Conveyance						
Bank	Upper Boghra	Aug '06	Oct '06	Nov '06	Jan '07	$1,071,914
Erosion	Shamalan	Aug '06	Oct '06	Nov '06	Jan '07	$1,706,835
Repairs	Nad-i-Ali	Aug '06	Oct '06	Nov '06	Jan '07	$711,477
	Marja	Aug '06	Oct '06	Nov '06	Jan '07	$423,829
	Darweshan	Aug '06	Oct '06	Nov '06	Jan '07	$1,858,935
Total						$5,772,990
Concrete	Upper Boghra	Aug '06	Oct '06	Nov '06	Nov '07	$108,514
Repairs	Shamalan	Aug '06	Oct '06	Nov '06	Nov '07	$60,757
	Nad-i-Ali	Aug '06	Oct '06	Nov '06	Nov '07	$11,505
	Marja	Aug '06	Oct '06	Nov '06	Nov '07	$56,074
	Darweshan	-	-	-	-	$0
Total						$236,850
Total Costs Water Conveyance						$6,009,840
Road Rehabilitation						
	Upper Boghra	Sept '06	Oct '06	Oct '06	Oct '07	$300,544
	Shamalan	Sept '06	Oct '06	Oct '06	Oct '07	$1,135,813
	Nad-i-Ali	Sept '06	Oct '06	Oct '06	Oct '07	$1,027,195
	Marja	Sept '06	Oct '06	Oct '06	Oct '07	$1,255,937
	Darweshan	Sept '06	Oct '06	Oct '06	Oct '07	$668,089
Total Costs Road Rehabilitation						$4,387,578
TOTAL						$10,397,418

HELMAND NEEDS ASSESSMENT - CASH FLOW REQUIREMENTS BY CALENDAR QUARTER

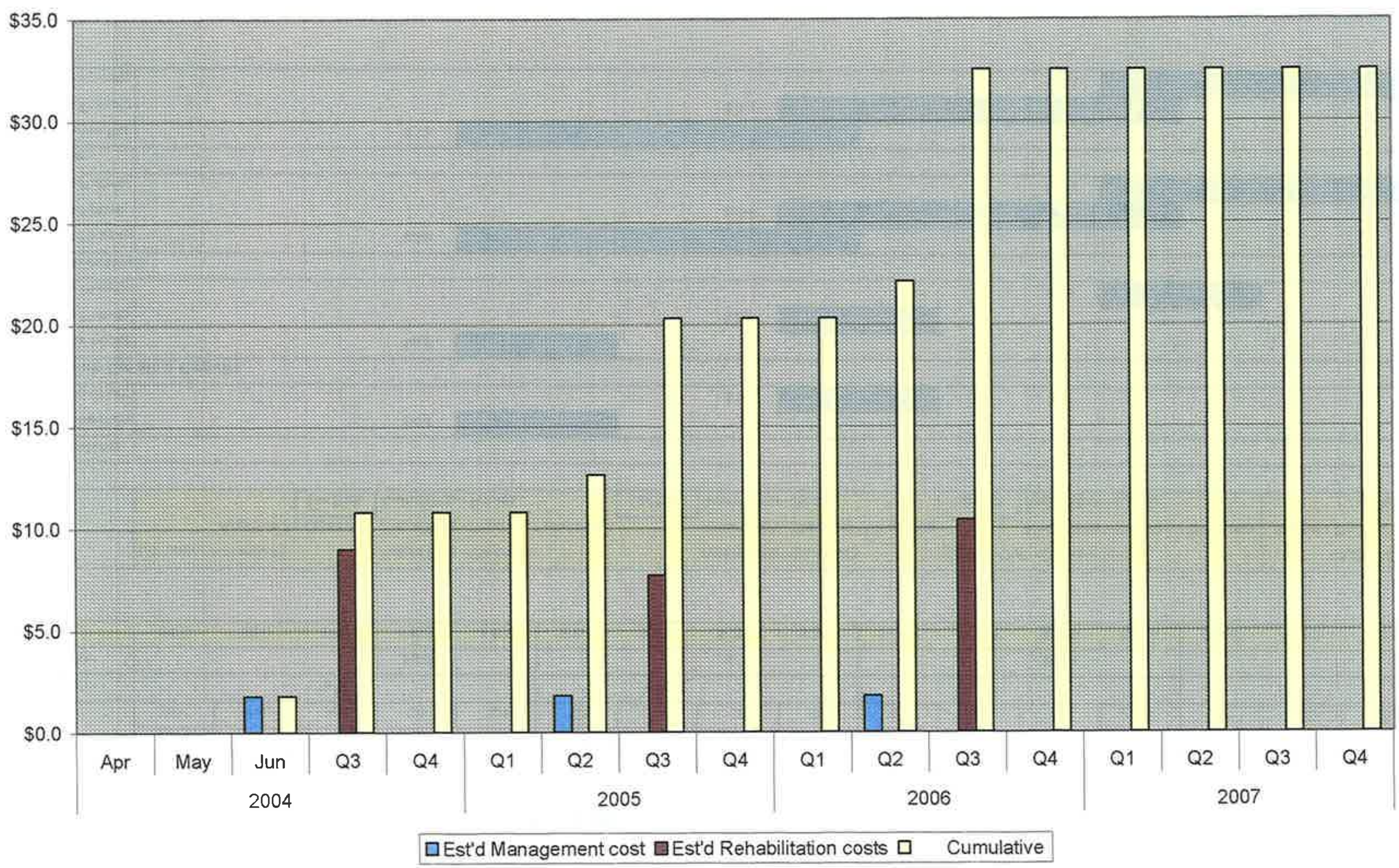
	2004					2005				2006				2007			
	Apr	May	Jun	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Est'd Management cost			$18				$18				$18						
Est'd Rehabilitation costs				$9.0				$7.7				$10.4					
Cumulative	$0.0	$0.0	$18	$10.8	$10.8	$10.8	$12.6	$20.3	$20.3	$20.3	$22.1	$32.5	$32.5	$32.5	$32.5	$32.5	$32.5

Management Schedule	2004		2005		2006		2007
	Complete Assessm't Approve Assessm't Let Bids	Award Bids - Diversion Award Bids - Cleaning / structures Award Bids - Roads	Let bids	Award Bids - Diversion Award Bids - Cleaning / Structures Award Bids - Roads	CLOSE OUT - Diversions Let bids	Award Bids - Cleaning / Structures Award Bids - Roads	CLOSE OUT Canals / Drains / Structural Work & Roads

	Apr	May	Jun	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Diversion Rehabilitation																	
Upper Boghra & Darweshan				$4.4													
Shamalan Shunt								$10									
Canal Cleaning / Bank Erosion Repairs																	
High Priority				$0.6													
Medium Priority								$2.9									
Lower Priority												$5.8					
Drain Cleaning & Structures																	
High Priority				$2.8													
Medium Priority								$0.4									
Lower Priority												$0.2					
Road Rehabilitation																	
Lashkar Gah Regional Rd.				$12													
Medium Priority								$3.4									
Lower Priority												$4.4					

	2004		2005		2006		2007	
Obligated Amounts as % of total		33.2% of total		62.4% of total		100% of total		
Total Management (@ 20%) &	$18		$18		$18		Total	$5.4
Rehabilitation Costs		$9.0		$7.7		$10.4	Total	$27.1

Helmand Needs Assessment - Cumulative Obligated Amounts



8.3 Institutional Reorganization

Background: Helmand and Arghandab Valley Authority (HAVA)

The Helmand and Arghandab Valley Authority (HAVA) was once established as a semi-autonomous authority of the government responsible for all functions for the development of land and water resources and generation of power, settlement of landless farmers on developed land, agricultural research and extension, improvement of seeds and animal husbandry, construction of canals, drains, farm roads, rural and urban development, and provision of health and educational services to the people living in this province. The president of HAVA was also the Governor of the Helmand Province. All this helped the Helmand Valley Project to become one of the most productive areas in Afghanistan. However, this drastically changed during the 23 years of war in the country. As a result, the authority and capability of HAVA has been reduced to a state of obsolescence.

Present Status of HAVA:

At present, the affairs of the Helmand Valley Project are controlled by different ministries from Kabul. They have their own representative/director in Lashkargah, the administrative center of the project. The HAVA exists only by name, it does not have the power, authority and funds that once it had to manage and coordinate what is needed for full utilization of water and land resources and achievement of high agricultural production and farm yields by water users and farmers in various areas of MHIAS. The result has been disrepair of the infrastructure, inability to deliver timely and adequate quantities of water to the farmers. Due to lack of management and maintenance erosion of canals below water control structures and some sections of the canals, silting and clogging of canals, irrigation and drainage systems and salinity of farmland has resulted in low agricultural productivity and income to the farmers.

Institutional Improvement:

To fully benefit from the recommended rehabilitation measures we believe that the institutions responsible for the implementation of government policies, project objectives, management and operation and maintenance of irrigation, drainage and road systems need to be reorganized. Reinstatement of the HAVA in its old form as an authority, we believe, will not be feasible under the present circumstances. On the other hand, continuance of current independent action by various entities is counterproductive. Coordination of inputs by local and central government departments and international entities is strongly needed in the MHIAS. The objective of helping water users and farmers to get full benefit of the recommended rehabilitation investments can only be realized with a well coordinated effort by all.

Reorganization of HAVA:

As an option, we recommend that HAVA be reorganized as Helmand Valley Coordination Board (HVCB), as follows:

- A Presidential Decree establishing and authorizing a Helmand Valley Coordination Board (HVCB) composed of representatives from related Central

Government Ministries, Local Authorities and Water Users Associations, in place of the old HAVA.
- The Chairman of the Helmand Valley Coordination Board to be appointed by the President of Afghanistan
- The appointment of the member/representatives of the HVCB by the proposal of the Chairman of HVCB, and agreement by the related ministry
- The appointment of member/representative of Water Users Associations to HVCB on the basis of election by the Board of the respective Association
- The HVCB to be responsible for the monitoring of all Government Policies, Coordination and Implementation of these Policies and the Project Objectives
- The HVCB to be responsible to coordinate all services and inputs by various Government Ministries and International Entities to Water Users and Farmers in MHIAS
- The HVCB to be responsible to assist water users and farmers in the formation of Water Users Associations (WUA) according to the policies, guidelines and regulations set for them

Operation and Maintenance of Dams:

Due to issues of water deliveries to areas above and below MHIAS, we recommend that the operation and maintenance of the Kajakai Dam, Boghra Canal Diversion and Intake, the Darweshan Canal Diversion and Intake, and the Shamalan Canal Diversion and Intake be assigned to the HVCB.

For this purpose and for the functioning of the HVCB, we recommend that necessary office space in the Head Quarters of the HVCB be set aside. Also, sufficient budgets for the O&M of dams, salaries of engineering, hydrological, contracting and clerical staff, cost of equipment and machinery need to be annually allocated by the Central Government upon request by the Chairman of the HVCB

Note: Number of staff and budget amounts for the above purposes would be relatively low in comparison to what was once in the old HAVA.

The cost of the maintenance of Regional and Inter-Area Roads need also be budgeted by the Central Government and contracted out annually by the HVCB to private contractors or the Helmand Construction Unit. For this purpose the HVCB need not have their own heavy machinery and equipment.

8.4. Water Users Associations

We recommend that the Operation and Maintenance of canals, irrigation and drainage systems, and farm road systems be relegated to the Water Users Associations, as discussed below:
- Steps be taken to empower groups of farmers and water users, who in turn elect their Mirabs, and representatives to the Association to take over the responsibility for the operation and maintenance of the rehabilitated infrastructure

- This will be a major step towards promoting sustainable irrigation and farming practices and high level of income to the farmers, as envisioned in the recommendations of this Rehabilitation Needs Assessment for the MHIAS.

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Organization of Water Users Associations:

We recommend that Water Users Associations be organized by the water users and farmers who benefit from the water, as follows:

- Provide help to water users to form their own Water Users Associations (WUA), elect their Mirabs, take over the O&M responsibilities, and prepare their Rules and Regulations
- Provide necessary organizational guidance and legal assistance to empower the water users and farmers to collect **proportional service charges** to cover the cost of management and technical staff, operation and maintenance of the systems that benefit them.
- The costs will include the O&M of the sub-systems, by the related Water Users Association in Upper Boghra, Nad-i-Ali, Marja, Shamalan, and Darweshan areas, for:
    - Conveyance canals
    - Lateral canals
    - Irrigation systems
    - Collector and Outlet drains
    - Farm drains and
    - Farm roads
- Water Users Associations may decide to do their maintenance work by direct labor, by hiring private contractors or the HCC

Capacity Building of Personnel for Operation and Maintenance:

It is recommended that a capacity building feature be included by the Management Firm retained for the implementation of rehabilitation in the scope of work of rehabilitation during the period of three years hired for this work. The objective shall be for contractors to hire employees with the caveat that they get hands-on training during the job as well as opportunity, if qualified, to be hired by WUA as technical and maintenance staff for future O&M work in their systems.

It is recommended that a program for assisting Water Users Associations to hire these trained cadres within the first three years and after the completion of rehabilitation work be made by the management of rehabilitation project. These trained cadres would be encouraged to take over a major part in the future O&M of the systems within their assigned areas.

Guidelines and Procedures for Water Users Associations:

Assistance should be given to the Water Users Associations for the preparation of Guidelines and Procedures for inclusions in their Charter and By-Laws.

Equipment for Operation and Maintenance:

New equipment and spare parts thereof, purchased by the Rehabilitation Contractors could be turned over, for future maintenance use, at depreciated value to HVCB, Helmand Construction Company (HCC) or the Maintenance Units of Water Users Associations (MUWUA). Provided that these equipment were purchased on the basis of specifications by the above entities. A Clause for inclusion in the Rehabilitation Contract or a Separate Contract could be prepared for this purpose. If this method is considered a viable option, lists and specifications of equipment and parts, costs and depreciated values, and source and allocation of funds will need to be determined.

8.5. Wind Break Tree Barriers

Sections of the West Boghra Canal, irrigation and drainage systems in the West Marja area are subject to windblown sand and silt from the Margo Desert. This condition causes excessive filling of the Boghra Canal, irrigation and drainage ditches results in high annual maintenance costs for the cleaning of canals and these systems.

The wind break tree barriers once planted were all destroyed during the 23 years of war, five years of draught and lack of water in the Marja area, necessitating our recommendation for the cleaning of these sections as a first priority item in this assessment.

However, past experience has shown that the need for the cleaning the Boghra Canal, irrigation and drainage ditches in this area would be greatly reduced if wind barrier desert trees were replanted as quickly as possible. The maintenance cost for watering and upkeep of these barriers is quite low, as compared to the cost of cleaning the Canal every three to four years.

We have not included the cost of replanting and maintenance of these wind break tree barriers in this assessment. However, we recommend that a program for the first cost of reforestation of these tree barriers could be justified for funding under RAMP, with the proviso that annual maintenance be under taken by the Marja area Water Users Association. In the mean time, a contract with a reputable NGO for the planting and maintenance of trees for a period of three years could be made under RAMP.

8.6. Illegal Water Use from Water Conveyance Channels

Water Pumps in Canals

Numerous water pumps are sucking water, for example, from the main Boghra Canal from the Upper Boghra to the Marja Area. While the downstream Marja area is suffering from shortage of water these pumps together with a number of drilled wells are irrigating out of project and low quality lands, mostly for the purpose of illicit plants, or poppies. Even after the rehabilitation of canals and irrigation systems downstream areas will not be able to get adequate irrigation water if pumps that illegally take water from the canals are not removed. A study of canal water carrying capacity and water demands for the farmlands in the project areas show that these pumps should immediately be removed and confiscated.

Similar situation of illegal pumps also exists in the Shamalan and Darweshan Canals. The downstream sections of all these canals are short of water while illegal pumps are irrigating out of project or higher elevation lands in these areas.

Investigation shows that most of these illegal pumps are the byproduct of 23 years war, neglect, lack of water management and the result of the prevalence of current gun-culture in these areas.

Obviously, the removal of these pumps will require full cooperation from the Water Department of HAVA, the Provincial and local Government, Police and in some cases the Military contingents in the area. However, intervention by the Central Government for this purpose will not be necessary.

The first action is to be taken by the Water Department of the HAVA, and if encountered with belligerence the HAVA may request help from local or provincial government's police department. Thereafter, continued monitoring and surveillance of the canals will be the responsibility of the HAVA Water Management, downstream Water Users Associations and Mirabs.

Water Pumps in Drains

A number of water pumps are also taking drain water from the collector drains. Since, the drain water salt content has reduced during the past 30 years of project operation, this water could be used as a supplemental source of water if co-mingled with fresh water from the irrigation system, without considerably hurting the farmland. However, the leaching capacity of this water will be lower due to the higher salt content of drainage water. Also, in most cases the farmers unnecessarily dam up the water in the drain for this purpose. The damming of the water flow in the drain results in raising of the water surface and drainage water backing into the farmland, causing subsequent water logging and salinity.

The Water Department of HAVA and the Water Users Associations and farmers after they are formed, should put a stop to this unnecessary practice. Instead of putting a dam in the channel, a pump suction hole in the side of the drain could accomplish the same purpose without getting the water dammed up in the drain.

Compliance with this rule should be implemented by the Water Users Associations and their Mirabs.

Footbridge Crossings

Communities and farmers who live in the proximity of drains usually construct their own footbridges for human and animal crossings. However, the foundation support of these crossings constrict the flow of water in the drain causing drain water to rise to a higher elevation. High water elevation in the drain backs into the farmland. This causes two immediate problems, the first is the reduction of drainage capacity from the farmland, the second is water logging and salinity in the farmland. We recommend that simple footbridges be made not to impede the flow of water in the drain. Two options could be considered in this respect.

1. Bridge Abutment Foundations to be spaced wide enough to allow free flow of water in the drain channel. In which case justification could be made to fund the cost of longer beam spans for the foot bridge.

2. Large diameter concrete or corrugated metal pipes laid side by side could form the footing of the bridge with sufficient number of pipes to allow for free flow of water in the drain channel. The cost of these pipes could be justified to be funded under RAMP.

Water pumped from drilled wells in the farmland

In many areas of the project lands farmers have drilled wells to about 40 to 80 meters deep to supplement irrigation water shortages. Depending in the area the quality of water from these wells could have lower salt content than drainage waters. However, since these pumps are run by diesel generators, the cost per unit volume of water is high. Farmers in project area lands use these pumps intermittently to meet water shortages.

Water pumped from drilled wells in desert areas

Quite a large number of wells are drilled in the desert area from Kandahar to Lashkargah, and from Girishk to the Marja area. Since, running of these wells by diesel generators are expensive, they are mainly used for high value crops, such as poppies.

Ground Water Geology studies by other agencies

In order to determine the discharge capacity and quality of water from deep wells, and recharge capacity of the aquifers feeding into them, it is necessary to carry underground water geological studies in the project farmlands and the extensive desert lands around project areas. These studies are, may be, outside the scope of the RAMP concept and fall within the scope of work by the Underground Water Geology Department of the Ministry of Mines who has done similar studies in the past. We recommend that necessary funding for these studies be sought from interested international donor agencies.

8.7. Future Studies

We recommend that a special study be approved under RAMP to further investigate drain water reuse with its implications on farmland salinity, high crop yields and returns to the farmers which were considered as primary objectives in establishing the recommendation priorities in this Helmand Needs Assessment Report.

We also recommend that RAMP authorize the following:

1. A rapid assessment of integrated water resources management needs in the Helmand Valley that includes institutional considerations and technical aspects, crop production and marketing issues.
2. An assessment of Rehabilitation and Integrated Water Resources Management.

These can be in two separate projects to comply with the current Helmand Needs Assessment and its recommendations, and/or Integrated Water Resources Management based on the above needs assessment.

DAI will consider it a privilege to be able to contribute to these further studies if so chosen.

END