RC-East, Eastern Afghanistan, Paktiya Province, Gardez District, Dawlatzi Watershed Assessment

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The purpose of this analysis is to review the identified watershed with the objective of finding the best feasible ways to restore it to a functional state. Problems to address include soil erosion, flood damage, peak flows and water availability, and rangeland/woodland productivity.

Methods include use of QuickBird satellite imagery (copyright Digital Globe, Inc.) at 1 m resolution; digital terrain data at 10 and 5 m resolution; and available geologic data, standard operating procedures for treatments, and soils/infrastructure data. The entire area was canvassed at scales of 1:400 to 1:3000. ARCMAP and ARCGLOBE were used for planar and perspective analysis. Images were rendered in color infrared (CIR) for vegetation and soil analysis, but are displayed in gray or brown scale for ease of use in maps. Groundwater relationships are based on general knowledge of hydrology of Afghanistan and review of geologic and physiographic spatial data; as well as client-provided ground data. Where imagery was cloud covered, GOOGLE EARTH PRO imagery was georeferenced to fill in gaps.

Project Area

The Study Area is 1,621 ha and approximates the Dawlatzi watershed as identified in the SE Afghanistan Water Resources Assessment (including 112 ha directly below the watershed). It consists of moderately-steep hillslopes in eroded sandstone/shale/limestone hills grading to a large gently-sloping alluvial fan (Figure 1). Precipitation is moderate (300 – 400 cm), with snow and spring rains making up most of this. Land use is primarily heavy grazing and irrigated agriculture (Figure 2), with gently-sloping irrigated lands in and outside, but directly-affected by the watershed at 327 ha, gently-sloping grazed lands at 349 ha, and steeply-sloping grazed lands at 1,025 ha. There are 11 small villages in the area.

A soils study was provided by the client. This consists of detailed land use and soils data, as well as an inventory of watershed problems on a set of eight transects low in the watershed (Figure 2). Primary problems low in the watershed were also identified. These data were used to establish watershed conditions and affected resources. Based on this study and observations, soils are high in clay, compacted, and highly-erodible with large barren areas in the lower watershed, but relatively low in erodibility in the steeply-sloping headlands.

About ½ of the water supplies in this area come from wells and ½ from subsurface Karez systems and diversion-based canals. Major canals were inventoried (13,607 m) (Figure 2), as were Karez systems (1,335 m). Major stream channels make up 27,848 m (ibid). The stream system is relatively unstable, with wide, barren flood plains with unstable banks, and most are dry part of the year. In July of 2007 all streams were dry in the lower 2/3 of the watershed. The soils study indicated streams are flashy and minor flooding occurs in the spring and during rainy periods. Though the watershed collection zone is located far from the depositional zone (Figure 2), little infiltration occurs in the transport zone (because of clayey soils and wide, fine-textured flood plains), thereby magnifying effects of high peak flows and sediment.

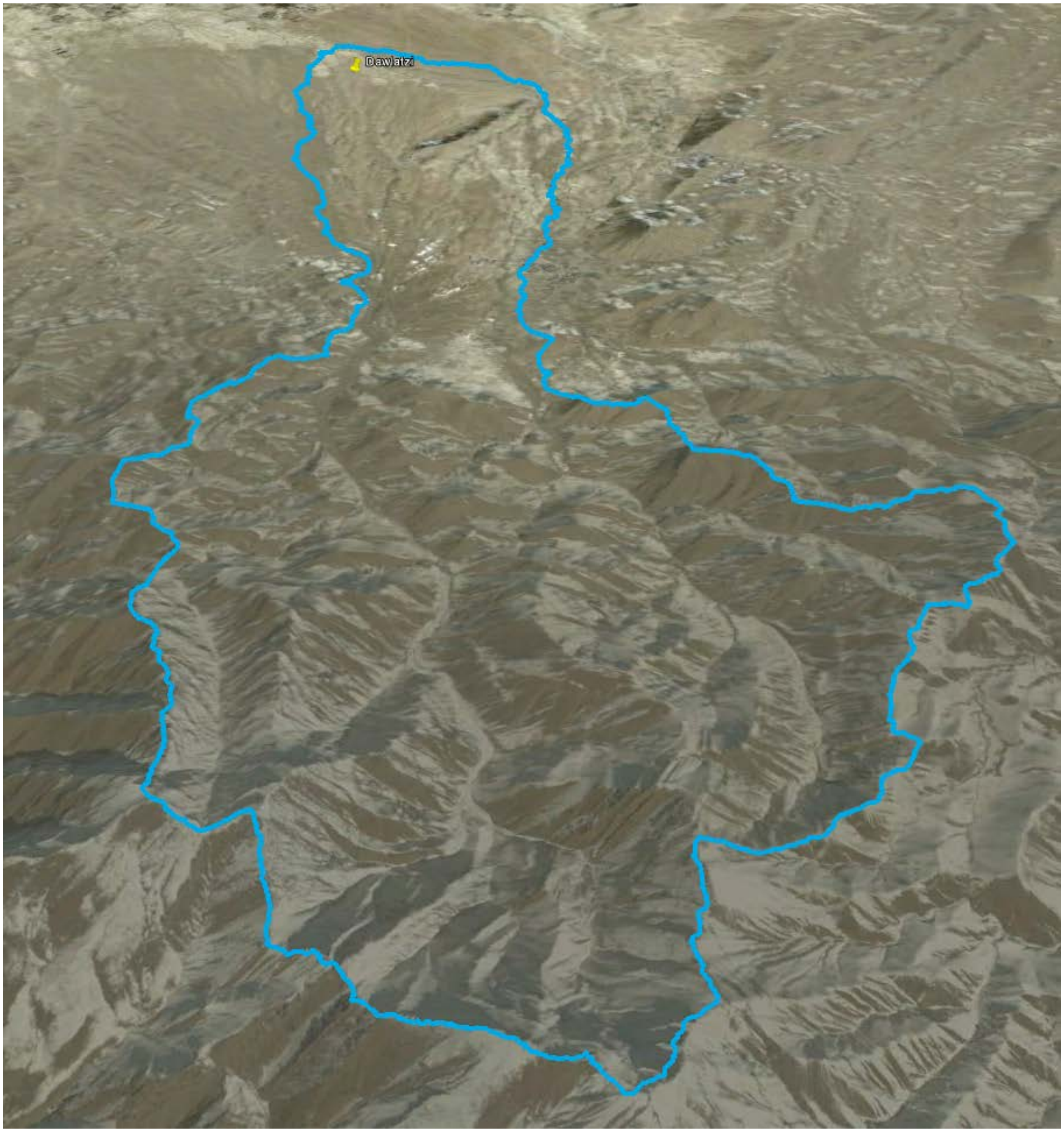

Figure 1. Overview of the Dawlatzi Watershed, looking north. (courtesy of Google Earth Pro)

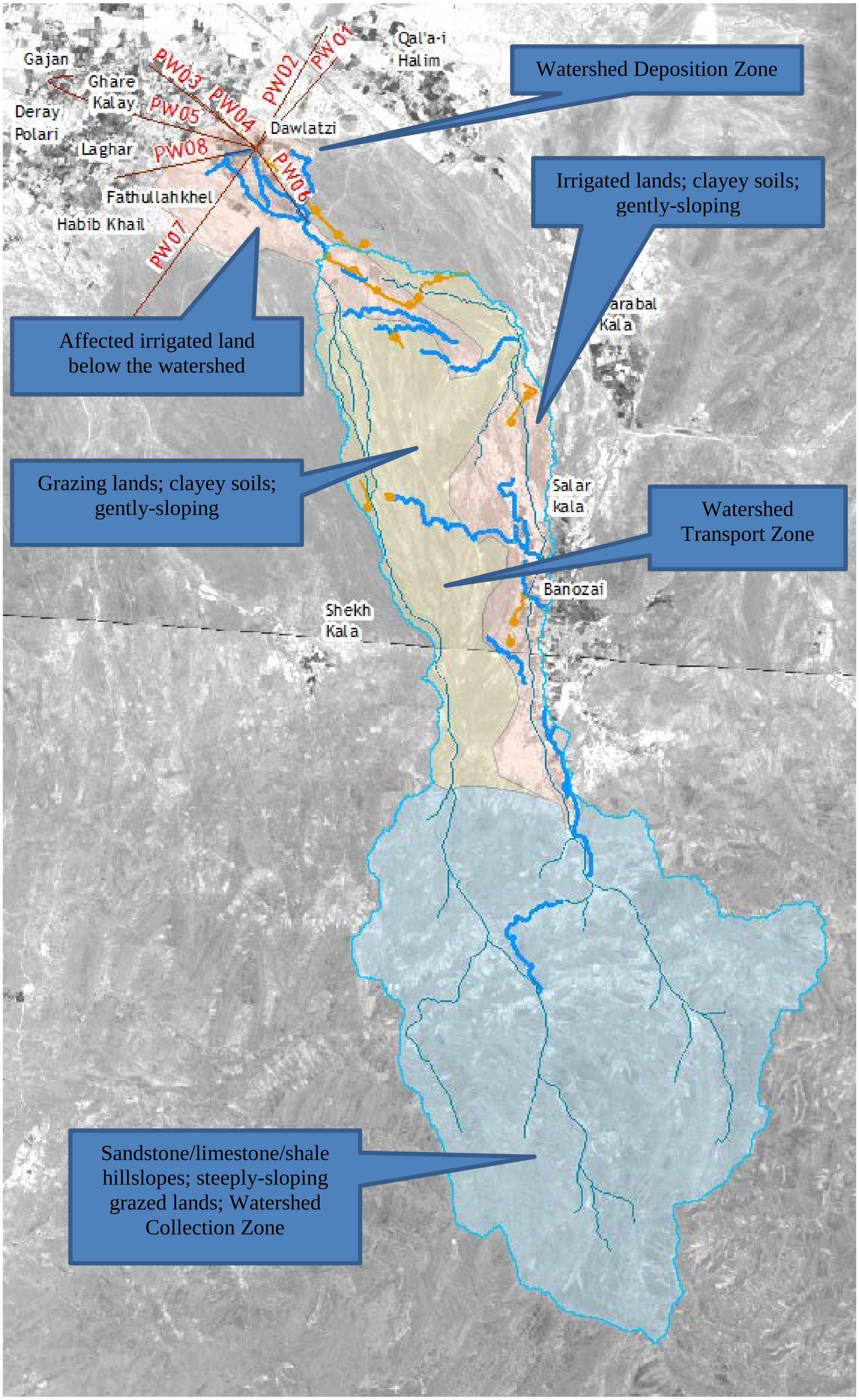
Watershed Deposition Zone
Irrigated lands; clayey soils; gently-sloping
Affected irrigated land below the watershed
Grazing lands; clayey soils; gently-sloping
Watershed Transport Zone
Sandstone/limestone/shale hillslopes; steeply-sloping grazed lands; Watershed Collection Zone
Gajan
Ghare Kalay
Deray Polari
Laghar
Fathullahkhel
Habib Khail
Qal'a-i Halim
Dawlatzi
Salar kala
Banozai
Shekh Kala
PW01
PW02
PW03
PW04
PW05
PW06
PW07
PW08

Figure 2. Dawlatzi Watershed. Dark blue shows the Study Area boundary. Light blue is steeply-sloping grazing lands. Pink is irrigated land. Tan is gently-sloping grazing land. Light-blue are major stream channels. Dark-blue polylines are major canals. Labeled brown lines are soil transects. Orange polylines are Karez systems.

Watershed Concerns

Refer to Figure 3 for points of interest (POI's) supporting these conclusions. MGRS locations of these POI's are given in Table 1).

Table 1. Points of Interest and locations in MGRS.

ID	Point of Interest Description	MGRS
1	Gullies	42SWC2439612815
2	Cattle Drive	42SWC2366512850
3	Large Canal Breach	42SWC2458508077
4	Large Flood Plain - Possible Flood Control	42SWC2411609767
5	Active Flood Plain	42SWC2478111472
6	Irrigation Pond	42SWC2483311631
7	Irrigation Pond	42SWC2462911459
8	Irrigation Pond	42SWC2460311298
9	Irrigation Pond	42SWC2388612254
10	Irrigation Pond	42SWC2446410479
11	Irrigation Pond	42SWC2296313787
12	Irrigation Pond	42SWC2243514133
13	Irrigation Pond	42SWC2278014463
14	Irrigation Pond	42SWC2296314423
15	Stream Channel leaving Study Area	42SWC2487811519
16	Active Flood Plain	42SWC2467510417
17	Active Flood Plain	42SWC2470310201
18	Developments - housing since 2004	42SWC2309513042
19	Active Flood Plain	42SWC2313413009
20	Irrigation Pond	42SWC2347313504
21	Grazing Trails	42SWC2580108210
22	Grazing Trails	42SWC2575208169
23	Active Flood Plain	42SWC2345211816
24	Gully Network	42SWC2464709260

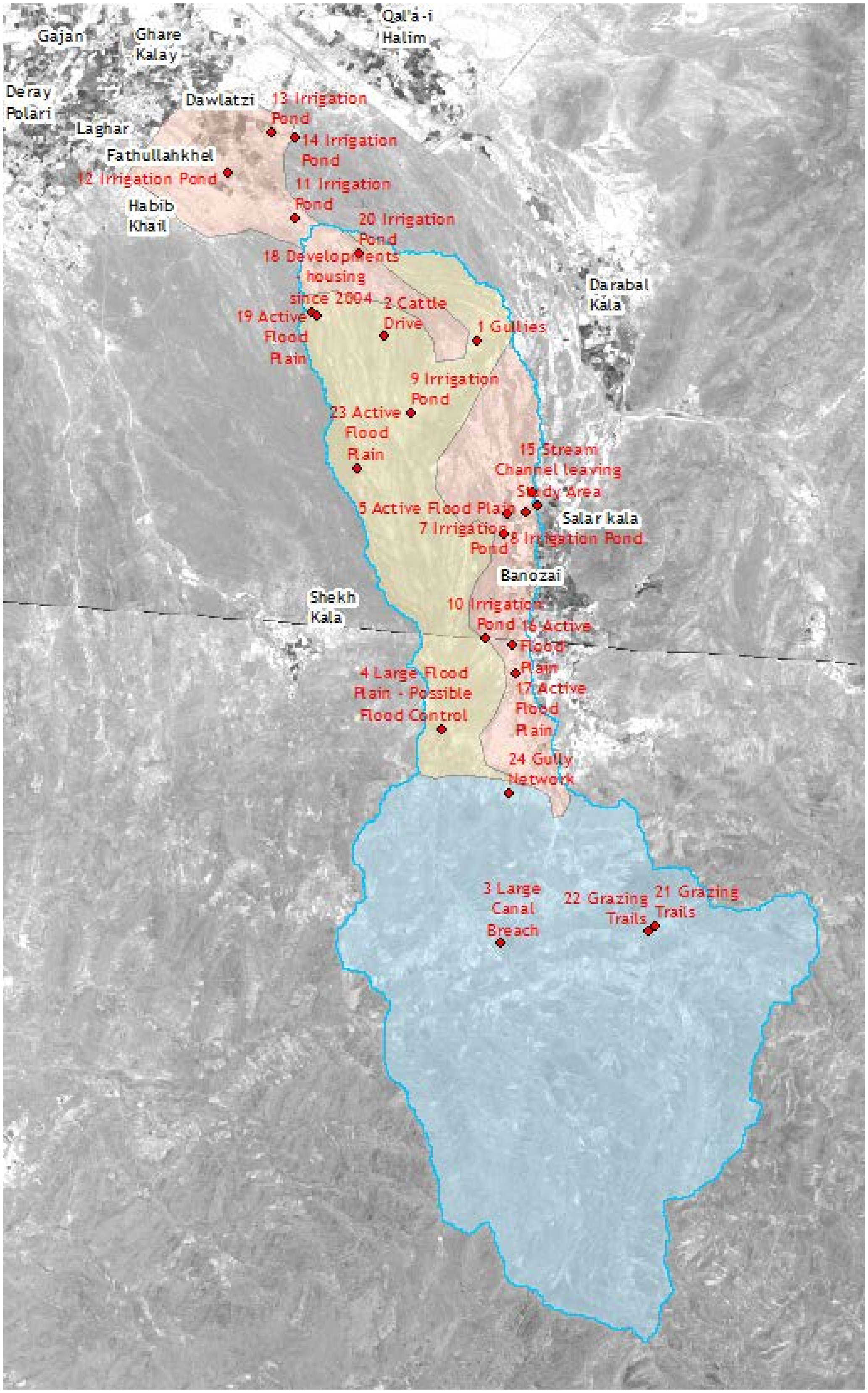

Figure 3. Points of Interest in the Dawlatzi Study Area

Irrigation is inefficient. The soils study noted this, and it is exacerbated by the high proportion of very small terraced agricultural areas, seasonally irrigated from small diversions and streams. Major canals and Karez systems (Figure 2) cross multiple fields and likely ownerships, so are likely to be under-maintained. Numerous ponds are used as storage, but are likely to be sediment-laden, based on aerial review (Figure 3, POI's 6-14, 20). A large canal breach was discovered at POI 3, high in the watershed.

Watershed effects also occur outside the mapped watershed. About 112 ha of irrigated land below the delineated watershed uses water from the Study Area watershed (Figure 2). The watershed boundary as delineated by the earlier study is not entirely complete, as a stream channel leaves the watershed midway through the Transport Zone (Figure 3, POI 15) near Salar Kala. This is unusual for a "normal" watershed, and helps support the conclusion that this watershed is relatively unstable.

Peak flows are damaging. Flooding is relatively minor, compared with larger watersheds (based on a National flood prediction map). However, seasonal peak flows have damaged or destroyed almost all inventoried irrigation structures in the lower watershed (based on the soils study). Rills and gullies are common in the studied areas. Topsoil is absent, likely from centuries of extensive erosion. Because of the nature of this watershed, these problems originate in the watershed collection zone, and flows are efficiently transmitted to the lower fields on the impermeable soils in the transport zone (Figure 2). Though bank erosion was identified as a problem in the soils study, no major bank protection problems were identified, as no major values at risk were discovered. The problem appears to occur along major streams.

Grazing is widespread and problematic. Remotely-sensed evidence appears to indicate grazing occurs on most of the landscape (POI's 21 and 22), including steep slopes. The soils study indicates Kuchi (nomadic tribes) cross the landscape with little control. A large cattle or camel drive was discovered at POI 2. Almost every household has 5-10 livestock (soils study), and grazing is listed as a primary land use, with concomitant concerns with low vegetation cover (5 – 25%).

Settlement development is also problematic. POI 18 is a housing development constructed sometime after 2004 in an active flood plain (POI 19). Fuelwood gathering from deciduous trees such as poplar is a significant impact on cover vegetation (soils study).

Recommendations

The most effective method of reducing flood damage and improving the watershed is probably grazing management in the Transport Zone. This would reduce the amount of water flowing through the Zone by promoting plant evapo-transpiration, as well as reducing ground-disturbance by livestock. This would require considerable local contact and cooperation, given the local population's dependence on livestock, the unregulated Kuchi impact, and it would probably require replacing grazing fodder with other sources, including purchased hay.

Reforestation, though also desirable, would require significant regional work to find and transport seedlings, prepare sites, irrigate sites, and find another source of fuelwood for the local population.

Localized repair and improvement of irrigation systems would also help reduce erosion and increase their efficiency, possibly by introducing drip irrigation and encouraging local irrigation farmer associations. Major canals and Karez systems that serve multiple farms may be candidates for community improvement. The extensive canal and Karez systems (Figure 2) are probably in poor condition and could benefit from cleaning, breach repair, leak repair, de-silting, vegetation removal, and lining where feasible. Irrigation ponds show evidence of siltation, and a program could be developed to clean them, restoring storage capacity.

Bank protection may be a good treatment along identified stream channels in the Transport Zone and Depositional Zone. See Figure 2 for stream channel delineations. This will require field review.

Protective works may be considered for reducing flows. Low dams in wide flood plains can temporarily catch water and reduce peak flows. These may be feasible in wide flood plains in low-slope areas. However, they require engineering support and maintenance. There are some candidate areas in the Transport Zone (POI's 4, 16, 17, and 23). POI 4 is the largest and may be most feasible for treatment. POI 19 is directly above a housing development, so is not considered feasible.

The last recommendation applies to the Collection Zone, with the objective of increasing infiltration and reducing peak flows high in the watershed. Hillside ditches and rock bunds (hillside ditches made of stones) can be constructed on appropriate hillsides to intercept runoff and provide opportunities for increased infiltration. This kind of treatment can be planned and designed remotely, so has an advantage over more intensive ground-based systems. It may be more effective than treatments lower in the watershed, since less grazing damage is likely due to steeper slopes, in-country contractors have experience in this kind of project, community labor can be used to construct and maintain the treatments, and there is less potential conflict with other land uses. A plan for this treatment is included under separate cover.

Infiltration check dams are normally used for gully restoration and there are gullies in this project area. There are also many ephemeral or small intermittent drainageways that could benefit from check dams to increase infiltration by slowing water flow. However, candidate slope either occur directly above terraced fields and are probably used for irrigation (see POI 24 on Figure 3), and slopes in other areas are generally too steep for effective treatment.