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Kurram Tangi Dam Construction

Environmental Mitigation and Monitoring Plan
Annex II: Watershed Management Plan

December 2013
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Map to Kurram Tangi Dam Project Documents

Shown below is the suite of documents submitted to USAID under Contract AID-391-C-13-00002 for the KTDP. This report is shaded in red in order to show its relationship to the full set of documentation.

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	VOLUME II: PROJECT ECONOMIC BENEFITS
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	SUPPLEMENTAL REPORT ON SEISMIC HAZARD
	SUPPLEMENTAL REPORT ON HYDROLOGY
	SUPPLEMENTAL REPORT ON CLIMATE CHANGE

All documents may be read as stand-alone documents, but the reader should be aware of the full set of documents available. Any one document may reference other documents in the suite in order to avoid duplication.

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Kurram Tangi Dam Construction

EMMP Annex II: Watershed Management Plan

USAID Environmental Assessment of Kurram Tangi Dam Construction
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To USAID/Pakistan Energy Office
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Author: MWH Americas, Inc.

The author's views expressed in this publication do not necessarily reflect the views of the United States Agency for International Development or the United States Government.

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List of Acronyms

Acronym	Term
ANDS	Afghanistan National Development Strategy
CROPWAT	Decision support tool developed by the Land and Water Development Division of FAO
DEM	Digital Elevation Model
DFO	Divisional Forest Officer
DSL	Dead Storage Level
EAKTDC	Environmental Assessment of Kurram Tangi Dam Construction
FATA	Federally Administered Tribal Areas
FR	Frontier Region
KP	Khyber Pakhtunkhwa
KR	Kurram Reservoir
KTDC	Kurram Tangi Dam Consultants
KTMDP	Kurram Tangi Multipurpose Dam Project
MCO	Male Community Organization
MST	Million Short Tons
MW	Megawatt
NCL	Normal Conservation Level
NESPAK	National Engineering Services Pakistan
NRM	Natural Resource Management
NWA	North Waziristan Agency
O&M	Operation and Maintenance
OP	Operational Policy
PES	Payments for Ecosystem Services
PWS	Payments for Watershed Services
SWHP	Surface Water Hydrology Project
USACE	United States Army Corps of Engineers
USLE	Universal Soil Loss Equation
WAPDA	Water and Power Development Authority
WASID	Water and Soils Investigation Division of WAPDA

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Watershed Management Plan

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EXECUTIVE SUMMARY

The Kurram Tangi Multipurpose Dam Project will provide both power and irrigation benefits by developing the Kurram and Kaitu river systems. The project lies in North Waziristan (FATA), the Frontier Region (FR) Bannu, and the Districts of Bannu, Karak and Lakki Marwat. Component 1 on the Kaitu River involves construction of a low-head weir to facilitate the diversion of water to irrigation canals to two new command areas totaling 16,380 acres and an 18 MW powerhouse. Component 2 comprises the Kurram Tangi Dam and related structures. The purpose of the dam is for storage of water for irrigation and for power generation. Three powerhouses downstream will have a total installed capacity of 65 MW. The reservoir will cover 10,939 acres and store 1.2 million acre feet of water at full supply. Further downstream, Component 3 will consist of the new Thal Canal and the rehabilitation and upgrade of the existing civil canals to irrigate a new command area of 278,000 acres.

The catchment areas above the Kaitu Weir and above the main dam of Component 2 are located in the Federally Administered Tribal Area (FATA), a semi-autonomous part of Pakistan. FATA is administered by the Governor of Khyber Pakhtunkhwa (KP), under the overall supervision of the Ministry of States and Frontier Regions. Each tribal agency within FATA is administered by a political agent.

The Kaitu watershed upstream of the weir covers a total area of about 1,947 square miles, out of which only about 8 percent of it lies in Pakistan while 92 percent of it is in Afghanistan. The overall population density is 411 per square mile. Upstream of the future reservoir the Pakistani Kurram watershed lies almost entirely in Kurram Agency. The agency has a total area of 1,305 square miles. The overall population density upstream of the Component 2 reservoir is 425 per square mile.

Erosion in the Kurram and Kaitu watersheds is a result of natural as well as anthropological activities. The natural erosion process is high because of unstable, semi-consolidated rock formations and steep to very deep slopes. Historically, about one third of the Kurram catchment area, from valley bottom to upper mountain slopes was under forest cover, depending upon the altitude, climate, and soil conditions. With the Afghan–Russia war, indiscriminate cutting of trees and removal of woody vegetation was started by the Afghan refugees. Currently, the overall forest cover is about 1.4 percent. In addition, indiscriminate and unchecked grazing by the livestock has accentuated the deterioration of the rangelands. About half of the mountainous rangelands are severely degraded.

Since most of Kaitu watershed lies in Afghanistan a Watershed Management Plan cannot be developed until there is a bilateral agreement between Afghanistan and Pakistan. Interim measures should consider modifying the design of the weir to enable flushing and/or the construction of check dams upstream. After the discussions with WAPDA during the Stakeholder Consultation Workshop dredging was considered to be an expensive process with limited use in Pakistan.

It is recommended that WAPDA along with the Forest Department (FATA) and FATA Secretariat should develop a watershed management plan considering this framework for implementation purposes. The structural and non-structural mitigation measures outlined in section 6 need to be elaborated in a detailed Watershed Management Plan, including measures that are sustainable both for the environment and for the local people. The issue of Afghan refugees settling in the area and overgrazing needs to be addressed. Bilateral relations with Afghanistan will have to be established in order to implement the Watershed Management Plan since most of the Kaitu watershed lies in Afghanistan. Interim measures should consider modifying the design of the weir to enable flushing and the construction of check dams upstream.

With regard to the Kurram reservoir, the simplest approach to watershed management would be to extend to Kurram Agency the pilot initiatives already being carried out through the FATA Rural Development Project in Khyber, Mohmand, and Bajaur agencies. If communities engaged in

reforestation of deforested area with native tree species, they could be eligible to sell their carbon credits through the World Bank's Adaptation Fund. Once underway, further funding might be possible through a PES mechanism and/or a PWS mechanism.

1. INTRODUCTION

Development of the Federally Administered Tribal Areas (FATA) located on the Pakistan/Afghanistan border is one of the highest priorities of the Government of Pakistan. The area is rugged, generally arid and historically susceptible to violence due to the interplay of conflicting political ambitions in the region. Most of the population ranks among the poorest strata of the Pakistani society, unable to afford even the basic necessities of life. Gul (2010) concludes that this extreme poverty, combined with a lack of planning and massive corruption by the administrative system, has resulted in an infrastructure that does not address modern, especially urban, requirements. The result has been a gradual degeneration in commercial, political, cultural and educational growth in the whole FATA region.

A pre-requisite for development is the availability of water and electricity so commercial activities can grow and create job opportunities. Constructing a dam to produce electricity and supply reliable irrigation water is an ideal activity to spur development in the region. The proposed Kurram Tangi Dam Project (KTMDP) is a first step towards achieving this goal.

In order for international donors to fund the KTMDP, a series of environmental and social studies must be carried out in accordance with the international requirements. This Watershed Management Framework is part of a comprehensive series of interrelated socio-economic and technical studies which include: an Environmental Assessment; an Environmental Mitigation and Monitoring Plan; a Resettlement Policy Framework; a Resettlement Action Plan; an Emergency Preparedness Plan for downstream communities in the event of a dam failure; an Instrumentation and Monitoring Plan; a Waste Management Plan; a Health and Safety Framework Plan; a Fisheries Management Plan; a Gender Plan; a Cultural Heritage Preservation Plan; and, a Vulnerable Tribes and Peoples Plan.

1.1. Reasons for Preparing a Watershed Framework

Watershed Management is an extensive exercise which requires precise existing quantitative land-use data including the following field investigations:

- Vegetation features (forest area, density and type of trees, area/s affected by grazing and its type);
- Waterways;
- Visible sediment yield (reliable information about erosion and sedimentation needs to be available only then can we calibrate information about erosion and sedimentation yield); and,
- Identification of type of erosion (rill, sheet, gully, etc.) in the area for deriving Erosion Intensity Maps.

It is then based on the above stated data that the capacity of the features, their sensitivity to change during the project and current operations and management practices which can be implemented could be understood for evaluation. Besides field investigations, a Watershed Management Plan comprises of a time bound action plan, cost estimates and assigned roles and responsibilities of the concerned departments with the basic aim to ensure that the proposed Project does not instigate issues such as erosion, sedimentation, reduction in vegetation, land degradation etc.

During the Scoping Exercise it had become evident that field investigation would be very difficult to conduct due to the security issues and sensitive conditions in the catchments areas which rendered it impossible for the experts to visit and collect information in the Project Area. Moreover, a substantial proportion (more than 90% of Kaitu Watershed and more than 35% of Kurram Watershed) of both the watersheds lie in Afghanistan which makes it difficult to collect data until and unless governments of both the countries sign a treaty and allow collateral framework/plan to be implemented. All these reasons made it impossible to prepare a Watershed Management Plan.

Since data was deficient, modeling was considered as another approach for analyzing the catchment area however, that was also not possible due to the lack of following information:

- Coefficient of soil resistance to erosion;
- Coefficient of land-use;
- Coefficient of observed erosion process; and,
- Rainfall erositivity etc.

Therefore due to all these reasons a Watershed Framework instead of a Watershed Management Plan has been prepared with a basic philosophy to provide guidelines for WAPDA and Forest Department, FATA to develop a Watershed Management Plan in the future while remaining within the boundaries of Pakistan either by sourcing out or by themselves depending on the funds and security conditions in the area.

Further the Land-use and the Erosion Vulnerability maps have been prepared in the light of the framework for assisting WAPDA and Forest Department, FATA to take prioritized actions specifically in erosion prone areas (although, these areas are subject to change depending on field investigations and site surveys that will be done in the future).

2. PROJECT DESCRIPTION

The Kurram Tangi Multipurpose Dam Project is a water resources development project that will provide both power and irrigation benefits. It focuses on the development of the Kurram and Kaitu river systems. The project lies mostly in North Waziristan (FATA), the Frontier Region (FR) of Bannu, and the Districts of Bannu, Karak and Lakki Marwat. The catchment areas spread across the international border between Pakistan and Afghanistan. The current estimated cost of the project is approximately $600 million. WAPDA has already completed all the regulatory paper-work to start construction as soon as funds become available.

For ease of planning and execution, the project has been divided by WAPDA into three major components.

2.1. Component 1: Kaitu Weir, Power and Irrigation (Tribal Area Development)

Component 1 involves construction of Kaitu Weir, Sheratalla Canal System, Spaira Ragha Canal System, Feeder Tunnel, Pump Stations, Powerhouse-IV, Powerhouse-V and other ancillary works such as roads and transmission lines.

A low-head weir will be constructed in the Kaitu River about 400 feet upstream of the Mirali -Thal Road Bridge. The weir forms a pool of water facilitating the diversion of water to irrigation canals on the right bank and to the Kurram Tangi Dam Reservoir via Powerhouse-IV. In addition, the weir provides a means to safely pass Kaitu flood during monsoon.

From the Kaitu Reservoir, there will be two separate off-takes for the Sheratalla and Spaira Ragha.

The proposed Spaira Ragha Canal System located on the left bank of the Kaitu River will comprise of concrete lined gravity and lift channels provided with regulating structures, cross drainage structures, bridges, culverts, escape structures and outlets. A pumping station, capable of lifting 10 cubic feet per second will feed water to Spaira Ragha Canal. The pumping station will comprise a pump house, five electric pumping sets and ancillary electrical and mechanical works.

The proposed Sheratalla Canal System on right bank will comprise of eight distributaries, seven minors and sub-minors, regulating structures including head regulators, cross drainage structures, bridges, escape structures and outlets. This canal divides into two canals, one of which will have a 55 foot lift and will use electricity produced from Powerhouse V.

The canals will have differing sizes at various segments but will have a trapezoidal shape and will have a concrete lining throughout. The scope of Component 1 works is limited to the construction of the main, distributary and minor canals. The tertiary canals will be constructed by the community user groups.

There will be a third off-take from the Kaitu Reservoir to provide water for a powerhouse located in the Kurram River watershed. A sediment excluder is provided at the beginning of the waterway. The excluder will be a 60 feet wide and 120 feet long concrete structure allowing the suspended sediment to settle down before entering the feeder channel. Water then travels through a 950 feet long feeder channel leading to a 14 feet diameter feeder tunnel excavated under the high mountain located in the left bank of the Kaitu River. The 6,100 feet long tunnel is followed by a headrace channel and a 900 feet steel penstock culminating in the Powerhouse IV. A short tailrace channel will discharge water from the powerhouse to the Kurram Tangi Dam Reservoir. Powerhouse IV and associated waterways thus facilitate the diversion of Kaitu River flows in excess of irrigation requirement at the Spaira Ragha and Sheratalla systems for storage in Kurram Tangi Dam and generate a maximum of 18 MW of hydropower.

A new 32 kV transmission line will connect the Powerhouse IV switchyard to the existing substation at Domail. A state-of-the-art computer based control system will be provided for the powerhouse.

The possibility of energy recovery from the gravity flow of the Sheratalla Canal has been identified. To that end, a small powerhouse will be constructed along the Sheratalla Canal. The energy generated from the Powerhouse V is expected to be used to run the pumping station provided in the Spaira Ragha Canal. Water will be conveyed to the surface type powerhouse via a waterways system consisting of a feeder tunnel, headrace channel and two parallel penstocks.

The Mir Ali-Thal Road and the bridges along the road will be upgraded to make them suitable for handling the design loads required to transport the heaviest piece of equipment used in the project. The Spinwam Bridge, especially, will be inspected for soundness. If its design loading is found to be insufficient to carry heavy load construction vehicles, the existing ford downstream could be modified with the addition of a concrete slab crossing.

2.2. Component 2: Kurram Tangi Dam and Related Structures (Dams and Hydropower Development)

The basic purpose of the proposed Kurram Tangi Dam is for storage of water for irrigation and for power generation. Its height will be 322 feet above the river bed and have a crest length of 1,035 feet. At present, up to 50 percent of the flows from Kurram River underutilized, as there is a lack of storage capacity within the river basin. By constructing the proposed Kurram Tangi Dam flows from Kurram River will be regulated. Water will be released according to the irrigation requirements and downstream user demands, while the excess water available will be stored for use during low flow periods. The Kurram Tangi Dam will also store excess water from the Kaitu River basin that will be diverted via a diversion tunnel. Additionally, a main powerhouse with an installed capacity of 38.0 MW is proposed at the foot of dam, and two additional powerhouses with a capacity 10.40 and 16.50 MW are proposed between the main dam and the Kurram Garhi Headworks.

The proposed Kurram Tangi reservoir will be used mainly to meet irrigation needs of the existing Civil Canals, Marwat Canal and the new area in Thal Plain. Water from the reservoir will be released back to Kurram River after generating electrical power. These releases will reach Kurram Garhi Headworks after passing through the main powerhouse (Powerhouse No. I) as well as two powerhouses located in between the dam and the headworks (Powerhouse II and III). At the Kurram Garhi Headworks water will be diverted to the respective canals as per their requirements and quotas. The Kurram Tangi Dam and Reservoir Characteristics can be seen in Table 2-1.

Weirs II and III: There are two weirs along Kurram River downstream of the dam which are used to create small reservoirs for power generation. Weir II, with a crest length of 414 feet, is located approximately 8,000 feet downstream of the main dam and will be used to divert water to Powerhouse II, and will be 496 feet long and 20 feet high. Weir III, with a crest length of 1,190 feet, is also located along the Kurram River, and is about 30,000 feet downstream of the main dam. Weir III will be 1,320 feet long and 75 feet high.

Powerhouses I, II, and III: Three powerhouses are proposed in Component 2. Powerhouse I, the main powerhouse, will be located at the toe of the dam, and have an installed capacity of 38.0 MW. Powerhouse II will be located 2.1 miles downstream of the dam and has an installed capacity of 10.4 MW. A 16 feet diameter, 5,400 feet long tunnel will be connected to the penstock through a forebay for conveying water to Powerhouse II. Powerhouse III will be located 4.8 miles downstream of Powerhouse II. A tunnel of 16 feet diameter and 3,400 feet long will be connected to the penstock for conveying water to Powerhouse III with an installed capacity of 16.5 MW. These three powerhouses will be connected by a new transmission line to the existing substation at Domail.

Road improvements include construction of a new access road for Powerhouse II on the right bank of the river. This road will take off from new access road from dam site and follow the existing track to Powerhouse II. It involves rock cutting but does not involve any bridge. Its length would be 4.7 miles. Its width will also be 30 feet.

A new approach road for Powerhouse III will also be needed. The road involves construction of a bridge. The road will be constructed along the right bank of the river for access to the intake tunnel and powerhouse. The total length of roads will be 1.9 miles.

The existing road from the dam site to Powerhouse III on the left bank of the river will be improved. The existing road is about 10 miles. Upgrades will include construction of 1 bridge, 12 culverts, and 12 causeways.

Weir and Powerhouse II: At the weir site, the river occupies a single channel near the right bank on the outside of a bend. The width of the whole channel at this point is about 640 feet, allowing space for construction of the weir against the left bank. A cofferdam will create a work space in that area, leaving the river to flow through the remainder. When the weir is complete the remaining space will be closed by an embankment, allowing the river to flow through the undersluices. Water from the weir will be conveyed by a horseshoe-shaped tunnel 16 feet wide and about 5,000 feet long, excavated by conventional means. It will end in a 400 foot open aqueduct conveying the flow over a nullah to a concrete forebay. A 14 foot diameter penstock will convey the water to the above-ground powerhouse, located on the Kaitu River, about 500 feet upstream of its junction with the Kurram. The powerhouse will be constructed of reinforced concrete. A tailrace channel about 500 feet long will discharge the water into the river.

Weir and Powerhouse III: The weir for Powerhouse III is much larger than the other weirs in the system, being more like a small dam. At the presumed site, the river flood plain is about 700 feet wide and the flow in April is restricted to the right bank, in a channel about 50 feet wide. The remainder of the flood plain appears consist of a sand bar, the part against the left bank being devoted to agriculture.

The circular power tunnel will be 3,250 feet long and 16 feet in diameter. The resulting 24,200 cubic yards of excavate will be spoiled from adits along the route. The land along the tunnel is largely uninhabited, but in the neighborhood of the powerhouse there is irrigated cropland.

Table 2-1: Kurram Tangi Dam and Reservoir Characteristics

Crest elevation	2,142 feet above sea level
Crest width	45 feet
Crest length	1,035 feet
Maximum height above river bed	322 feet
Full Reservoir Capacity	1.2 million acre feet
Live storage	0.9 million acre feet
Dead storage	0.3 million acre feet
Reservoir area	10,939 acres
Average annual flow at dam site	908,000 acre feet

2.3. Component 3: New Thal Canal and Command Area (Irrigation System Development)

Component 3 includes the new Thal Canal and the rehabilitation and upgrade of the existing civil canals to improve the water conveyance performance of the present systems.

A new head regulator will be constructed at the Kurram Garhi Headworks to service the new Thal Canal. The head regulator has one bay with vertical lift gate. Thal Canal will be on the left bank of Kurram Garhi Headworks and leads to a tunnel. The tunnel will run underneath the high mountain for 3,100 feet before it transitions back into a trapezoidal channel. The canal takes its course through undulating hills, crosses various streams and ends in Karak District. The canal system will have 19 distributaries, 4 minors, 2 sub-minors totaling in length about 73 miles.

The project will also upgrade about 200 miles of old canals (collectively called civil canals and built by landowners) with a command area of approximately 107,500 acres, and the Marwat Canal with a command area of 170,500 acres.

The existing Marwat Canal located on the left bank of the Kaitu River will be upgraded to concrete lined gravity channels provided with new or rehabbed regulating structures, cross-drainage structures, bridges, culverts, escape structures and outlets.

The canals will have differing sizes at various segments but will have a trapezoidal shape and will have a concrete lining throughout. The scope of Component 1 works is limited to the construction of the main, distributary and minor canals. The tertiary canals will be constructed by the community user groups.

3. ADMINISTRATIVE AND LEGAL FRAMEWORK

3.1. General Policy for Watershed Management Plan

Watershed management should be an integral part of water resources development. Large projects are designed by using the historical values for erosion and sediments, hydrology, and water quality. Any large-scale changes in land-use in the catchment area will affect these values and will generally have a negative impact on the project(s) downstream.

Sediments reduce the storage capacity of the reservoir. Once sediments begin to pass through the turbines, scouring and damage will occur. The useful life of the project ends when the production of electricity no longer covers the cost of maintenance and repair and the generating losses caused by shut-downs.

Wherever there are small permanent streams, which flow during the dry season, then there must be aquifers upstream where water is being stored. These are usually areas of deep soil which act like sponges, soaking up water when it rains and releasing the water slowly all the time. The vegetation may be forest, or it may be low shrubs covering a peat bog. Whatever the vegetation, it is usually a "climax" community of plants. If the plant cover is degraded or removed, the soil erodes away and the aquifer is eventually lost. Once the aquifer is lost, there will be an increase the frequency and amplitude of floods, resulting in less efficient generation of electricity and less water for irrigation during the dry season.

Direct corrosion of both concrete and steel structures of hydroelectric dams is known to be produced by water. Turbine generator parts may be corroded by H_2S if made of materials that can form metallic sulfides. Increased nutrient input can cause excessive eutrophication, resulting in the proliferation of aquatic weeds.

The principles of watershed management have been summarized by Ali (2013):

1. Watershed management must be participatory. Target communities have to be motivated to function and contribute as groups to perform various tasks. Thus, the adequacy of planning depends on the human element and not only on physical or technical aspects. Planning must start from people living on the land. The watershed communities must be involved in all stages of implementation of watershed development activities.
2. Watershed management is a continuous process and should take an inter-disciplinary approach. It requires a coordinated analysis by a team of scientists representing various disciplines like environment, hydrology, geology, engineering, soil science, forestry, agronomy, and economists.
3. Watershed management must be gender sensitive. Women are the most affected by environmental hardships. For example, they need to walk long hours to fetch increasingly scarce water, firewood and animal dung in addition to attending livestock, to name a few. Their involvement in watershed development planning, implementation and management is the key to ensure that they equally benefit from the various measures.
4. Watershed management plans must focus on local experience, strengths and weaknesses. Local knowledge is essential to improve the existing technologies, to adopt new ones and to manage natural measures once they are introduced and established. Social attitudes and socio-economic conditions may limit the adoption of a plan.
5. Watershed management plans must be realistic, integrated, productive and manageable, and based upon local capacity, available resources and of government and partner support. Integrated conservation and development base is the guiding principles of watershed management. The watershed activities must be tangible and provide quick benefits the households. The measures must accommodate both production and conservation. Management is not only for the sake of conservation it must include both conservation and production.

6. Watershed management must be flexible at different levels. Flexibility is needed during the selection of community based, their size (slightly smaller or flexibility or higher than the ranges indicated), and clustering and during the steps of the producer. Flexibility is also essential when considering the choice and design of measures within agreed criteria of quality and integration.
7. Watershed management must be cost-sharing and empowerment/ownership building. Cost-sharing by stakeholders contributes to the sustainability of the projects for establishing the responsibility of various stakeholders in the management of the resource.
8. Watershed management must be complementary to food security and rural development. Watershed deployment planning should incorporate additional elements related to basic services and social infrastructure.
9. Flexible approaches are always needed. There is never a rigid, step-by-step "cookbook recipe" for watershed management. Different regions have watersheds that function in different ways, and even neighboring watersheds can have major differences in geology, land use, or vegetation that imply the need for different management strategies. Different communities vary in benefits they want from their watersheds. Therefore, watershed management is a dynamic and continually readjusting process that is built to accommodate these kinds of changes.
10. A watershed management framework shall support partnerships, using sound science, taking well-planned action, and achieving results.

3.2. Administrative Structure in the Project Area (FATA and KP)[1]

The catchment areas above the Kaitu Weir and above the main dam of Component 2 are located in the Federally Administered Tribal Area (FATA).

FATA is a semi-autonomous part of Pakistan. It is represented in the National Assembly and the Senate but remains under the direct executive authority of the President. The FATA is governed primarily through the Frontier Crimes Regulation 1901. It is administered by Governor of Khyber Pakhtunkhwa (KP) in his capacity as an agent to the President of Pakistan, under the overall supervision of the Ministry of States and Frontier Regions in Islamabad.

In 2002, the FATA Secretariat was set up. In 2006, the Civil Secretariat FATA was established to take over decision-making functions, with an Additional Chief Secretary, four secretaries and a number of directors. Project implementation is now carried out by line departments of the Civil Secretariat FATA. The KP Governor Secretariat plays a coordinating role for interaction between the federal and provincial governments and the Civil Secretariat FATA.

Each tribal agency is administered by a political agent, assisted by a number of assistant political agents, tehsildars (administrative head of a tehsil) and naib tehsildars (deputy tehsildars), as well as members from various local police (khassadars) and security forces (levies, scouts). As part of his administrative functions, the political agent oversees the working of line departments and service providers. He is responsible for handling inter-tribal disputes over boundaries or the use of natural resources, and for regulating the trade in natural resources with other agencies or the settled areas.

The political agent plays a supervisory role for development projects and chairs an agency development sub-committee, comprising various government officials, to recommend proposals and approve development projects. He also serves as project coordinator for rural development schemes.

Interference in local matters is kept to a minimum. The tribes regulate their own affairs in accordance with customary rules and unwritten codes, characterized by collective responsibility for the actions of individual tribe members and territorial responsibility for the area under their control. The government functions through local-level tribal intermediaries, the maliks (representatives of the

[1] http://fata.gov.pk/index.php?option=com_content&view=article&id=50&Itemid=84

tribes) and lungi holders (representatives of sub-tribes or clans), who are influential members of their respective clan or tribe.

FATA elects members to the federal legislature through adult franchise. A system of partial local-level governance operates through councils in the tribal agencies. Elected councilors are involved in various aspects of development planning and decision making.

FATA is divided into two administrative categories: protected areas are regions under the direct control of the government, while non-protected areas are administered indirectly through local tribes.

Existing Institutional Setup in the Project Area

As per discussion on September 17, 2013, with DFO, North Waziristan Forest Division, the Forest Department is the only department involved in watershed management activities in the catchment areas (falling in Pakistan) of Kaitu and Kurram. These activities involve; increasing green cover, protecting the existing cover, undertaking soil conservation and adopting structural measures (loose stone, contour ditches, check dams in nullahs on hilly slopes etc). Besides this their main roles and responsibilities include the following;

- To motivate and convince local tribes to protect and enhance forest cover; and,
- Regulate grazing practices by undertaking relevant activities on their communal lands/hills.

According to the DFO the local tribes need to be organized to ensure their fruitful involvement in all such activities for greater success and for this purpose the political administration has to take the leading role.

Further details of the discussion have been annexed as **Annex 4.**

3.3. Environmental Legislation

The Pakistan Environmental Protection Act, 1997 is the principal legislative tool empowering the government to frame regulations for the protection of the environment. However, the primary legislation that deals with watershed management in Pakistan is related to forestry.

The Forest Act, 1927, authorizes Provincial Forest Departments to establish forest reserves and protected forests. The Act prohibits any person to set fire in the forest, quarry stone, remove any forest produce or cause any damage to the forest by cutting trees or clearing areas for cultivation or any other purpose. However, under the Constitution, a law enacted by the parliament is not applicable to FATA unless the President of Pakistan issues special orders regarding its extension there. This has yet to be done with the Forest Act.

Wani (2005) reviewed the National Forest Policy, 2002. He states: *With the construction of dams and reservoirs to generate hydropower and supply water to the massive irrigation works that support the national agricultural economy, watershed management in the mountains has become a national priority. Loss of vegetation cover in the watershed areas seriously impairs the hydrological cycle resulting in landslips and flashfloods, causing damage to infrastructure, settlements and loss of human and animal lives. The main causes of watershed degradation are forest conversion, improper agricultural practices and fragmentation of land, complex land tenure arrangements and poverty. During the last three decades, watershed management has assumed special significance and received attention in federal and provincial governments. A number of integrated watershed rehabilitation projects with a focus on community organization and participation have been implemented with considerable success. Experience has shown that the sectoral approach to mountain development has to be replaced by an integrated NRM approach with multi-stakeholder participation to address*

the special environmental values of mountain watersheds. Prolonged drought and a reduced amount of snowfall in the mountainous areas have decreased water availability in major rivers considerably, creating water scarcity in the country. Since water-related issues and conflicts are expected to worsen due to the effects of climate change, the management of upland watersheds will become the policy thrust area during this century. Pakistan, like other countries, is celebrating the International Year of Mountains 2002 under Agenda 21. There is a need to prepare a strategic plan for sustainable mountain development in partnership with local communities and the private sector. The 1955 policy recommended coercive measures to control land use. However, plans to construct dams in the late 1950s brought the need for large-scale watershed management programs to the fore. Recommendations on watershed management have been an integral component of forest policies since 1962. Large-scale afforestation, planting of fruit trees, and soil and water conservation measures have been major recommendations. The policies also recommended the provision of incentives to farmers and subsidies on cooking stoves and kerosene to reduce the use of fuelwood. The 1991 policy recommended watershed planning and coordination as a federal function, with implementation continuing to be the responsibility of the provinces.

Wani (2005) notes further: *Donor-assisted community forest projects have been able to revive some of the old traditional of "asher" (collective labour). Many community organizations voluntarily contribute to afforestation and watershed rehabilitation programs. The concept of Joint Forest Management Committees, in which all the stakeholders are involved through dialogue and consensus, of sustainable forest and watershed management is also gaining momentum. The revised Forest Policy 2002 seeks to strengthen local institutions for the protection and management of natural forests.*

The Pakistan Forest Institute is carrying out research in watershed management http://pfi.gov.pk/Watershed%20Management.html.

4. BASELINE INFORMATION

Given the fact that the border with Afghanistan is 14 river miles upstream of the site of the proposed Kaitu Weir, the baseline studies for the Kaitu watershed have been less detailed.

The base line data are derived mainly from the following sources:

- HARZA – NESPAK (1978) Soil Studies of D.I. Khan Area.
- KTDC (2004) Feasibility Report. Kurram Tangi Dam Consultants comprised of PES (Pakistan Engineering Services) Pvt. Ltd., MMP (Mott MacDonald Pakistan) Pvt. Ltd., Progressive Consultants (PC) Pvt. Ltd., In-Consult Pvt. Ltd., and Khyber Consulting Engineers in association with Coyne et Bellier (France).
- TNO-DGX and WAPDA (2001) Bannu Basin Studies.
- WAPDA (1960) Planning Report Kurram River Basin WAPDA.
- WAPDA (1967) Reconnaissance Report on Kurram River Basin.
- WAPDA (1990) Conceptual Report on Kurram Tangi Dam.
- WAPDA (1992) Kurram Tangi Dam Multipurpose Project – Pre-feasibility Report.
- WASID WAPDA Geohydrology Studies of Bannu Basin – 1968.
- WASID WAPDA Geohydrology Studies of Bannu Basin – 1986.
- WASID WAPDA Geohydrology Studies of Bannu Basin – 1987.

Additional information was obtained through discussions with:

- Geological Department of FATA DC.
- Geological Survey of Pakistan.
- Peshawar University

4.1. Kaitu Watershed

Information with regard to the Kurram Watershed has been mainly extracted from the Feasibility Report, Kurram Tangi Dam Construction Project (KTDC, 2004). However, the same could not be done for the Kaitu Watershed primarily due to the security issues and sensitive conditions in the Project and watershed area which rendered it impossible for the experts to visit the Project Area. A field team comprised of locally recruited surveyors was mobilized to survey the area. However, they were not specialists in erosion and the information collected by them was of limited use. Therefore, the information has relied on similar projects involving same areas or projects having similar transboundary issues.

The Kaitu watershed covers a total area of about 1,947 square miles, out of which only about 8 percent of it lies in Pakistan while 92 percent of it is in Afghanistan.

Table 4-1 shows the distribution of Kaitu watershed in both the countries. The watershed area is generally barren, very undulating with higher elevations composed of bare rock surface. In Afghanistan the watershed mainly lays within the Khost province while in Pakistan it mainly lies in North Waziristan Agency in FATA.

Table 4-1: Distribution of Kaitu Watershed areas in Pakistan and Afghanistan	
Kaitu watershed in Afghanistan	1,798 square miles
Kaitu watershed in Pakistan	149 square miles
Total :	1,947 square miles

Figure 1 (3553-NES-KTDP-EA-0005) shows the land use statistics of the Kaitu watershed according to the GIS analysis. From the figure it can be evaluated that about 83 percent (1,611 square miles) of the area is barren/hilly, 9 percent (184 square miles) of the area is agricultural land, 4 percent (75 square miles) of the area is covered by forest, 2 percent (36 square miles) of the area is built-up, 0.12 percent of the area is covered by glaciers and about 2 percent (39 square miles) is nullahs/streams.

The Kaitu River is called the Shamal River in Afghanistan. It drains approximately 1,796 square miles in Afghanistan before entering Pakistan. Most of the Shamal watershed lies within Khost Province with very small portions (13 percent) in the Paktika and Paktya Provinces.

The Khost Province covers an area of 1,556 square miles with 59 percent being mountainous/semi-mountainous terrain and 39 percent made up of flat lands. The province is divided to 13 districts. The total population (2007) is 640,000, of which 160,000 live in the provincial Khost City. Thus, the overall population density is 411 per square mile.

Agriculture is the main source of income for nearly half (46 percent) of households (ANDS 2007). Over half (54 percent) of rural households own or manage agriculture land or garden plots. However, around half (54 percent) in rural areas also derive income from trade and services and a quarter (24 percent) earn income through non–farm related labor. Livestock also accounts for some income for around a third of rural households. The most commonly owned livestock are cattle, goats, donkeys, and sheep. A variety of industrial crops (including sugar cane, sesame, olives, and cotton) are produced in Khost. Food processing industries are very scarce in Khost. They exist in only 29 villages, 20 of which produce honey and 4 which produce milk. Handicrafts are produced in 116 villages. Other small enterprises include carpet and rug weaving, and jewelry. Iodine salt and plastic factories are also in the province. On average 64 percent of household in the province have access to irrigated land, and two fifths of rural households (41 percent) have access to rain fed land.

The 2009 report of the US Army Corps of Engineers describes the Shamal watershed as primarily weathered, interbedded sandstone, siltstone, clay and limestone, with large areas of deep unconsolidated sediments ranging from gravel to loess. Slopes range from >30 percent in the west to 0 to 5 percent in the east.

The valley is heavily irrigated with networks of irrigation diversions, canals and drains. They concluded that the watershed does not have high potential for irrigation storage dams nor for hydropower. Most of watersheds contributing stream flow are in poor condition. Any new dams would have to be designed and maintained to handle high sedimentation rates in the reservoirs. The project watersheds generally consist of erodible soils and there is widespread active gully and rill erosion. The stream systems are unstable resulting in high sedimentation potential and flash flooding. A significant amount of recent deforestation has exacerbated the sediment problem.

4.2. Kurram Watershed

Note: The information (especially quantitative figures) stated for the Kurram watershed has mainly been extracted from the EIA-Feasibility Report (2004).

About six miles upstream of the future reservoir of Component 2, the Pakistani Kurram watershed lies almost entirely in Kurram Agency. The agency has a total area of 1,305 square miles. The population is estimated to be 935,000 (http://frc.com.pk/administrative-units-2/agencies/kurram-agency). In general, the people are not literate and earn their livings by farming as tenants on land owned by others. However, a significant number of locals are residing and working abroad and have brought some prosperity to the area. Upstream of the Kurram Agency, in Afghanistan, the Kurram River drains from Paktika Province (http://www.aims.org.af). The watershed covers the districts of Chamkani, Dand Wa Patan, Jaji, Jani Khel, and Lija Mangal. Their combined population is 142,400 (http://www.statoids.com/yaf.html). Thus, the overall population density upstream of the Component 2 reservoir is 425 per square mile.

The Kurram Tangi Watershed extends between latitudes 32°09'N and 34°00'N north and longitudes 69°15'E and 71°15'E east. It covers an area of 6,080 square miles comprising of catchment area that drains water through the Kurram and Kaitu Rivers which confluence three miles downstream of the proposed Kurram Tangi Dam site.

The Kurram River watershed can be divided into two sub watersheds:

- Upper Kurram sub-watershed covering 3,298 square miles.
- Lower Kurram sub-watershed covering 2,786 square miles.

The Upper Kurram River sub-watershed is subdivided further into:

- Upper Kurram valley.
- Lower Kurram valley.

The Upper Kurram sub watershed lies between Kohe-e-Sufaid and Thal and is most productive. Forests, pastures and terraced agricultural fields are common features of this part. The main forest species are deodar blue pine and *Quercus* (Baloot). The valley is famous for apples, pears, grapes, peaches and cherries.

The lower Kurram sub-watershed comprises the southern half of the Kurram River catchment which includes Tochi River sub-catchment of the Gardez province of Afghanistan and is characterized by steeply dissected mountain ranges, poor rangelands, and sparsely vegetated slopes.

There are two prominent valleys in this sub catchment:

- Daur valley.
- Khaisor valley.

Separated by high barren hills composed of fragile rocks of Eocene sandstone and conglomerate interbedded with limestone, these valleys generate large amounts of sediments.

4.2.1 Hydrology

The Hydrological review of the Kurram Tangi Dam was a part of the study of this project. For further details please refer to the Hydrology Supplemental Report. However the inferences concluded from the report have been stated as under.

The stream flow records have been updated. The flow data for the Kurram River at Thal and Kurram Garhi Headworks has been checked for consistency. The discharge data of Kurram River at Thal has been found to be consistent, which was indicated inconsistent by Design Consultant. The water availability was estimated with Kurram Garhi Headworks flows. It is also recommended that a site visit of all three stream gauging stations should be carried out by flow measurement Specialists to check the accuracy of discharge measurement procedures and rating curves. Moreover, Review Consultants have estimated water availability with Thal data due to its hydrological homogeneity

with Kurram Tangi Dam catchment area, which shows 8% more inflows from Design Consultant estimates. It is recommended that a site visit of all three stream gauging stations should be carried out by flow measurement Specialists to check the accuracy of discharge measurement procedures and rating curves. Once historical flow data for the Kaitu weir and Kurram Tangi reservoir have been confirmed, weir and reservoir operation studies should be updated. Diversion design flood has been estimated with updated data and shows some difference with design consultant estimates, which is due to updated data. Catchment areas have been delineated by using DEM and it is suggested to re-delineate a few areas having significant difference. Design Consultant grossly underestimated the (Probable Maximum Precipitation) PMP and it is recommended to revise PMP studies by Design Consultant. It is also recommended that the PMF should be reviewed and recalculated after revising the PMP. Once a new PMP and PMF are calculated, the adequacy of the proposed spillway should be re-evaluated and revised.

4.2.2 Geology

The Kurram river watershed presents a complex geological and geomorphological history of orogenic disturbance and erosional depositional cycles. Predominantly, the rocks exposed in the watershed are sedimentary, comprising the following formations and groups.

4.2.3 Topography

The Kurram river watershed ranges from more than 14,000 feet to less than 1,000 feet. The valley bottoms are narrow and V or U shaped which open up into a broad flood plain south of Bannu Town.

The principal mountain range in Kurram agency is the Koh-e-Sufaid or Spinghar with peak of Sikaram Sar (15,512 feet) which remains covered with snow throughout the year. South of the Peiwar Kotal, the hills of the Mandher range (below 8,860 feet) rise gradually till they drop to the south-west corners of the plateau at Kharlachi. Kurram valley extends from Thal to Peiwar Kotal, a distance of 195 miles. For the first 45 miles it is narrow and hedged in by low hills on either side of the Kurram River. After that it opens out into Parachinar plateau sloping south-eastwards with an average breadth of 8 miles.

The Bannu valley is a low structural basin and is bounded by Karaghoza hills rising up to 2,323 feet. The important passes of the area are Kurram and Tochi named after Kurram and Tochi rivers. The Bannu basin is a large alluvial plain with general elevations from 984 to 1,969 feet.

The study of the downstream reach of the river was also undertaken by NESPAK. In this study, additional information was obtained for the reach through satellite imagery analysis to identify agricultural areas, forests, grazing lands, human settlements, etc., which depend on Kurram River flows for their sustenance. The downstream reach of Kurram River will continue to receive flows from the Tochi and Kaitu rivers and hill torrents (algads) to fulfill limited domestic, livestock, and wildlife requirements.

4.2.4 Landforms

The following landforms have been identified in Kurram river watershed.

Mountains
The exposed mountainous rock covers a major part of the watershed. The rocks are mostly sedimentary with some metamorphic and igneous ranging in age from Cretaceous to Tertiary. They rise in elevation from more than 1,000 feet to above 14,000 feet. Geological erosion on these mountains has been accelerated by anthropogenic activities.

Hills
In the southern part of the watershed, hills comprised of rocks of the Upper Pleistocene to Miocene age. They have low relief amplitude, steep and very steep slopes of weatherable shales and clays forming troughs and resistant sandstone, capped by sandy or stony material. Deep gullies and rills also occur on the slopes, where erosion is active and vegetation cover is non-existent.

Gravelly Terraces
Vast expanses of gravelly terraces occur in the mountain foot slopes of gravelly and stony piedmont material. The highest terraces are the oldest ones belonging to Pleistocene age, the middle ones are of Sub-recent age and the lowest ones of recent origin. They suffer from physiological drought and support only a sparse cover of vegetation.

River Terraces
River terraces occur as narrow strips along the Kurram River and its tributaries, terraced post-glacially.

River Plains
River plains have been formed as the broad flood plains in this reach. Scouring and sediment deposition are prominent, resulting in the development of a series of gravel/stony bars. These plains are predominantly used for irrigated agriculture by the Marwat canal and some civil canals.

Piedmont Terraces
These occur in small patches in the Parachinar valley, comprising loamy to fine silty materials derived from northern metamorphic and sedimentary rocks. They occupy level to nearly level physiographic positions; lower than the gravelly terraces are predominantly used for irrigated agriculture.

4.2.5 Soils

A major part of the watershed comprises residuum and alluvium derived from in-situ weathering of bedrock.

Soils of the mountains and hills (residuum and colluviums)
Steep mountains and hills with 50 percent to 80 percent slopes comprise bare rocks. The soil cover is of shallow to moderate depth over bedrock, and is often patchy and discontinuous. In the sub-humid and at higher altitudinal zones, the soils are non-calcareous or, at the most, slightly calcareous, and well humified. They contain a higher content of organic matter and are neutral to acidic, with pH ranging from 5.8 to 7.0. The soils of semi-arid regions and lower altitudinal zones are calcareous and alkaline, containing lesser amounts of organic matter with pH ranging from 7.6 to 8.1. All of the mountain soils are weakly developed and range in thickness from 12 to 30 inches over bedrock.

Soils of Piedmont Gravelly Terraces
Highest, intermediate, and lowest terraces have been found based on elevation, age and degree and depth of dissection.

The highest terraces belong to the Pleistocene age, which contain shallow to moderately deep gravelly loams/clay loams strongly calcareous soils having soft caliche in the subsoil, where desert varnished stones on the surface and semi-weathered rock fragments are present.

The intermediate surface belongs to the subrecent age. The soils of this terrace are similar to its highest counterpart but differ in degree of soil development, amount of lime content and amount of desert varnishing of surface rock fragments, which are less as compared to the higher surface.

The third and lowest surface has been developed in recent coarse alluvium. Being youngest in age, the soils show no signs of profile development. These soils do not contain secondary lime content in the profile and lack desert varnish on the surface rock fragments. Rather they bear a fresh appearance.

Soils of the Piedmont Plains

These are moderately deep and deep, loams and clay loams over gravels and stones. They are well drained, with good water holding capacity and fertility level. These soils are used for terraced cultivation for a variety of crops, chiefly rice and fruit orchards under irrigation.

Soil Surface Erosion

The Feasibility Consultants are of the view that half of Kurram river watershed is highly degraded ecologically. The gravelly fans and terraces, in the upper catchment in temperate climate, are less susceptible to erosion, and erosion damage is reversible. Surface erosion is less conspicuous in the Kurram River watershed compared to other forms of erosion such as rill, gully, and mass wasting, but the former is more prominent.

Soil erosion in the Kurram River watershed has the following major potential impacts:

Irreversible loss of soil and vegetation on the mountain slopes, that covers about 50 percent of the watershed.

Increased sediment loads of the western rivers originating in the degraded mountains in Afghanistan. However, the amount of man-made or accelerated erosion although considerable, is negligible compared with that of natural geological erosion. Natural soil erosion rates are high in the Kurram River watershed because of the Neogenic rock formation, unstable and highly erodible mountains, and their constant tectonic uplifting and subsequent incision of rivers. Enhanced sedimentation has a number of downstream impacts, such as a shortening of the lifetimes of the reservoirs, dams, irrigation channels and other water control structures.

Loss of top soil containing most of the nutrient and organic matter resulting in reduced soil fertility, and water holding capacity and, therefore, productivity.

The barren mountain slopes left after the complete erosion of soil have a reduced moisture storage capacity, resulting in large flash floods during the erratic monsoonal rainstorms. Such flash floods make complete flood control engineering impossible. On the other hand, water catchment yield is higher from barren slopes and if managed well, represents an opportunity for both range rehabilitation and groundwater recharge on the gravelly fans and terraces downstream.

The loss of topsoil by surface erosion is a direct result of heavy rains pounding unprotected soils. The loss of a fraction of an inch of topsoil every year may not make a spectacular visual impact, but the cumulative effect is the impoverishment of the soil base.

Soil Rainfall Erodibility and Aridity

All the mountain soils in the watershed are characterized by shallower depth over bedrock, having a clayey texture with a low amount of fine sand, silt, organic matter, and an unstable structure. They have low infiltration and high surface run-off.

The magnitude of surface soil erosion is directly related to the type and intensity of rainfall. The Kurram River watershed in all its length and breadth, receives monsoon rains of high intensity rainfall. All of the land systems (landforms) therefore, are subject to rainfall erosivity to various degrees depending upon their topographic forms and landuse/land cover. Due to the reduction of historic forest cover from 30 percent to the current 1.4 percent in the watershed, this area has become vulnerable to aridity.

Bank Cutting / Erosion
As a result of cutting the trees and other vegetation in the upper watersheds the mountain slopes have been rendered barren resulting in loss of water as runoff or flash floods which causes undermining and scouring of banks during high peak periods of water-intake. Sporadic structures of gabions spurs have been constructed but with little success.

4.2.6 Vegetation

The land cover of this watershed is shown in Table 4-2:

Table 4-2: Kurram River Watershed Land Cover

Type of Land	Square kilometers	Square miles	Percentage of total
Forest	220	85	1.4
Scrub Forest	1,653	638	10.5
Rangeland	10,908	4,212	69.3
Cultivable land	2,968	1,146	18.8
Total	15,748	6,080	100.0

The biological environment of the Kurram River watershed has been divided into nine zones:

Zone 1 – Snow Desert
The upper most part of Kurram River basin including Koh-e-Sufaid remains covered with snow above an elevation of 13,800 feet throughout the year. In summer, some lichens appear on exposed rocks. However, this zone is the main source of water supply to the Kurram River during low rainfall period.

Zone 2 – Alpine Zone
This zone lies between elevations 12,000 feet and 13,800 feet. The flora in this zone is made up of:

- Dry alpine plateau pastures;
- Dwarf scrub; and,
- Dwarf Rhododendron scrub.

Dwarf Juniper shrubs are commonly found on rocky and drier sites.

Zone 3 – Sub Alpine Zone
The Sub-alpine zone is located between 10,400 feet and 12,400 feet elevation. The sub alpine zone is indicated by Birch (*Betula*), Blue Pine (*Pinus wallichiana*), Deodar (*Cedrus deodara*), Juniper (*Juniperus macropoda*), and Silver Fir (*Abies pindrow*). The zone is prone to heavy grazing and removal of fuel wood to the extent of uprooting even the shrubs. The vegetation as a whole is xerophytic; the foliage giving grayish tinge and leaves smaller than ordinary size. Aromatic shrubs are dominated by *Artemisia*. Many shrubs are thorny and tufted.

Zone 4 – Dry Cool Temperate Forest Zone (Conifers)
The dry cool temperate forests can be divided into two parts. The upper part containing mostly conifers and the lower part containing mixed forests. The upper part containing conifers extends from an elevation of 8,900 feet to 10,400 feet. The flora is dominated by Chilgoza pine, Deodar, Blue Pine, Junipers, Fir and Spruce.

Zone 5 – Dry Cool Temperate Forest (Broad Leaved and Coniferous)
The forests occupy an elevational zone between 7,400 feet and 8,900 feet. At 7,900 feet, the Piewar forest typically represents the broad leaved forest on shaley limestone. The major tree species is *Quercus ilex*. Eight different species of flora are found in this zone.

Zone 6 – Dry Temperate Zone
This zone is located between elevation 5,400 feet and elevation 7,400 feet. Cardinal points in this zone are Parachinar (elevation 4,300 feet) and Chapri (elevation 7,600 feet).

Zone 7 – Warm Temperate / Sub Tropical Zone
This zone lies between 3,000 feet and 5,400 feet elevation. Important locatable spots in the zone are Mandori (elevation 3,200 feet), Ali Zai (elevation 3,400 feet), Sultan (elevation 4,000 feet), Sadda (elevation 4,026 feet) Arwali (elevation 4,106 feet), Shah da Kot (elevation 4,106 feet), Haider Ali (elevation 4,533 feet), Malikilli (elevation 4,765 feet), Sragalla (elevation 5,238 feet).

Zone 8 – Dry Sub-Tropical Forest
Subtropical zone is located between 2,000 feet and 3,000 feet elevation above sea level. The dam site, the weir on Kaitu River and the storage reservoir are located in this zone. Important locations in this zone are the Kurram Tangi Reservoir dam site pool with 2,200 feet elevation, the Kaitu Weir 2,345 feet elevation, Shewa town at 2,345 feet elevation and Thal at 2,838 feet elevation.

Zone 9 – Hot Sub Tropical Thorn Forests
This is the lowermost zone in the Kurram river watershed and is located between 1,000 feet and 2,000 feet elevation. The zone lies just below Kurram Tangi Dam site. The other important locations in this zone are Bannu (1,190 feet) and the Thal Plains.

4.2.7 Kurram Watershed Land-use

The Kurram watershed covers an area of about 2,536 square miles with about 64 percent of the watershed area being in Pakistan while the rest of it lies in Afghanistan. Table 4-3 shows the distribution of Kurram watershed in both the countries. The watershed area is generally mountainous and barren with sparse cover of vegetation mostly used for grazing. Runoff in the area is very high and geological erosion on these mountains is also active which has been further accelerated by man as a result of devegetation.

About six miles upstream of the future reservoir of Component 2, the Pakistani Kurram watershed lies almost entirely in Kurram Agency. The agency has a total area of 1,305 square miles. The population is estimated to be 935,000 (http://frc.com.pk/administrative-units-2/agencies/kurram-agency) giving a density of 716 per square miles. In general, the people are not literate and earn their livings by farming as tenants on land owned by others. However, a significant number of local inhabitants who are residing and working abroad and have brought some prosperity to the area.

Table 4-3: Distribution of Kurram Watershed areas in Pakistan and Afghanistan

Kurram watershed in Afghanistan	919 square miles
Kurram watershed area Pakistan	1,617 square miles
Total :	2,536 square miles

The Kurram watershed area is shown in Figure 2 (3553-NES-KTDP-EA-0007). Land use statistics according to GIS analysis at watershed level include: agricultural land 9 percent (219 square miles); barren/hilly areas 75 percent (1,896 square miles); built-up areas 1.5 percent (38 square miles); forest 13 percent (321 square miles); glaciers 0.7 percent (19 square miles); and, nullahs (streams) 1.72 percent (43.74 square miles).

4.3. Area of Influence

The AOI has a relatively plain landform as compared to the catchment areas of Kurram and Kaitu Rivers. In the westward direction, the areas adjacent to Janikhel up to Khairokhel lies along the foot

hills of north-south oriented mountains, which are adversely affected by flash floods especially during the monsoon season which prevails from June to September. Hence, these areas are prone to erosional hazards caused by flash floods and sheet flows. Similarly, erosion caused by land degradation further reduces the agriculture productivity of this area. This can be overcome by planting trees and channelizing the drainage network of the area.

In the northeast direction of the AOI near Sadakhel, number of waterways passes through the area, originated from east-west oriented mountains in the north. These include a number of local nullahs (streams) flowing in the area including Khurra Nullah near Omarzai settlement, Chashma Nullah near Sadakhel, Tarkhobakaal Nullah near Sharifwala and many more feeding the Kurram River. Due to non-cohesive nature of the top soil, water is the principal agent of erosion in this area; especially along the banks which are prone to erosional hazards. Excessive erosion in this area may cause problems such as collapsing of banks, sedimentation in waterways and ecological disturbance due to loss of the nutrient rich top soil layer.

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5. ASSESSMENT OF IMPACTS

5.1. Natural Erosion

The project comprises parts of the two watersheds, the Kaitu and Kurram watersheds. The two major impacts expected to occur in both the watersheds include erosion and sedimentation. Further ahead impacts on both the watersheds are discretely discussed with their mitigation measures suggested accordingly. The reasons for the stated impacts in both the watersheds remain the same because the climatic and the geological formations are similar.

Erosion in the Kurram and Kaitu watersheds is a result of natural as well as anthropological activities. Another important point to be kept in mind is that the assessment and analysis stated in this annexure is strictly based upon desktop studies of the previous documents and evaluation of the experts. A detailed field survey has not been carried out, due to sensitive security conditions in the area.

The fragile geological formation, rainfall, land sliding and sloughing are all natural reasons for erosion in both of the watersheds. The watershed conditions upstream of the dam, reservoir and the three irrigation schemes are poor. The natural erosion process is high because of neogenic, unstable, semi-consolidated rock formations and steep to very deep slopes.

Landslides and mud flows are common features in the Upper Kurram watershed. They can mainly be attributed to tectonic movements in combination with frequent earth tremors, related to unstable geological conditions and concentration of run off on roads because of improper construction and insufficient drainage. Furthermore, unprecedented landslides upstream of Kaitu Weir can further create a situation that may deprive water to flow downstream. While on the other hand sloughing can bring large trees and heavy boulders from upstream changing the morphological configuration of the river.

5.2. Anthropogenic Erosion

Historically, about one third of the Kurram catchment area, from valley bottom to upper mountain slopes was under forest cover, depending upon the altitude, climate, and soil conditions. With the Afghan–Russia war, indiscriminate cutting of trees and removal of woody vegetation was started by the Afghan refugees. Initially the trees were lopped and branches removed for construction, firewood and forage for the livestock. Subsequently, almost all available trees and shrubs in the vicinity of their camps were wiped out and lastly even the plant roots were dug out for fuel, leaving the area, a bleak denuded region. Currently, the overall forest cover is about 1.4 percent.

Wholesale deforestation by and for Afghan refugees from steep and very steep fragile mountains and persistent overgrazing and uprooting of shrubs has given rise to accelerated erosion in the area. Soils on the mountains slopes are thinning out. They have lost or are losing fertility and productivity irreversibly. The result has been that the bedrocks to the extent of 70-80 percent have been exposed; the trend is ever on the increase. Rainwater falling on the bare rocks, without being absorbed, immediately flows down the slopes, as runoff with greater velocity, carrying greater amount of sediments and depositing them in the lower reaches of rivers in the watershed and causing flash floods, damaging agricultural land and infrastructures. This will be a potential threat to the life-span of the Kurram Tangi Dam, if this scenario continues.

The indiscriminate and unchecked grazing of the local livestock (especially that of Afghan refugees) has accentuated the deterioration of the rangelands. Free access of the livestock herds of the refugees to the already degraded rangelands has devastated a large proportion of the ranges. In the southern part of the watershed they are reaching a point of no return. About half of the mountainous rangelands are severely degraded.

Due to persistent grazing pressure, palatable grass species of good forage value have been more or less wiped out from the rangelands which have been greatly invaded by inferior species of grasses and shrubs in the area. In general, the grasses and shrubs in the area have decreased to an alarming extent. Currently they are producing 10 to 20 percent of their potential production.

This has created a serious imbalance between forage production and requirements in the area. The animals are underfed with low body weights, low wool and hair production, low resistance to disease and climatic harshness. Mortality among them is high.

If the present trend of range and watershed areas deterioration continues, the remaining rangelands might well be gone in the next decade. If this does occur it will have a negative impact on the proposed Kurram Tangi Dam and the reservoir which will be silted up faster than estimated, due to excessive sedimentation from its catchments.

During initial operational time of the dam, less nutrients and sediments will cause the river to become sediment hungry which will also affect the biota of the river.

5.3. Transboundary Issues

Pakistan has a water treaty with India. Afghanistan has water treaties with Iran, Tajikistan, Uzbekistan, Turkmenistan, and Kyrgyzstan. However, there is no water sharing agreement between Afghanistan and Pakistan.

Neither Pakistan nor Afghanistan is a signatory to the 1997 United Nations Convention on the Law of the Non Navigational Uses of International Watercourses. In fact, as of September 24 2013, only thirty-one countries have acceded to the UN global convention on transboundary river use and four more countries are still needed for the agreement to come into force (International Water Law Project, 2013).

If WAPDA were to seek funding from the World Bank for the KTDP, then OP 7.50 (Projects on International Waterways) would apply. This OP defines the procedure to be followed for projects that the WB finances which are located on any water body that forms a boundary between, or flows through two or more states.

This policy applies to the projects related to; (a) hydroelectric, irrigation, flood control, navigation, drainage, water and sewerage, industrial, and similar projects that involve the use or potential pollution of international waterways including any river, canal, lake, or similar body of water that forms a boundary between, or any river or body of surface water that flows through, two or more states, and (b) detailed design and engineering studies of projects, including those to be carried out by the Bank as executing agency or in any other capacity.

The Bank requires the beneficiary state, if it has not already done so, formally to notify the other riparians of the proposed project (World Bank, 2001). If the prospective borrower indicates to the Bank that it does not wish to give notification, normally the Bank itself does so. If the borrower also objects to the Bank's doing so, the Bank discontinues processing of the project. The Bank ascertains whether the riparians have entered into agreements or arrangements or have established any institutional framework for the international waterway concerned. In the latter case, the Bank ascertains the scope of the institution's activities and functions and the status of its involvement in the proposed project, bearing in mind the possible need for notifying the institution. Following notification, if the other riparians raise objections to the proposed project, the Bank in appropriate cases may appoint one or more independent experts to examine the issues.

5.4. Summary of Sedimentation

Sedimentation is a major issue during the construction and operation a dam which determines the life of the reservoir; therefore sediment study has been carried out as a part of the Kurram Tangi Dam Project. For more details please refer to the Hydrology Supplemental Report. As per review that was done by the Design Consultants the following inferences had been concluded:

- Average annual sediment yield of Kurram River at Thal: 1.48 acre-feet/square mile.
- Total sediment load entering into Kurram-Tangi reservoir: 5.93 MST per year. This total load includes suspended and bed loads of Kurram River and only suspended load of Kaitu river; bed load transport through Kaitu-Kurram feeder has been assumed zero as the crest level of Kaitu weir has been set significantly higher than the river bed level.
- Particle size distribution of sand, silt and clay likely to enter into Kurram Tangi reservoir;
  Sand 14.4%
  Silt 63.3%
  Clay 22.2%
- Reservoir effective life estimated as 225 years.
- Sediment storage or dead storage fixed as 200,000 acre-feet, based on a dead storage level (DSL) fixed at 1,975 feet above sea level.

However, after reviewing and evaluation the following conclusions were drawn by the Review Consultants;

- SWH's measured mean annual sediment yield of 1.56 acre-feet per square mile of Kurram River at Thal is underestimated on the basis of correlation of long-term published mean-annual specific runoff and sediment yield of Gomal, Darban Zam and Tochi rivers at various gauging stations.
- Based on the regression analysis of long-term observed mean annual sediment yields of the river basins contiguous to the Kurram catchment, an estimate of mean annual sediment yield for Kurram River at Thal was calculated.
- Sediment studies carried out at feasibility and detailed engineering design stages lacks detailed numerical modeling exercises for estimating temporal and spatial distribution of sediments in the Kurram Tangi reservoir.
- Sediment deposition and distribution of deposited sediments in the Kurram Tangi reservoir have been estimated at detailed engineering design stage by employing the empirical methods of Brune's curve and empirical area-reduction methods. The estimated sediment deposition and the corresponding distribution at various reservoir depths have been determined by the design consultants according to which the sediment dead/storage fixed as 200,000 acre feet would be lost by sediment deposition in about 85 years. The overall effective life of the reservoir would be of the order of 225 years. These estimates have been made by considering average annual sediment influx of 5.93 MST into the Kurram Tangi reservoir.
- To verify the Design Consultant's estimates of reservoir sedimentation, the same annual sediment load of 5.93 MST has been used and Brune's curve has been used to determine the time to fill the reservoir storage capacity. The analyses indicates that the time to deposit 200,000 acre-feet of sediments - as being equivalent to the dead/sediment storage fixed at detailed engineering design – is 55 years.
- By using a revised sediment influx of 12.52 million Tons per annum into the Kurram Tangi reservoir, the dead/sediment storage of 200,000 acre-feet would be filled with sediments within 25 years of project operation.
- To retain the detailed engineering design's DSL (1,974 feet asl) and a live storage of 1,000,000 acre-feet, the Normal Conservation Level (NCL) would be required to be raised by 22 feet. This would require raising the height of dam, resulting in an increase of the effective life of the project from 25 to 55 years.
- If the dam height, NCL and DSL are unchanged, the live storage would be reduced to 760,000 acre-feet which would reduce the amount of water for irrigation and hydropower.

- By not employing sediment management measures, it is expected that the capacity of the reservoir would be filled with sediments in about 170 years of operation.
- Given a host of uncertainties in the measured runoff and particularly sediments, it is recommended to undertake a detailed sediment measurement program so that the sediment yield may be verified.
- There is a need to carry out numerical modeling of reservoir sedimentation to determine the effectiveness of drawdown flushing or pressure sluicing (the best known sediment removal methods).
- Channel degradation in the river stretch downstream of the dam needs to be studied to determine the potential change in river regime and its effect on aquatic ecology.
- Besides the channel degradation, sediment ingress into the power tunnel should also be studied to better manage the potential threats of turbine abrasion associated with reservoir sedimentation.

5.5. GIS Analysis of Erosional Hazards in the Catchment Areas

GIS Analysis of the catchment areas of Kaitu River (Figure 3 (3553-NES-KTDP-EA-0052)) and Kurram Tangi Dam reveal (Figure 4 (3553-NES-KTDP-EA-0053)) that they have a significant potential of erosion hazard which cannot be ignored during the studies. But due to the limitation of the desktop studies, a comprehensive analysis of the erosional hazard cannot be achieved. However, an effort has been made to highlight the potential areas which might be subject to erosional hazard and also to provide a guideline for further detail studies during the course of preparation of Watershed Management Plan by Forest Department FATA and WAPDA in the future.

For this purpose, high resolution satellite imageries of April 2013 were used for the interpretation and analysis of erosional features within the catchment areas of Kurram Tangi Dam and Kaitu River. Based on the information extracted from satellite imageries are tied up with the geological and geo-morphological conditions of the catchment areas (Kurram and Kaitu) and its vicinity. As earlier discussed the limitations of desktop studies, precise categorization of erosional features (i.e. sheet erosion, rill erosion, gully erosion etc.) cannot be made. Therefore, depending upon the geological conditions and intensity and severity of the erosional features a broader and generalized classification has been developed i.e. (a) More Significant, (b) Moderate significant and (c) Less significant based on expert judgment.

Geo-morphologically, the catchment area has a high relief and number of local streams/nullahs flows in the area, feeds the Kurram and Kaitu Rivers. The areas along the streams are prone to more significant erosion hazard as compare to the areas high relief. Excessive erosion especially along the streams causes problems such as bank collapse, sedimentation in waterways and ecological disturbance due to loss of the nutrient rich upper soil layers. Therefore a detailed Watershed Management Plan should be prepared considering the guidelines given in this framework.

6. MEASURES

Though erosion usually has irreversible impacts, adopting mitigation measures will reduce its magnitude and thus increase the life of the reservoir while maintaining its capacity. Some of these measures are structural (engineering) while others are non-structural (non-engineering/management) measures.

The Kaitu and the Kurram watersheds can be managed by adopting non-structural (management) as well as structural (technical) measures. The structural measures can be planned and implemented as short term plan and those of non-structural ones as long term arrangements. Both types of arrangements would, however, need constant maintenance, monitoring and improvements in accordance with the new developments and facilities.

6.1. Structural Measures

As envisaged from the available resources/studies, the following types of structural measures can be adopted for watershed management in Kurram Tangi Dam watershed:

- **Diversion Drains:** In case of landslides it is imperative to prevent new run-off formation along the existing gullies and drainage lines. If this is not possible, diversion drains have to be constructed in order to safely evacuate excess run-off.
- **Erosion Control Principles:** All efforts should be undertaken to ensure construction and maintenance of roads in the upper watershed in accordance with erosion-control principles.
- **Gully Plugs:** These can be constructed. Gully Plugs are small earthen structures which are constructed across the nullahs. Their main purpose is to hold water and let it percolate into the ground rather than retaining sediments.
- **Community Involvement in Afforestation:** The community in the area needs to be trained and should be involved in afforestation activities so that the run-off does not cause soil erosion in the area, especially in the rainy season.
- **Natural Vegetative Management:** Natural vegetative management including temporary protection from grazing, or limiting grazing lands to a particular common area as discussed by the community.
- **Boulder Check Dams**: These are made of stones, in places where hard, durable stones are abundant for the treatment of gullies and streams.
- **Check Dams:** Check dams generally regulate and control the slope of water ways and flood channels. However, they are constructed according to problems, needs and aims. Usually they are constructed as flood walls (to control flood) and silt traps (to control sediment).
- **Gabion Check Dams:** These are flexible structures and easy to construct, especially in catchments with difficult access.
- **Masonry Check Dams:** They are constructed with cement mortar and non-disintegrating stones which are generally used in torrent control. The main objective of the dam is to hold fine and coarse material carried by flowing water in the gully or torrent.
- **Bio-Engineering Methods:** These include open check dams to retain floating debris. Floating logs and debris are considered as major problems in the upper watershed. The most simple protection measure, especially against floating debris, is so called Living combs. A slightly more sophisticated retention structure can be constructed from impregnated poles, placed in V-shape across the channel. However, regular maintenance and removal of logs and debris are required to ensure the functioning of the structure.
- **Mixing of Layers:** For keeping a balance of sediments downstream after dam operation water to be released from the dam should be a mix of upper and lower layers along with effective monitoring to be carried out at the rivers with the results analyzed accordingly. Moreover, when the river becomes sediment hungry due to the construction of dam it naturally starts

collecting sediments from the banks of the river. Therefore, all these factors will make sure that the biota downstream is affected to the minimum.

- **Reduction of Steepness of Slopes.**
- **Stone Pitching for Slope Stabilization.**
- **Landslide Entrapments.**
- **Flood Diversion Structures.**
- **Detention Dams.**
- **Delay Action Dams.**
- **Flood Alleviation Reservoirs.**
- **Flood Diversion Tunnels/channels.**
- **Sediment Sluicing Tunnels.**
- **A combination of two or more of above structural measures.**

A specific detailed study, along with the topographic as well as geotechnical surveys, would be needed for the proper planning and designing of these alternatives.

6.2. Non-structural Measures

The non-structural measures, inter-alia, include the following hierarchical steps:

Step-I: Setting up of Watershed Management Organization

- Identifying Goals and Objectives.
- Identifying the stake holders.
- Delineation of Duties and Role of Each Stakeholder.
- Delegation of Authorities and Responsibilities.

Step-II Outline Inventory of Resources

- Preparation of Inventory Map indicating the location of Resources.
- Qualitative and Quantitative enlistment of Resources.
- Preparation of Land Form Map (LFM).
- Preparation of Water Resources Location Map with its Quantitative Assessment (WQA). Drinking water, fit for irrigation, fit for industrial use etc.
- Preparation of Inventory of Government Organizations/NGOs related to Watershed Management including EPA.
- Preparation of Landuse Map
- Preparation of Communication System Map.
- Preparation of Forest Range Land Map.
- Prepare Fishing Site Map.
- Prepare Agricultural /Irrigated Area Map, Identify Command Areas.
- Prepare Soil Types Map.
- Prepare Geological/Mineral Area Map.
- Prepare Inventory/Map of Wildlife.
- Prepare Property Right Map/Inventory.
- Prepare Water Right Inventory Map.
- Any other Specific Map/Inventory.

Step-III: Assessment of historical Conditions

- Identify natural conditions causing changes, e.g. periodic flooding, landslide etc.
- Identify anthropogenic conditions causing changes e.g. shifting of population, war, conflicts, landuse changes, etc.

Step-IV: Identification of Issues

- Prepare Inventory of Demands versus Resources.
- Identify Issues of Rights versus Envisaged Plans (Social Issues, Land Acquisition etc).
- Identify Dangers to Resources
- Identify Areas to be Protected e.g. Tourist Resorts, Grave-Yards, Mosques, Historical Places etc.

Step-V: Preparation of Action Plan

- Prepare a Comprehensive Plan of All Possible Alternatives of Non Structural Measures Using all Available Resources and Keep all Issues in View. Choose the Most Cost Effective Plan With Minimum Investment and Maximum Benefits.
- In case of a Greater Plan, Make Sub Projects and Schemes to be executed.
- In Case of Successive Availability of Fund, Make a Schedule of Investment Keeping In View the Priority and Emergency Conditions.

Step-VI: Execution of Sub Projects/Plan

- Employ Execution Agency with Most Efficient Facilities and Expertise for Execution.
- Monitor Timely Progress on the Basis of Quality and Quantity.
- Prepare Completion Report/As Built Report.

Step-VII: Prepare O&M Plan

Step-VIII: Prepare Monitoring Plan

Step-IX: Train the O&M Experts and Hand Over the System to O&M Institution

Step-X: Carryout Periodic Inspections, Repair, Maintenance, Remodeling and Modernization after Specified Periods/Intervals.

6.3. Community Involvement

Some community-based watershed management initiatives are already being carried out in FATA. Mian (2010) reports on an ongoing FATA Rural Development Project in Khyber, Mohmand, and Bajaur agencies. The total cost of the project is 60 million USD, with 70 percent from the ADB, 20 percent from the Government of Pakistan, and 5 percent from other sources.

The project objectives are to: improve the productive potential of watersheds; strengthen the capacity of the communities; and, support the implementing departments to operate in more socially inclusive manner. The project will benefit 1.483 million persons living in these agencies, representing 23 percent of the total area of FATA and 47 percent of the population. Forty-four watersheds are covered by the project.

The project includes three key components:

- Integrated resource management.
- Community infrastructure.
- Project planning, management, and other support services.

The project is administered by a Project Steering Committee, a Project Scheme Approval Committee, three Agency Project Boards, and three Agency Scheme Approval Committees.

The implementation strategy includes the formation and registration of Male Community Organizations (MCOs), surveys by social development teams, identification of sites for community

works in consultation with Political Agent, implementation through MCOs, and capacity building of MCOs in different skills development and technical trainings. As of June 2010 the progress of the project is summarized in Table 6-1.

Table 6-1: Community Mobilization & Development

Name of Activity	Number of MCOs	Number of Households
Formation of Community Organizations	1,714	7,529
Formation of Village Organizations	192	--
Office Bearers Trainings	120	797
Managers Conference	37	1,453
Activists Training	47	205
Skill Development Trainings	1,335	1,785

The Integrated Resource Management component includes:

- Farming Systems and Crop Production Development in Watersheds.
- Livestock and Fodder Development.
- Community Forestry and Range Management.
- Capacity Building of Farming communities/MCOs.

The Community Infrastructure includes:

- Surface irrigation.
- Dug Wells and Tube Wells.
- Delay Action Dams.
- Road development (low cost shingle roads and up gradation of link roads).
- Community Drinking Water Supply Schemes.

A watershed-based assessment of water resources study was carried out. It consisted of five components:

- I. Surface hydrology/hydrological study.
- II. Ground water assessment study.
- III. Consumption by human beings and livestock population in the area.
- IV. Agriculture studies (estimation of crop water requirements through CROPWAT[2]).
- V. Water balance model (watershed based).

The findings of the water assessment study concluded that out of 44, only 17 watersheds have potential for ground water exploitation in the future. The water balance model estimation estimated that annual water consumption will increase by 40 percent over the base year of 2008.

The study points out that the ground water resource is under pressure due higher abstractions, unchecked run off, and low recharge. There are only a few watersheds with some potential for groundwater exploitation. They recommend that:

- Check dams will help to recharge the ground water and address future/projected water consumption needs in the area.
- A Comprehensive water monitoring plan must be adopted by all stakeholders in the area.

[2] A decision support tool developed by the Land and Water Development Division of FAO.

7. CONCLUSIONS AND RECOMMENDATIONS

Both the Kaitu and Kurram are braided rivers with a single channel of low sinuosity and high gradient, with multiple `thalwegs' and bars. Braided rivers are characterized by a highly irregular water regime, and abundant sediment supply. The amount of sediments transported at any given time will depend on the flow. During periods of low flow fine sediments will predominate. During periods of high flow coarser material will be washed downstream.

- It is important to note that a Watershed Management Plan requires extensive quantitative land-use data regarding;
  - Vegetation features (forest area, density and type of trees, area/s affected by grazing and its type);
  - Waterways;
  - Visible sediment yield (reliable information about erosion and sedimentation needs to be available only then can we calibrate information about erosion and sedimentation yield); and,
  - Identification of type of erosion (Rill, sheet, Gully etc) in the area for deriving Erosion Intensity Maps.

  The above was not possible due to security reasons in the Project Area.
- Modeling was also considered as another approach for evaluating the watershed area but due to lack of field investigations, information about important coefficient such coefficient of soil resistance to erosion; coefficient of land-use; coefficient of observed erosion and rainfall erositivity, modeling was not possible.
- Erosion Vulnerability Maps were therefore prepared for assisting WAPDA and Forest Department, FATA to take prioritized actions specifically in erosion prone areas (although, these areas are subject to change depending on field investigations and site surveys that will be done in the future).
- Watershed Management Framework has been prepared as a guideline document for WAPDA, and should be referred to when the detailed Watershed Management Plan will be prepared.
- Ground realities with regard to the Kurram and Kaitu Watersheds are not available due to the security issues and sensitive conditions in the Project Area.
- Natural erosion and anthropogenic erosion are both highly prevalent in the watersheds as a result of which the watersheds are highly degraded as conditions upstream of the dam, reservoir and the three irrigation schemes are poor.
- From the anthropogenic perspective, erosion has accelerated due to deforestation by refugees, and persistent and unchecked overgrazing. About half of the mountainous rangelands are severely degraded due to overgrazing.
- The mitigation measures proposed, especially the structural measures such as landslide entrapments to control erosion from landslides, the construction of diversion drains, gully plugs, Masonry check dams, Flood Diversion Structures and Flood Alleviation etc. need to be implemented accordingly to reduce erosion.
- Construction and maintenance of roads in the upper watershed should be in accordance with erosion-control principles.
- Importance should be given to non-structural mitigation measures to reduce erosion such as setting up a Watershed Management Organization, making a detailed inventory of the resources in the area, identifying major issues, developing a detailed action plan etc. These measures are equally important as the structural ones since these help ensure sustainable use of the watersheds in the future.

The following recommendations are proposed:

- WAPDA along with the Forest Department (FATA) and FATA Secretariat need to come together and devise a watershed management plan considering this framework for implementation purposes.
- Mitigation measures stated in section 6 (structural and non-structural) need to be elaborated in the detailed Watershed Management Plan to include measures that are sustainable both for the environment and for the locals.
- At a policy level, the issue of refugees settling in the area and overgrazing (contributing to erosion) need to be addressed.
- The simplest approach would be to extend to North Waziristan the pilot initiatives already being carried out through the FATA Rural Development Project in Khyber, Mohmand, and Bajaur agencies. If communities engaged in reforestation of deforested area with native tree species, they would be eligible to sell their carbon credits through the World Bank's Adaptation Fund:
  http://web.worldbank.org/WBSITE/EXTERNAL/EXTABOUTUS/ORGANIZATION/CFPEXT/0,,contentMDK:22468029~pagePK:64060249~piPK:64060294~theSitePK:299948,00.html
  If and when these get underway, further funding might be possible through a PES mechanism (Greiber, 2009 and UNEP, 2008) and/or a PWS mechanism (Porras *et al*, 2008)
- Bilateral relations with Afghanistan will have to be established in order to implement the Watershed Management Plan since most of the Kaitu watershed lies in Afghanistan. Interim measures should consider modifying the design of the weir to enable flushing and the construction of check dams upstream.

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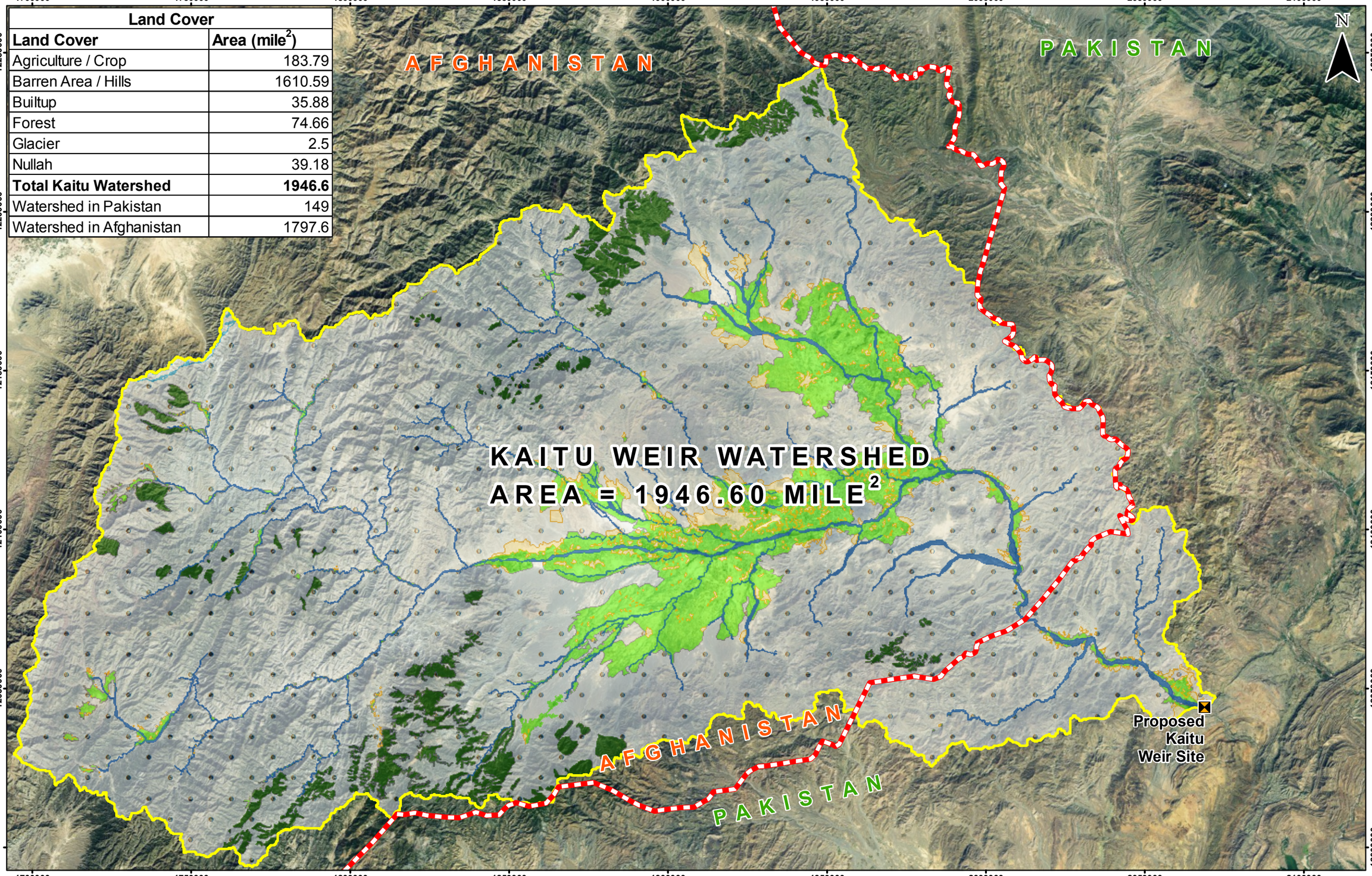
Land Cover	
Land Cover	**Area (mile^2)**
Agriculture / Crop	183.79
Barren Area / Hills	1610.59
Builtup	35.88
Forest	74.66
Glacier	2.5
Nullah	39.18
Total Kaitu Watershed	**1946.6**
Watershed in Pakistan	149
Watershed in Afghanistan	1797.6



VER.	DATE	PREP.	CHECK.
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2.0	03.09.2013	S.HUSSAIN	U.TARAR
1.0	19.08.2013	S.HUSSAIN	U.TARAR

LEGEND

- International Boundary
- Proposed Kaitu Weir Site
- Kaitu Weir Watershed (1946.60 sq.mile)
- Builtup
- Nullah / River
- Agriculture/ Crop
- Forest
- Glacier
- Barren Area/Hills

DISCLAIMER

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PROJECTION INFORMATION

Projection: **UTM Zone 42 N**
Datum: **WGS84**
Units / Dimensions: **Feet / Miles**

PROJECT:

ENVIRONMENTAL ASSESSMENT OF KURRAM TANGI MULTIPURPOSE DAM PROJECT

CLIENT:

UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT (USAID)

USAID FROM THE AMERICAN PEOPLE

CONSULTANT:

MWH GLOBAL, INC.
NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LIMTED

MWH BUILDING A BETTER WORLD

NESPAK

DOCUMENT TITLE: PROPOSED KAITU WEIR WATERSHED LANNDUSE MAP

DOCUMENT NO. : 3553-NES-KTDP-EA-0005

FIGURE NO. :

SCALE: 1:350,000 (0 1 2 3 4 5 10 Miles)

ORIGINAL SIZE : A3

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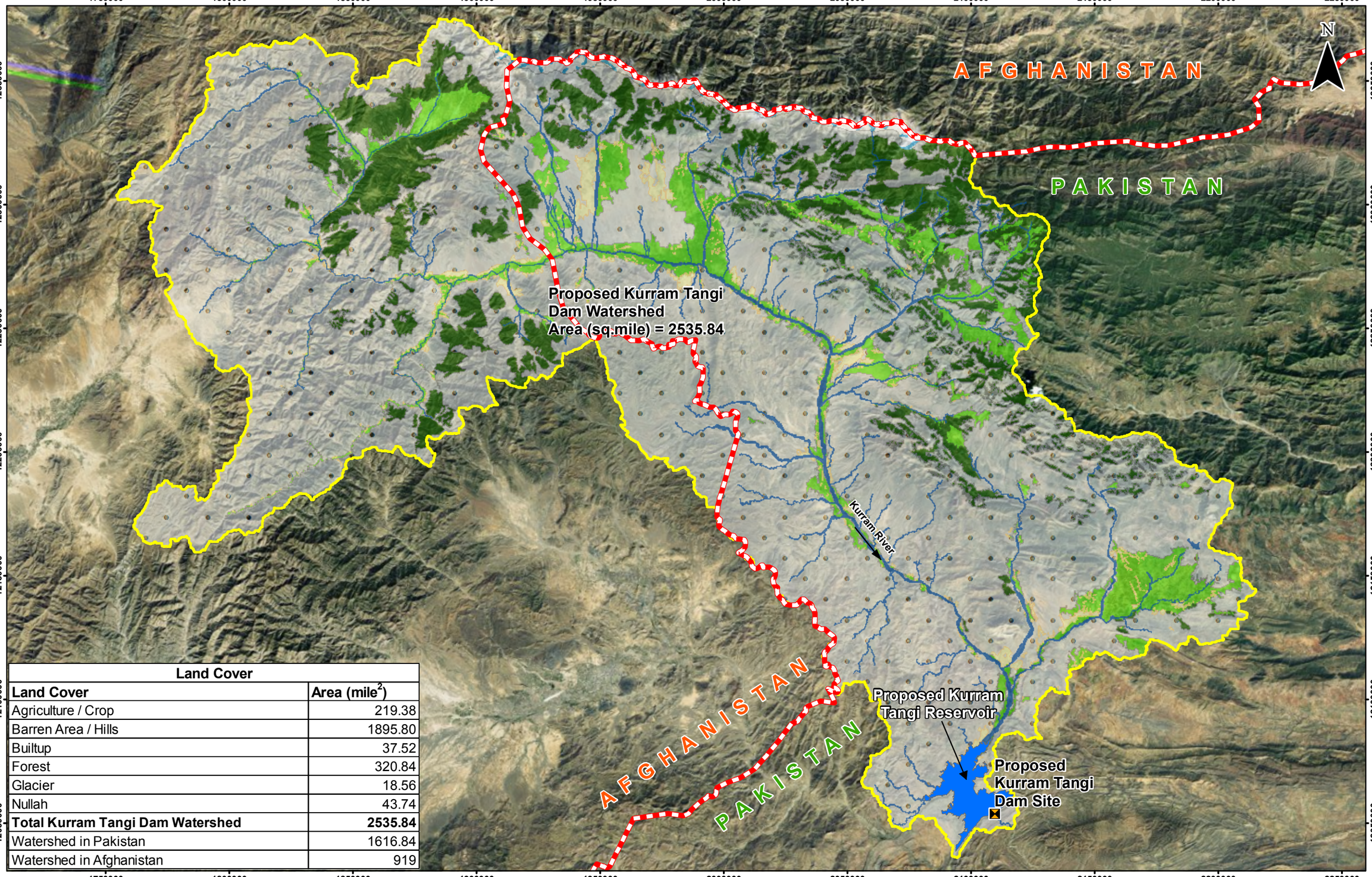

Land Cover

Land Cover	Area (mile^2)
Agriculture / Crop	219.38
Barren Area / Hills	1895.80
Builtup	37.52
Forest	320.84
Glacier	18.56
Nullah	43.74
Total Kurram Tangi Dam Watershed	**2535.84**
Watershed in Pakistan	1616.84
Watershed in Afghanistan	919

VER.	DATE	PREP.	CHECK.
3.0	23.09.2013	U. AHMAD	U.TARAR
2.0	03.09.2013	S.HUSSAIN	U.TARAR
1.0	19.08.2013	S.HUSSAIN	U.TARAR

Legend

- Proposed Kurram Tangi Dam Site
- Kurram Tangi Dam Watershed (2535.84 sq.mile)
- International Boundary
- Builtup
- Nullah / River
- Agriculture/ Crop
- Forest
- Glacier
- Barren Area/Hills

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MWH BUILDING A BETTER WORLD

NESPAK

DOCUMENT TITLE: PROPOSED KURRAM TANGI DAM WATERSHED - LANDUSE MAP

DOCUMENT NO. : 3553-NES-KTDP-EA-0007

FIGURE NO. :

SCALE: 1:450,000

0 1 2 3 4 5 10 Miles

ORIGINAL SIZE : A3

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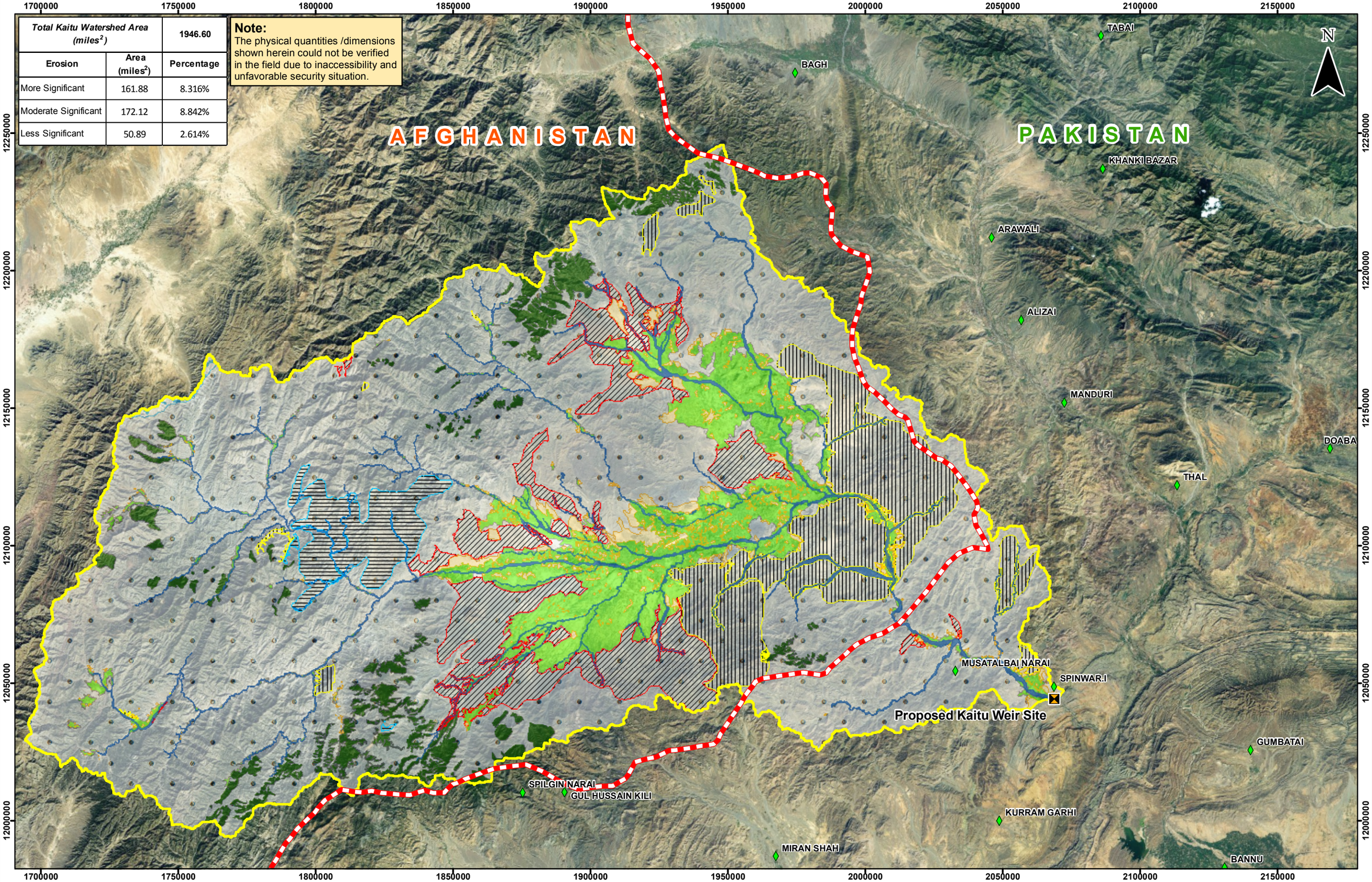
Total Kaitu Watershed Area (miles^2)		1946.60
Erosion	**Area (miles^2)**	**Percentage**
More Significant	161.88	8.316%
Moderate Significant	172.12	8.842%
Less Significant	50.89	2.614%

Note:
The physical quantities /dimensions shown herein could not be verified in the field due to inaccessibility and unfavorable security situation.



VER.	DATE	PREP.	CHECK.
3.0	25.09.2013	U. AHMAD	U.TARAR
2.0	03.09.2013	S.HUSSAIN	U.TARAR
1.0	10.06.2013	S.HUSSAIN	U.TARAR

LEGEND
- Proposed Kaitu Weir Site
- Kaitu River Watershed
- International Boundary

Erosion
- Less Significant
- Modrate Significant
- More Significant

Landuse
- Agriculture/ Crop
- Forest
- Glacier
- Barren Area/Hills
- Builtup
- Nullah / River
- Settlements

DISCLAIMER
This Map is for informational purposes and may not have been prepared for, or be suitable for legal, engineering, or surveying purposes. Users of this information should review or consult the primary data and information sources to ascertain the usability of the information. This contents / data used in this map are not verified on ground thus NESPAK makes no warranty, express or implied, related to the accuracy or content of these materials and map/data.

PROJECTION INFORMATION
Projection: **UTM Zone 42 N**
Datum: **WGS84**
Units / Dimensions: **Feet / Miles**

PROJECT:
ENVIRONMENTAL ASSESSMENT OF KURRAM TANGI MULTIPURPOSE DAM PROJECT

CLIENT:
UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT (USAID)

CONSULTANT:
MWH GLOBAL, INC.
NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LIMTED

DOCUMENT TITLE: EROSION VULNERABILITY MAP (KAITU WATERSHED)

DOCUMENT NO. : 3553-NES-KTDP-EA-0052

FIGURE NO. :

SCALE: 1:400,000 (0 – 2.5 – 5 – 10 Miles)

ORIGINAL SIZE : A3

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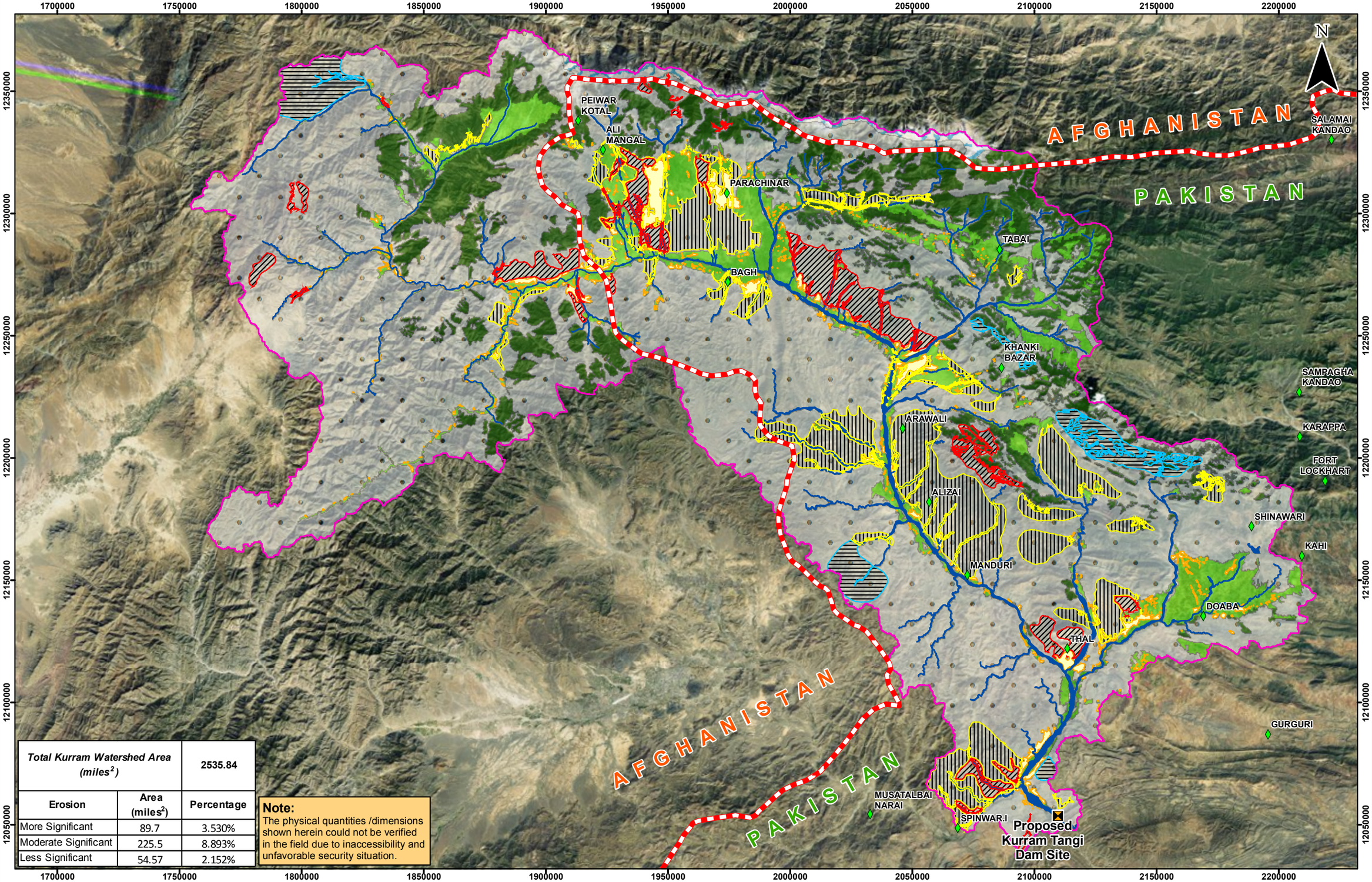

Total Kurram Watershed Area (miles^2)		2535.84
Erosion	**Area (miles^2)**	**Percentage**
More Significant	89.7	3.530%
Moderate Significant	225.5	8.893%
Less Significant	54.57	2.152%

Note:
The physical quantities /dimensions shown herein could not be verified in the field due to inaccessibility and unfavorable security situation.

VER.	DATE	PREP.	CHECK.
3.0	25.09.2013	U. AHMAD	U.TARAR
2.0	03.09.2013	S.HUSSAIN	U.TARAR
1.0	21.08.2013	S.HUSSAIN	U.TARAR

LEGEND
- Proposed Kaitu Weir Site
- Kurram River Watershed
- International Boundary

Erosion
- Less Significant
- Modrate Significant
- More Significant

Landuse
- Agriculture/ Crop
- Forest
- Glacier
- Barren Area/Hills
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PROJECTION INFORMATION
Projection: **UTM Zone 42 N**
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NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LIMTED

DOCUMENT TITLE: EROSION VULNERABILITY MAP (KURRUM WATERSHED)

DOCUMENT NO. : 3553-NES-KTDP-EA-0053

FIGURE NO. :

SCALE: 1:450,000

ORIGINAL SIZE : A3

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Annex 1: Photographs of Component 1

General Landscape of the area
(Bobal Narai)

Existing Vegetation in Bobal Narai

Livestock Pattern as seen in Kand

Erosion on the banks of
Kurram River near Shewa (Bobali)

Loose Soil as seen in North of Datta Khel

Serwek Datta khel (South of Kaitu River)

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Annex 2: Photographs of Component 2

Shewa (Sai Pali)

Shewa

Shewa

Proposed Kurram Tangi Dam Area

Shewa

Pasta Pal Shewa

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Annex 3: Photographs of Component 3

Talaum, Gumatti, FR Bannu

Forest at road side Gumatti, FR Bannu

Awan Kala

Land form in Ghani Khel

Marwat Canal

Ghani khel

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Annex 4: Data Acquired from the Forest Department, North Waziristan Forest Division

AMJAD ALI
Divisional Forest Officer
North Waziristan Forest Division
Sector-D Phase-I Town Ship Bannu.

PHONE NUMBER/0928-633184
FAX NO.0928/633185
E-Mail: dfonwfd@ ymail.com
No. 183 /NWFD
Dated: 18/9 /2013.

To

Mr. Kamran Yousaf,
Chief Engineer, GT & GE
Division, NSPAK, Lahore.

SUBJECT:- **DATA REQUIRED FOR WATERSHED MANAGEMENT KURRAM TANGI DAM PROJECT.**

Dear Sir,

As desired, the available data/information is reported as under :-

S.No.	Data/Information required.	Reply of Forest Department NWA at Bannu.
1-	Details of department/ Agencies involved in Watershed Management activities of Kurram and Kaitu rivers catchments falling in Pakistan See attached Figure).	Only Forest Department is involved in Watershed Management activities in the catchments of subject rivers by increasing green cover, protection of existing cover and under-taking soil conservation activities (Loose stone, Check dams in nullahs in hill slopes, contour ditches etc).
2.	Present role and responsibility of these agencies and departments and possible alteration in their domain of responsibility – Institutional arrangements (Organogram).	Present role and responsibility of Forest Department is to motivate and convince local tribes to protect and enhance forest cover, regulate grazing practices by undertaking relevant activities on their communal lands/hills etc. Local tribes need to be organized to ensure their fruitful involvement in all such activities for more success and long lasting impact. For this purpose Political Administration has to be take the leading role.
3.	Resources Inventory outline covering the following:- • Water Resource • Forest/ Rangelands • Livestock Census and Grazing pressure.	No authentic Inventory/Survey has been undertaken so far due to many impediments (Law & Order situation, lack of financial and technical resource etc). However, the estimated inventory figures are reported as under:- • Water Resource – No data available. • Forest Rangeland – 82% of total land area. - 15% Forest/Tree cover. - 67% Rangeland (with grasses & shrubs). • Livestock Census and Grazing pressure. -About 20,000 livestock heads (Cows) & 30,000 Sheeps/ Goats exist in the catchments area of these rivers . Grazing pressure is high and un controlled thereby cause depletion of foliage.
4-	Grazing pressure by access of Afghan Refugees and other Nomades, with possible measures to reduce over-grazing.	Presently there are quite a few Afghan Refugees in the catchments of these rivers .However, Afghan Nomads cross these areas twice in a year in autumn and spring seasons as per their centuries old routine. Their animal herds ruthlessly graze these areas and cause depletion of rangelands and loss of green cover. Moreover, due to trampling they loosen the top soil and thus accelerate the erosion process. Possible measures to reduce overgrazing could be as under:- 1- To regulate grazing by adopting rotational grazing practices. 2- Specify routes for movements of Nomads and diss-allow their camping in the catchments areas.

		camping in the catchments areas.
5.	Factors causing change in watershed area.	Following factors cause change in watershed area:- 1- Overgrazing and over exploitation of forests. 2- Querying of stones and other physical disturbances(road construction, blasting, construction of houses etc).
6.	Any commercial/industrial activities causing population in the area.	It is generally a desolate area and no such activity is taking place here.
7.	Existing projects/activities to combat erosion in catchments'.	No significant projects/activities exist in the area to combat erosion. Activities of Forest Department are also very thin and sparsely located with minor impact.
8.	Future 5-years short-term and long-term Plans/Projects for increase in vegetative cover and flood, sediment and erosion control in catchments including range improvement practices.	There is a single forestry projects for the entire area which has very low level impact. To achieve substantial results, new projects are required to be implemented.
9.	Population Census in Watershed area.	About 20,000 Population is residing in the jurisdiction of N.W.Agency and FR Bannu in the catchments areas of these rivers.
10.	Concerns of Forest Department.	Concern of Forest Department are as under:- 1- To conserve the existing flora and fauna. 2- To increase in the green cover in the target area and maintain eco-balance. 3- To arrest erosion, conserve fertile soil and implement all forestry practices on perpetual basis in target area. 4- To educate, motivate and organize local tribes to protect enhance and properly utilize their natural forest resource on sustainable basis. 5- To promote recreational facilities and Wildlife in the area.
11.	Resources required by Forest Department for Watershed Management .	Forest Department has ample staff and technical expertise to implement its desired activities and achieve the goal if financial assistance and security needs are met with as required. For this purpose special project can be designed if asked. For security purpose and public consensus Political Administration's assistance is must.

Divisional Forest Officer,
North Waziristan Forest
Division Bannu.