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4.10 Biodiversity

4.10.1 Approach and Methods

Development of the baseline for biodiversity and ecosystems that might be affected by the Project was informed by the requirements of national laws relating to nature conservation and protection, relevant international conventions and agreements signed by the RA and other international policies and standards related to biodiversity and ecosystems. In line with IFC's Performance Standard 6 (2012) (PS6) and EBRD's Performance Requirement 6 (PR6), Lydian International aims to achieve 'no net loss' of natural habitat and a 'net gain' outcome for any residual impacts on critical habitat.

Searches of existing information were carried out to identify the biodiversity and ecosystems likely to be affected by the Project and to establish the potential presence of:

- Legally protected areas for nature conservation within a potential zone of influence of the Project and areas which are internationally recognised as having high biodiversity, including Key Biodiversity Areas, Global 200 Ecoregions, Endemic Bird Areas and Important Bird Areas;
- Species which are protected in the RA (listed in the RA Red Book);
- Species which are considered by specialists to be threatened or declining either in the RA or in the region and for which the Project-affected area might be considered core habitat;
- Areas of natural habitat according to the definition in PS6/ PR6;
- Species which might suggest or trigger the presence of critical habitat according to PS6/ PR6. This includes species listed by IUCN as Endangered (EN) or Critically Endangered (CR) at a global and European level as well as species meeting other criteria listed in the Performance Standards; and
- Habitats or ecosystems which might be considered "critical" according to PS6 / PR6.

The Integrated Biodiversity Assessment Tool (IBAT) was also used to obtain information on internationally recognised Key Biodiversity Areas, legally protected areas and known distributions of species included in the IUCN Red List.

Surveys in the field were designed on the basis of literature review and consultation with relevant biodiversity specialists (national and international, scientific institutions and

biodiversity Non-Governmental Organisations (NGOs)), including, but not exclusively limited to:

- The Armenian Society for the Protection of Birds (ASPB);
- The Caucasus Nature Fund;
- The World Wide Fund for Nature (WWF);
- The American University of Armenia (between 2011 and 2012);
- The Institute of Botany of the National Academy of Sciences of the Republic of Armenia (NAS RA); and
- Institute of Zoology and Hydroecology of the NAS RA.

Literature sources consulted for background information on the RA's biodiversity included:

- The RA Red Book, 2010;
- Chemonics International Inc, 2000, Biodiversity Strategy and Action Plan for Armenia;
- Ministry of Nature Protection, 1999a, Biodiversity Strategy and Action Plan for the Republic of Armenia, Yerevan, 1999;
- Ministry of Nature Protection, 1999b, First National Report to the Convention on Biological Diversity incorporating A Country Study on the Biodiversity of Armenia, Yerevan, 1999; and
- Khanjyan N., 2004, Specially Protected Nature Areas of Armenia, Ministry of Nature Protection, Yerevan, 2004.

Online resources consulted included:

- Millennium Ecosystem Assessment: <http://www.maweb.org/en/index.aspx> (accessed on 04.07.2014);
- Biodiversity of Armenia - <http://enrin.grida.no/biodiv/biodiv/national/armenia/index.htm> (accessed on 04.07.2014); and
- The IUCN Red List of Threatened Species - <http://www.iucnredlist.org/> (accessed on 04.07.2014).

Overview of field surveys

Information on the biodiversity baseline at Amulsar has been built up over many years, beginning shortly after the gold discovery was made. Table 4.10.1 summarises the ecological surveys undertaken between 2008 and 2015, and Appendices 4.10.1 and 4.10.2 list, respectively, the plant and animal species recorded during all of the surveys. Surveys during

winter are difficult or impossible due to deep snow cover. This, and the fact that many species are hibernating, inactive or dormant in winter, means that field surveys were generally carried out in the period between spring and early autumn, though some limited observations were made of winter tracks.

Preliminary baseline surveys in the field carried out between 2008 and 2011 identified the need for more detailed surveys for some biodiversity components. Supplementary field surveys were carried out in 2012 to obtain more details about the plant species composition of vegetation within the Project-affected area. The additional botanical surveys carried out in 2012 revealed the presence of *Potentilla porphyrantha* Juz. on Amulsar Mountain. This species is listed as Critically Endangered in the Red Book of Armenia and was previously known from only two other sites in Armenia. Specialist advice was therefore sought with respect to this species from the NAS RA Institute of Botany. Areas proposed for the open pit, barren rock storage facility (BRSF) and processing plant were surveyed by the Head of Department of Physiology and Environmental Geo-botany at the NAS RA Institute of Botany, Sc.D. (Professor G.M.Fayvush) to obtain some indication of population distribution and size. Searches were carried out by Geoteam in the surrounding region during August 2012 to see if further populations could be found. A more detailed census of plants on Amulsar Mountain was carried out in 2013 by a botanist from the University of Cambridge, UK. Additional areas on the borders of the population distribution were searched in 2014.

During 2013, a detailed census of migratory raptors passing over and/or using the Project-affected area was also carried out due to the presence of potential critical habitat for Egyptian Vulture (*Neophron percnopterus*), listed as Endangered by the IUCN, as well as the possibility that the Project-affected area might form part of a significant migratory stopover.

During 2014, further botanical surveys were conducted for the revised Project-affected area, as well as surveys of breeding birds, aquatic species and bats. Use of the Project-affected area by raptors was also monitored, focusing on foraging patterns of the breeding pair of Egyptian Vulture in Jermuk Gorge and hunting patterns of Lesser Kestrels. Ongoing monitoring surveys were carried out by the NAS RA Institutes of Botany and Zoology.

In 2015, a detailed baseline survey for Brown Bear (*Ursus arctos*) was conducted on Amulsar Mountain and in the wider region. The focus on this species reflects its protected status under the European Union Habitats Directive, with which the Project has committed to align as a

result of its shareholder relationship with EBRD. Also in 2015, a supplementary amphibian and reptile baseline survey was undertaken on Amulsar Mountain due to the presence of suitable habitat for species listed in the RA Red Book.

Previous drafts of the Amulsar Project ESIA committed to the establishment of an offset to compensate for the Project's impacts on natural habitat. For the purposes of offset planning, preliminary ecological surveying was undertaken in an area north and west of Jermuk which has been proposed for National Park status. The results of these surveys are summarised in this baseline chapter. The rationale for and details of the proposed offset are described later in Chapter 6.11.

Section 4.10.2 describes the international and national context for biodiversity which might be affected by the Project, as determined through review of existing literature and data including that available from IBAT.

Section 4.10.3 provides an explanation of the survey methods used for vegetation and plants and describes the main plant communities and species observed in baseline studies. Subsequent sections describe the approach taken for each taxonomic group of animals, together with a description of their baseline situation in the Project-affected area.

Table 4.10.1: Summary of Ecological Surveys Undertaken	
Year	Survey
Between 2008 and 2010	Review of literature to identify species likely to be present in all taxonomic groups and preliminary surveys of vegetation, plants, birds and mammals by Geoteam
Between 2008 and 2011	Surveys for reptiles and amphibians by Geoteam and birds and terrestrial invertebrates with American University of Armenia
August 2011	Freshwater ecology including incidental comments on fish by Golder
October 2011	Mammals by Geoteam with Institute of Zoology and Hydroecology/ Scientific Center of Zoology
February 2011 to March 2012	Breeding and migratory birds and terrestrial invertebrates (butterflies, moths, dragonflies, damselflies and beetles) by American University of Armenia
2012	Ethnobotanical review (plants used for herbs and medicine) by Geoteam
	IBAT search
	Satellite image and multispectral data analysis, including NDVI and land cover by Astrium Ltd
	Additional vegetation transects and quadrats to identify plant communities by Geoteam with input from Treweek Environmental Consultants and Wardell Armstrong

Table 4.10.1: Summary of Ecological Surveys Undertaken	
Year	Survey
	Special surveys to determine the extent of Armenian Red Data Book plant species <i>Potentilla porphyrantha</i> in the Project's area of influence as well as a wider search for additional populations (Geoteam and Institute of Botany)
2013	Detailed census of <i>Potentilla porphyrantha</i> sub-population in Project-affected area and further surveys of surrounding mountains
	Natural Vegetation Mapping by Dr Peter Carey (University of Cambridge) and Trewweek Environmental Consultants
	Surveys to determine presence and distributions of RA Red Book plant species and plant species endemic to the Caucasus and Trans-Caucasus Regions within the Project-affected area
	Surveys of fish and benthic fauna by Golder Associates and the Institute of Zoology and Hydroecology
2013	Further surveys of mammals, reptiles, amphibians and terrestrial and aquatic invertebrates by Institute of Zoology and Hydroecology/ Scientific Center of Zoology
2014	Further botanical surveys of revised project layout
	Further breeding bird surveys and surveys of raptors, in particular use of the Project-affected area by Egyptian Vulture
	Follow-up observations on freshwater ecological impacts and use of the Project-affected area by Brown Bear
	Follow-up survey of use of the Project-affected area by bat species
2015	Regional camera/hair-trap survey of Brown Bear baseline by TEC, Alberta Innovates and RA Institute of Zoology (survey is ongoing; to be concluded in 2016).
	Amphibian and Reptile survey on Amulsar Mountain.
	General ecological baseline surveys in the proposed Jermuk National Park area, to inform Project offset planning.

4.10.2 Biodiversity Context

In common with the Caucasus Region as a whole, the RA supports a high diversity of plants and animals of which a relatively high proportion are endemic or considered to be important for national, regional or global nature conservation. The RA's rich biodiversity reflects:

- Its varied geology, topography, altitudinal range and climate (seven main landscape types are represented across the different altitudinal zones of Armenia within a relatively small territory);
- Its location at the junction of major biogeographic zones;
- A long history of traditional, relatively low-intensity land uses; and
- Its position with respect to an international fly-way for birds, in particular migrating raptors.

The whole of the RA is within an area of global significance for biodiversity - the Caucasus Biodiversity Hotspot (one of 34 in the world identified by Conservation International as being the richest and most threatened reservoirs of plant and animal life on earth) - which spans 500,000 square kilometres of mountains in Eurasia between the Black and Caspian seas, including Armenia, Azerbaijan and Georgia as well as small parts of Russia, Iran and Turkey. The Hotspot has very high animal and plant diversity as well as high levels of endemism in several taxonomic groups. The RA is particularly important as a centre of endemism for wild relatives of domestic crops and has long been a centre for breeding and selection of cultivated plants and livestock. There are also relatively high proportions of endemic mammal, reptile and fish species: of the 90 species of reptile found in the region, for example, 20 are endemic. An IUCN project to create a complete plant list for the Caucasus is nearing completion. Currently, there are thought to be approximately 1600 endemic plants within the Caucasus Hotspot.

The Caucasus Hotspot is also one of WWF's 35 'priority places' for conservation in the world. The Project lies on the southern edge of the Caucasus Mixed Forest Ecoregion, which is designated as a Global 200 Ecoregion by WWF, within the larger Caucasus Ecoregion. The Global 200 ecoregions have been identified by WWF as priorities for global conservation due to their conservation importance and exposure to threat. The list of 238 Global 200 ecoregions includes all major habitat types, ecosystem types and species from every major habitat type. The Caucasus Mixed Forest Ecoregion covers an area of 170,300 km² including portions of Georgia, Russia, Azerbaijan as well as Armenia. The Ecoregion has been assigned a status of 'critical/endangered' due to rapid land use changes, including widespread deforestation. The Project-affected area does not support forests of the type prioritised within the Ecoregion, but scattered remnants occur in the surrounding landscape, which potentially offer scope for restoration.

The whole of the RA is within a BirdLife International Endemic Bird Area (EBA)¹ which covers an area of 170,000 km² and includes portions of Azerbaijan, Georgia, Iran, Russia and Turkey. The EBA is important for several restricted-range species as well as breeding populations of raptors and reflects the importance of the Caucasus as a centre of bird endemism. Armenia also provides important habitat for many migratory bird species as part of an international

¹ BirdLife International (2014) Endemic Bird Area factsheet: Caucasus. Downloaded from <http://www.birdlife.org> on 04/07/2014

flyway between Africa and Europe, notably migratory raptors.

There are two Important Bird Areas (IBAs) in the vicinity of the Project: Jermuk and Gorayk IBAs (see Figure 4.10.1). The IBAs constitute Key Biodiversity Areas (KBAs)² according to the definition in IFC PS6 and have been identified at national level using the globally standardised criteria which underpin the KBA methodology³. An earlier Project design involved physical footprint and direct impacts within Gorayk IBA. This is avoided in the current design; however, the Lesser Kestrels which are the primary designated feature of the IBA hunt in the Project-affected area.

Gorayk IBA

The boundary of the Gorayk IBA represents the limits of an assumed hunting area around the Lesser Kestrel breeding colony, which is the only one in Armenia. The status of Lesser Kestrel (*Falco naumanni*) has decreased from Vulnerable to Least Concern on the IUCN Red List, though it is still listed as Vulnerable on the Armenian Red List and the fact that it is the only breeding colony in the country makes it important in a national context: it is the focus of ongoing monitoring and research by ASPB as well as public interest. Gorayk IBA also was identified because of a large number of other species associated with the surrounding mountains, the Vorotan River Valley and the wetlands at the confluence of the Vorotan River with Spandaryan Reservoir (see Table 4.10.2). Other trigger species are listed in Table 4.10.3. They include Egyptian Vulture (*Neophron percnopterus*) which is listed as Endangered by IUCN as well as several other raptor species and a large number of passerine and wetland birds.

Table 4.10.2: Details of Gorayk IBA	
Location	RA, Syunik
Central co-ordinates	45° 46.73' East 39° 41.05' North
IBA Criteria	A1, B2
Area	5,923 ha
Altitude	2,028 – 2,871m
Year of IBA Assessment	2002

² Key Biodiversity Areas (KBAs) are sites of global significance for the conservation of biodiversity, identified nationally using simple, globally standardised criteria and thresholds.

³ To meet the KBA criteria, a site must contain: One or more globally threatened species; One or more endemic species which are globally restricted to the site or surrounding region; Significant concentrations of a species (e.g. important migratory stops, nesting sites, nurseries or breeding areas); and/or Globally significant examples of unique habitat types and species assemblages.

Species	Season	Period	Population Estimate	Quality of Estimate	IBA Criteria	IUCN Category
<i>Falco naumanni</i> Lesser Kestrel	breeding	1995-2006	10-20 breeding pairs	Good	A1, B2	Least Concern
<i>Neophron percnopterus</i> Egyptian Vulture	breeding	1995	1-2 breeding pairs	Medium	A1	Endangered
<i>Buteo rufinus</i> Long-legged Buzzard	breeding	1995	5-6 breeding pairs	Medium	B2	Least Concern
<i>Aquila chrysaetos</i> Golden Eagle	breeding	1995	2-3 breeding pairs	Medium	B2	Least Concern
Notes: BirdLife International (2014) Important Bird Areas factsheet: Gorayk ¹ .						

Jermuk IBA

Jermuk IBA has very varied habitats for birds, including mountains, montane meadows and meadow steppes and also Jermuk Gorge, which provides important raptor nesting habitat, as well as being important for the conservation of other taxonomic groups, notably mammals. Jermuk IBA, together with other existing protected areas adjoining it, forms part of the proposed new Jermuk National Park (see Table 4.10.4 for details of the Jermuk IBA). Breeding raptors include Egyptian Vulture, for which 2-3 nest locations were thought to be present in 2002, though there is now only one.

Location	RA, Vayots Dzor
Central co ordinates	45° 38.24' East 39° 47.59 North
IBA Criteria	A1, B2, B3
Area	9,467 ha
Altitude	1,369- 2,685m
Year of IBA Assessment	2002

The populations of IBA Trigger species for Jermuk are listed in Table 4.10.5.

Species	Season	Period	Population Estimate	Quality of Estimate	IBA Criteria	IUCN Category
<i>Alectoris chukar</i> Chukar	breeding	1995	1,500-2,000 individuals	medium	B2	Least Concern

Table 4.10.5: Populations of IBA Trigger Species for Jermuk

Species	Season	Period	Population Estimate	Quality of Estimate	IBA Criteria	IUCN Category
<i>Pernis apivorus</i> European Honey-Buzzard	breeding	1995	2-3 breeding pairs	medium	B3	Least Concern
<i>Neophron percnopterus</i> Egyptian Vulture	breeding	1995	2-3 breeding pairs	medium	A1	Endangered
<i>Accipiter brevipes</i> Levant Sparrowhawk	breeding	1995	3-5 breeding pairs	medium	B2	Least Concern
<i>Aquila chrysaetos</i> Golden Eagle	breeding	1995	2-3 breeding pairs	medium	B2	Least Concern
<i>Crex crex</i> Corncrake	breeding	1995	10-25 males only	medium	B2	Least Concern
Notes: BirdLife International (2014) Important Bird Areas factsheet: Jermuk.						

Legally Protected Areas

The RA has the following types of legally recognised protected area:

- **State Reserves** – Protection status equivalent to IUCN Category 1 protected areas, established to protect the natural course of dynamic processes and rare species of flora and fauna;
- **National Parks** – IUCN Category 2, areas of ecological, historical-cultural, aesthetic significance; and
- **State Reservations/Sanctuaries** – can be protected areas of national or local significance, protection status close to IUCN Category 6 protected areas.

Natural monuments are also protected and are selected according to international criteria, IUCN Category 3. Figure 4.10.1 shows the distribution of protected areas within 10 km of the Project.

The closest National Park to the site is the Sevan National Park located approximately 44 km to the north-north-west of the Project. Three specially protected State Sanctuaries are located in the vicinity, as illustrated in Figure 4.10.1: Jermuk Forest (2.9 km north), Herher Open Woodland (5.1 km west) and Jermuk Hydrological (6.4 km north). These are state sanctuaries. WWF has put forward proposals to develop a new National Park centred on Jermuk, which would encompass the State Sanctuaries mentioned above and the Jermuk IBA.

Proposals are still under discussion.

Various initiatives have been developed to strengthen the RA's protected area system. These have aimed *inter alia* to increase the area of land under protection, address gaps in the level of protection afforded to different habitats and species and develop capacity for monitoring and management. Montane meadow steppe grassland such as that found over much of the Project-affected area is acknowledged to be under-represented within the country's protected area system and is relatively well represented in the area identified for a potential new Jermuk National Park.

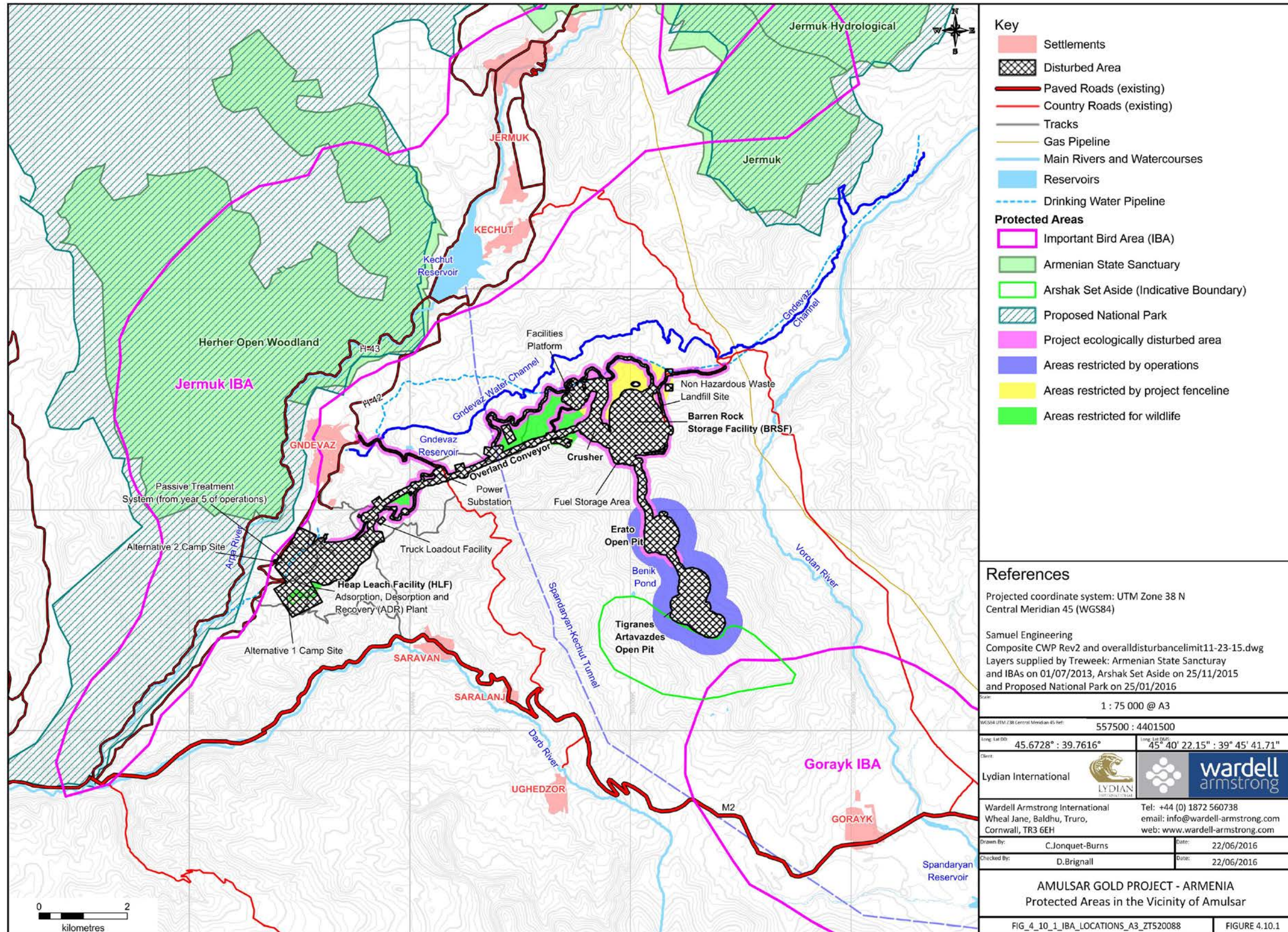


Figure 4.10.1: Protected Areas in the Vicinity of Amulsar

Species of Conservation Concern

The 2015 IUCN Red List of Threatened Species identifies around 50 species of globally threatened animals in the Caucasus region as a whole. Review of desk-top information and IBAT indicated the possible presence of several IUCN listed and Armenian Red Book (updated in 2010) species in the Project-affected area.

IBAT provides species information in the form of 'Threatened species grids' which are derived directly from the species distribution maps produced as part of each individual IUCN Red List assessment. Distribution maps show the distribution of the species within its native range. A polygon displaying the limits of a species distribution is essentially meant to communicate that the species potentially occurs within this polygon, but it does not mean that it is distributed equally within that polygon or occurs everywhere within that polygon.

The Project lies within grid cell 34991. Globally threatened species which potentially occur within this polygon (but not necessarily recorded within the Project-affected area) are listed in Table 4.10.6. Of these species, the following are prioritised for action in the wider region⁴:

- ***Panthera pardus tulliana* (Leopard)** - RA Red Book species and IUCN Red List – Near Threatened.
- ***Ovis orientalis Gmelin* (Mouflon)** – RA Red Book and IUCN Red List – Vulnerable.
- ***Capra aegagrus erxleben* (Bezoar Wild Goat)** – RA Red Book and IUCN Red List - Vulnerable.
- ***Ursus arctos* (Caucasian Brown Bear)** RA Red Book – Vulnerable and IUCN Least Concern.

These species are all threatened throughout the region by loss and fragmentation of habitat and also by hunting. Consultation and literature searches carried out prior to field surveys suggested the possible presence of Bezoar Wild Goat and Caucasian Brown Bear in the Project-affected area. There had not been any recent sightings of Mouflon or Leopard though both reputedly occurred in the area in the past.

⁴ Conservation Plan for the Caucasus Ecoregion (WWF 2012)

Table 4.10.6: Globally Threatened Species (IBAT) according to the IUCN Red List			
Birds		Mammals	
<i>Aegypius monachus</i> (Cinereous Vulture)	NT	<i>Mesocricetus brandti</i> (Brandts Hamster)	NT
<i>Anser erythropus</i> (Lesser White Fronted Goose)	VU	<i>Miniopterus schreibersii</i> (Common Bentwing Bat)	NT
<i>Aythya nyroca</i> (Ferruginous Duck)	NT	<i>Panthera pardus ciscaucasica</i> (Leopard)	NT
<i>Branta ruficollis</i> (Red Breasted Goose)	EN	<i>Rhinolophus Euryale</i> (Mediterranean Horseshoe Bat)	NT
<i>Coracias garrulous</i> (European Roller)	NT	<i>Rhinolophus mehelyi</i> (Mehely's Horseshoe Bat)	VU
<i>Falco cherrug</i> (Saker Falcon)	EN	<i>Capra aegagrus</i> (Bezoar)	VU
<i>Falco naumanni</i> (Lesser Kestrel)	LC	<i>Hyaena Hyaena</i> (Striped Hyaena)	NT
<i>Ficedula semitorquata</i> (Semi-collared Flycatcher)	NT	<i>Lutra Lutra</i> (Eurasian Otter)	NT
<i>Tetrao mlokosiewiczi</i> (Caucasian Black Grouse)	NT	<i>Ovis orientalis</i> (Mouflon)	VU
		<i>Ursus arctos arctos</i> (Brown Bear)	LC
<i>Marmoronetta angustirostris</i> (Marbled Teal)	VU	<i>Barbastella barbastella</i> (Western Barbastelle)	NT
<i>Milvus milvus</i> (Red Kite)	NT		
<i>Neophron percnopterus</i> (Egyptian Vulture)	EN		
<i>Otis tarda</i> (Great Bustard)	VU		
Note: LC is Least Concern; NT is Near Threatened; VU is Vulnerable; EN is Endangered.			

4.10.3 Vegetation Surveys and Results

Vegetation and Botanical Survey Methods

There was no documented information on the vegetation of the Project-affected area in the available literature. Vegetation types were therefore identified and classified based on interpretation of satellite imagery and the results of field surveys. Preliminary “walk over” surveys were conducted between May and October 2010 over a 4 km² area followed by more intensive sampling in sample areas of 100 m² selected at random. Some plant specimens (and photos) were taken to provide a reference collection in collaboration with the National Herbarium and to obtain information needed to understand conservation requirements for the Project’s rare and Armenian Red Book species. The plants were collected from different altitudinal zones within the Project-affected area.

Further surveys were undertaken in 2012 to clarify the species composition of vegetation within the proposed Project physical footprint (not including the conveyor or access roads). A set of transects was identified with a series of survey points designed to cover a range of altitudes and soil types and to encompass the main vegetation types affected (see Figure

4.10.2). At each survey point, information on environmental parameters was collected and a set of three 4x4m quadrats was sampled to determine plant species composition and percentage cover. This information was used to help classify the main vegetation types present.

Although satellite imagery provided an adequate map of landcover, it could not be used to distinguish or identify the different habitats or vegetation types accurately. A detailed vegetation classification was also needed for the entire Project-affected area. A ground survey was therefore carried out in May-June 2013 and May 2014 using GPS to improve interpretation ability. This was supplemented by inspecting photographs taken during the survey. Each polygon was given attributes for the vegetation type identified, moisture and slope. In total, an area of 13,538 ha of vegetation was mapped, 1,765 ha of this area lying within the footprint for infrastructure, associated buffer zones and restricted areas.



Figure 4.10.2: Locations of Vegetation Transects and Survey Points

The vegetation surveys carried out in 2012 revealed the presence of a previously unknown population of *Potentilla porphyrantha* on Amulsar Mountain. A preliminary population count

was made. Searches for the plant were also carried out in similar habitat on surrounding mountains.

Because of the global importance of the sub-population discovered on Amulsar in 2012 and its conservation importance in Armenia, a second survey was carried out in 2013 to verify the distribution and size of the population and confirm the extent of critical habitat according to PS6/ PR6. A team of four people spent three days searching the mountain rigorously for *Potentilla porphyrantha* plants, led by Dr Pete Carey, a botanical specialist and plant population ecologist and assisted on the first two days by S. Arevshatyan (the Geoteam environmental specialist who had carried out the survey in 2012). The southernmost part of the massif towards the village of Gorayk was left unsurveyed due to a lack of time. The only other areas unsurveyed were steep cliffs on the east side of Tigranes Peak which were too dangerous to survey without climbing equipment.

Locations of outcrop or boulders with *Potentilla porphyrantha* plants were recorded using ArcPad GIS with built in GPS. The GPS had been previously verified in February 2013 and had accuracy to within approximately 5m on all days. Outcrops without plants were mapped as 'absences' and a distribution map of presences and absences across the mountain was created.

Specimens were collected during surveys to carry out preliminary research on translocation and restoration methods. Herbarium materials were dried and transported for storage in the herbaria of the NAS RA Institute of Botany. As the population biology and environmental requirements for *Potentilla porphyrantha* are unknown, a programme of research has been designed to investigate ecological requirements and propagation techniques. This research will also provide information needed to model the viability of the affected population so that an effective restoration strategy can be developed and ability to achieve a net gain in population can be tested. A permit to translocate *P.porphyrantha* plants was granted in August 2015. In September and October 2015 1685 plants were collected and translocated to the Sevan Botanical Garden of the National Academy of Sciences RA.

Monitoring surveys carried out in 2014 and 2015, and further searches carried out while reviewing potential topsoil storage locations, revealed additional rocks with *Potentilla porphyrantha* on the eastern flank of Amulsar. The distribution map was updated accordingly. The baseline population was set as 2014 because new plants were discovered in 2015 in

places that had been searched previously. The assumption is that these are truly new plants which could have been spread around the mountain by human activity.

During 2013, surveys of surrounding areas were carried out to identify suitable source locations to harvest seed and turves for potential restoration of natural vegetation as part of an ongoing programme of research into reliable and effective techniques to feed into closure planning.

Results of Terrestrial Vegetation Surveys

Vegetation types

Based on the results of the vegetation transects and habitat survey, the main vegetation types found in the Project-affected area were defined as shown in Table 4.10.7. These types are largely determined by altitude, levels of moisture and land use and reflect the Armenian vegetation or biotope classification. Further detail on the characteristics of each vegetation type may be found within the Natural and Critical Habitat Assessment (Appendix 4.10.3).

Habitat	Altitude	Moisture	Land Use
Cultivated land	Low (<2100masl)	Moist to average	Arable and/or pasture
Montane Meadow	Low to medium (<2450masl)	Moist to average	Pasture
Montane Meadow Steppe	Low to medium (<2450masl)	Average to dry	Pasture or unused
Sub-alpine Meadow	High (>2450masl)	Average	Pasture or hay
Sub-alpine Meadow With Alpine Elements	Very high (>2700masl)	Average	Pasture or hay or unused
Rocks/Scree	All Altitudes	Dry	Unused
Vegetation With Shrubs	Low to medium (<2450masl)	Moist to dry	Sparsely used as pasture
Wetland	Low to medium (<2450masl)	Moist	Within pastures
Riparian	Low (<2100masl)	Moist to saturated	Pasture or unused
Gorge	Low (<2100masl)	Dry	Unused

Following discussions with the NAS RA Institute of Botany it was concluded that Amulsar does not support alpine vegetation as defined within the Armenian classification, though plant species do occur which are typical of the alpine zone. The presence of these plant species makes the vegetation important for biodiversity despite its non-typical nature and a new description (“Sub-alpine Meadow with Alpine Elements”) was defined to describe the type of

vegetation found on the highest areas of the mountain. Typically, the alpine plants are found in rocky areas.

A vegetation type including shrubs was also included because of the conservation importance of remaining shrub habitat and the fact that it is one of the characteristic vegetation types of the Caucasus Mixed Forest Ecoregion. Shrubs grow extremely slowly and tend to disappear from grazed areas. They are therefore difficult to restore or replace.

Figure 4.10.3 is a map of the main habitat types occurring in the area surrounding the Project. The “mapped area” was designed to incorporate all areas expected to be affected by mine infrastructure or by mining-related activity and to be extensive enough to support comparisons of affected vegetation with some unaffected examples of the same types of vegetation. In addition to the nine habitat types listed in Table 4.10.7, small areas of urban development were identified and there were many polygons that had combinations of the different habitats forming mosaics, e.g. ‘Sub-alpine Meadow/Rocks’ would be a polygon with both Sub-alpine Meadow and Rocks but where the Sub-alpine Meadow covered a larger area and was considered ‘dominant’. In total, thirty-two distinct habitats and habitat mosaics were identified. To enable the habitat map to be interpreted easily this list was reduced to the nine most pertinent categories. The map shows the dominant habitat (by area) identified for each polygon. All habitat mosaics containing shrubs were included in the Vegetation with Shrubs category, and habitat mosaics where rocks were dominant have been assigned to the second-most dominant vegetation type, if there was one. Wetland is found largely in the Vorotan Valley but there are also small ponds and some perched mires on the western side of the mountain.

Table 4.10.8: Extent of Different Habitat Types Within the Mapped Area		
Habitat	Area in ha	% Area
Cultivated	462.00	3
Montane Meadow Steppe	4,914.00	36
Montane Meadow	2,814.00	21
Sub-alpine Meadow	1,885.00	14
Sub-alpine Meadow with Alpine Elements	147.00	1
Vegetation with Shrubs	1489.00	11
Rocks	81.00	1
Wetland	433.00	3
Urban	2.00	0
Orchard	8.00	0
Gorge	1301.00	10

The wider Project area is dominated by Montane Meadow Steppe alone or in combination with other types, including species-rich Sub-alpine Meadows. Montane Meadow Steppe accounts for 44% of the mapped area and Sub-alpine Meadow for 18% (see Table 4.10.8). Sub-alpine Meadows in “good condition”, such as those found at the summits of Tigranes, Artavazdes and Arshak, are relatively rare in Armenia. They retain high endemic species richness and are considered to be relatively important in a national context by specialists. Alpine species considered to be noteworthy within Amulsar’s Sub-alpine Meadows with Alpine Elements include: *Potentilla porphyrantha*, *Aetheopappus caucasicus*, *Arabis caucasica*, *Aster alpinus*, *Campanula bayerniana*, *Cystopteris fragilis*, *Erigeron venustus*, *Helichrysum plicatum*, *Huynhia pulchra* (endemic), *Jurinea moschus* and *Potentilla crantzii*.

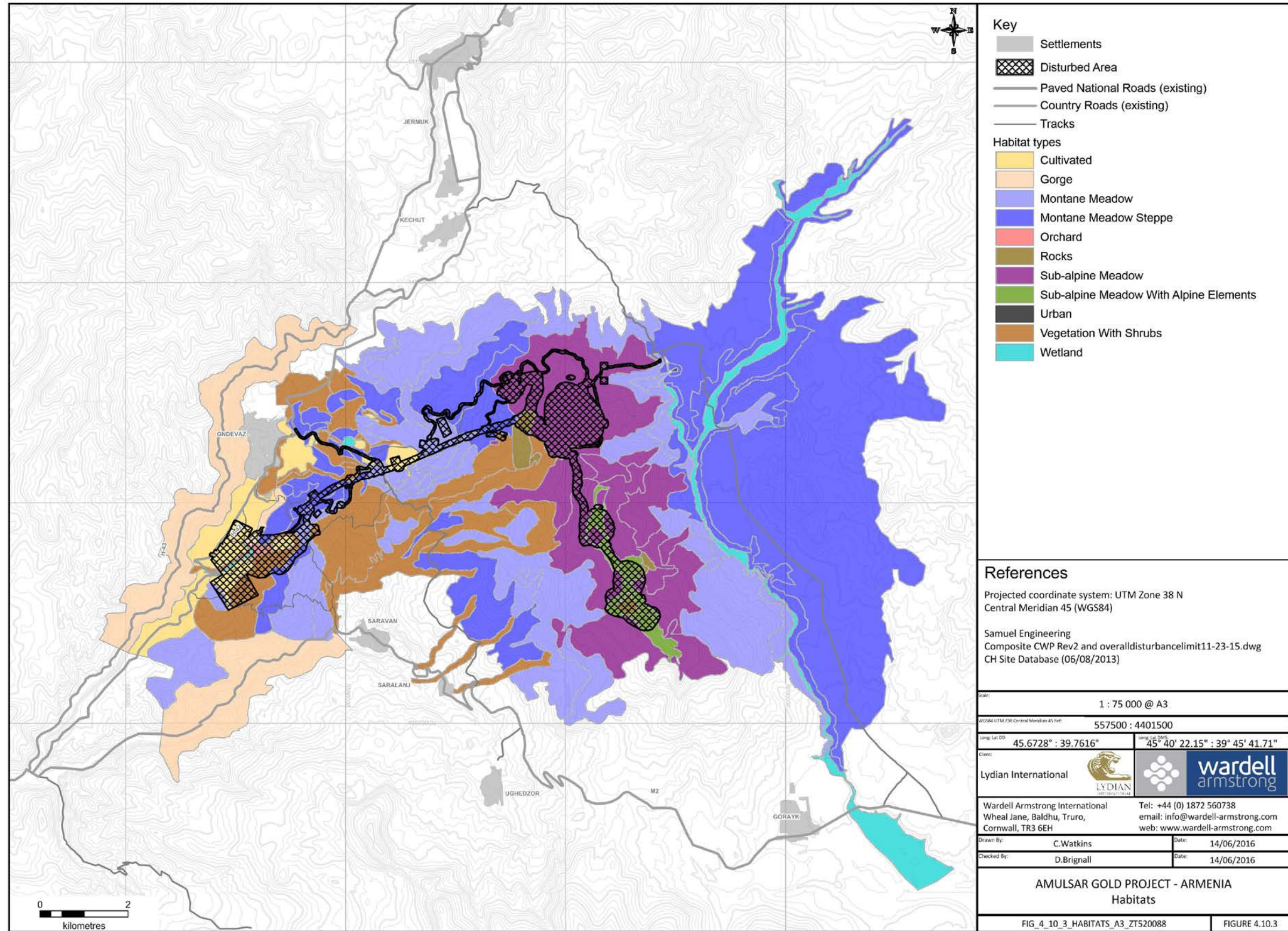


Figure 4.10.3: Habitat Map of the Amulsar Area

Results of vegetation surveys: natural and modified habitat

A detailed assessment was undertaken to assign the vegetation encountered in the area to “natural” and “modified” categories according to the guidance in PS6 and PR6. Full details are included in the Natural and Critical Habitat Assessment (Appendix 4.10.3) and a summary is included here.

Sub-alpine Meadow with Alpine Elements is found at the highest areas of the mountain that are not rock outcrops. It is seldom grazed or used and can be considered entirely natural.

Sub-alpine Meadows are found on flat or sloping ground (sometimes very steep) above 2450 m above sea level (asl). They have native species and are only grazed lightly (usually in mid-summer) due to late snow lie, or sometimes used for a late hay cut. The Project has chosen to take a conservative approach and define these as natural.

Prior to the Soviet era, Montane Meadows and Montane Meadow Steppes in the Project area were managed as a transhumant grazing and hay meadow system. Botanically diverse vegetation with characteristic native species developed over centuries (and possibly millennia) of traditional management under this system, which has disappeared from most areas of the world where it used to be widespread, and is also declining throughout the Caucasus Region. The associated cultural landscapes have become increasingly rare as a result. The Project area is in a recovery phase following more intensive use during the Soviet era and traditional management practices have become re-established. Transhumance is still practised with animals coming with their herders from long distances away or on a daily or seasonal basis from local villages. Montane Meadows and Montane Meadow Steppes are currently managed by relatively extensive summer grazing and/or harvesting for hay.

These habitats have been defined as natural where they have predominantly native species and where species-rich communities have persisted under traditional land management without significant modification due to addition of inorganic fertilisers or reseeded. They meet the definition of ‘semi-natural’ used in European conservation programmes where allowances have been made for some mechanisation and the evolution of grazing animals and systems.

Vegetation with Shrubs occurs in both the Mountain Meadow and Mountain Meadow Steppe zones. The characteristic species of shrub are *Juniperus communis*, *J. polycarpus* and

Crataegus meyeri. Juniper scrub is one of the characteristic vegetation types of the Caucasus Mixed Forest Ecoregion and is of conservation importance. Small fragmented examples of this vegetation type remain which would be classed as truly natural. Where the vegetation type is more affected by grazing and has sparse presence of characteristic shrub species, it has been defined as modified.

Areas immediately surrounding seasonal herder camps are heavily grazed and have become dominated by agricultural weed species. Local communities also have land holdings within the Project-affected area used for grazing and for hay. These are defined as modified but are generally too localised to indicate on the habitat map.

Figure 4.10.4 illustrates the distribution of natural and modified habitat types in the mapped area.

A large part of the wider Project area constitutes “natural” habitat according to the definition in PS6/ PR6.

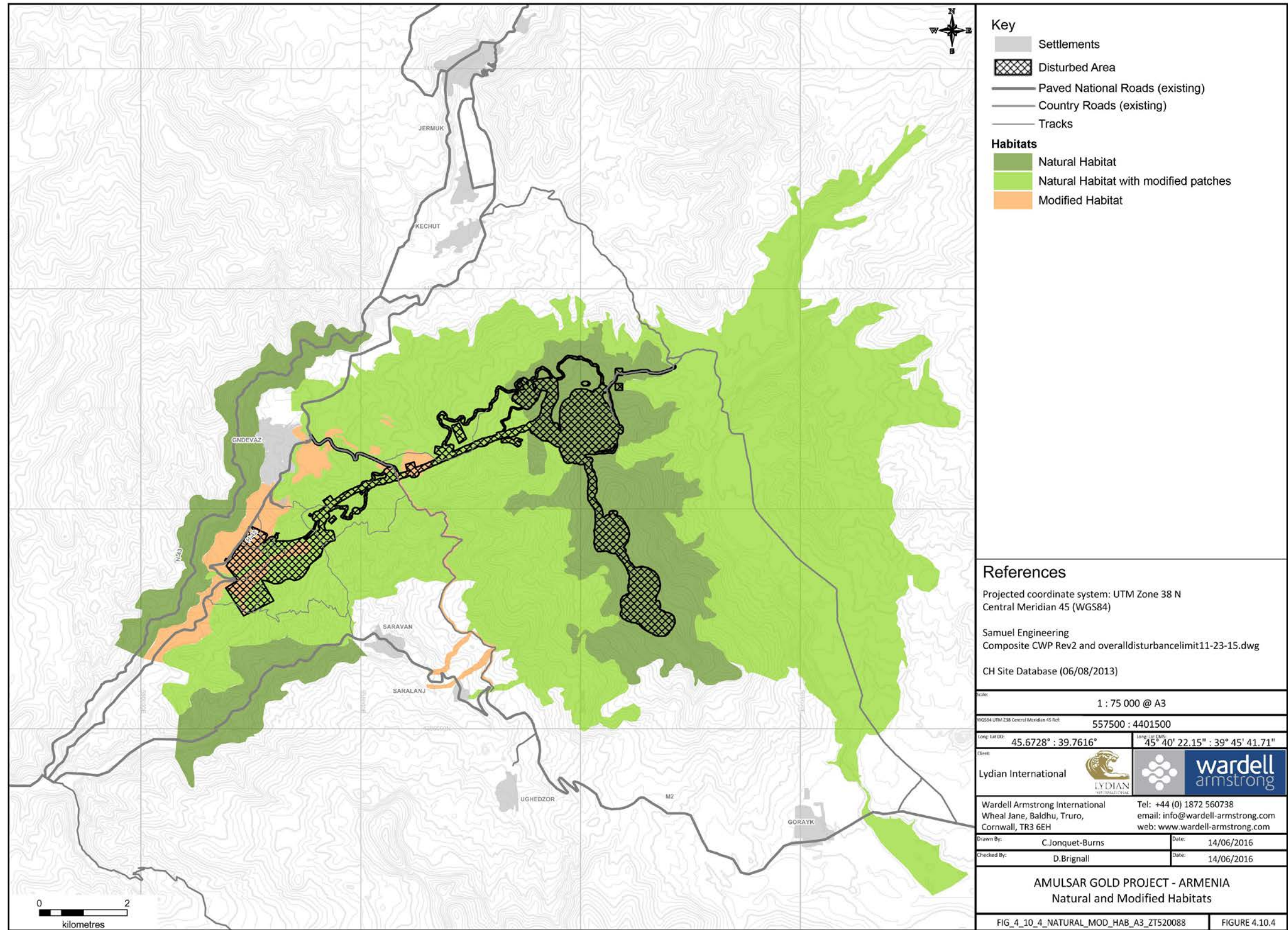


Figure 4.10.4: Natural and Modified Habitats

Endemic Plants within the Project-affected area

A number of species within affected vegetation types are regional endemics, either within the Trans-Caucasus (TC) or the Caucasus (C). In addition to *Potentilla porphyrantha*, endemic plant species recorded during surveys included the following 21 species: *Astrantia maxima* Pall., (C) *Huynhia pulchra* (Willd. ex Roemer & Schultes) Greuter & Burdet (Syn.: *Macrotomia echioides* (L.)(C), *Noccaea tatiana* (Bordz.) F.K. Mey. (= *Carpoceras tatiana* (Bordz.) Grossh.) (TC), *Cerastium szowitsii* Boiss. (Syn.: *C. araraticum* Rupr.)(TC), *Hylotelephium caucasicum* (Grossh.) H. Ohba (= *Sedum caucasicum* (Grossh.) Bor.)(C), *Sedum gracile* C.A. Mey (C), *Sempervivum transcaucasicum* Muirhead (C), *Cephalaria gigantea* (Ledeb.) Bobrov (C), *Scabiosa caucasica* M. Bieb.(C), *Anthyllis lachnophora* Juz. (= *Anthyllis boissieri* (Sagorski) Grossh)(C), *Vicia alpestris* Steven(C), *Tulipa Julia* k. Koch (TC), *Iris demetrii* (TC), *Papaver orientale* L. (C), *Delphinium flexuosum* (C), *Delphinium freynii* conrath (TC), *Crataegus caucasica* C. Koch (C), *Saxifraga cartilaginea* Willd. ex Sternb. (C), *Linaria schelkownikowii* Schischk. (TC), *Rhynchocorys orientalis* (L.) Benth. (C). and *Fritillaria armena* Bois. var *lucida* Hausskn. et Bornm (also called *Fritillaria caucasica* Adam and *F.tulipifolia* M.Bieb.). These species are sparsely, but widely distributed throughout the landscape apart from *Potentilla porphyrantha* which has only three populations in Armenia (see next section). *Fritillaria armena* is rare within the Project-affected area but does occur elsewhere in the surrounding landscape. It has a localised, small population near to the proposed conveyor route and does not occur anywhere else within the Project-affected area.

At least 22 plant species recorded during baseline surveys are regional endemics, either within the Trans-Caucasus (TC) or the Caucasus (C) region. Species potentially affected by the Project are *Potentilla porphyrantha* and *Fritillaria armena* .

Rare Plants within the Project-affected area

Appendix 4.10.1 lists all the plant species recorded in the Project-affected area or referred to in relevant literature sources. The only plant species recorded in the Project-affected area included in the Armenian Red Book of Plants (2010) is *Potentilla porphyrantha* (Juz). The species is classified as Critically Endangered by criteria D 1 ab(iii) + 2 ab(iii), which reflects the fact that the area occupied by the species in Armenia is less than 10 km² in total.

The species has not hitherto been evaluated against IUCN Red List criteria at global level. Therefore, in accordance with PS6 guidance, a provisional assessment was made against the latest version 3.1 criteria, by botanical experts in consultation with IUCN Red List specialists

and the Missouri Botanical Garden. This assessment concluded that *Potentilla porphyrantha* meets two criteria for Endangered status (EN), based on its small area of occupancy and a perceived threat of significant population size reduction (see the Natural and Critical Habitat Assessment in Appendix 4.10.3 for further details).

The distribution of the plant is highly fragmented and the extent and quality of the habitat in which it occurs is generally considered to be declining. In addition to degradation of habitat, climate change is a possible additional threat. The population discovered on Amulsar is important because it is one of only five known sub-populations globally (a sixth is known from historical records). The population on Amulsar brings the number in Armenia to three (others are at Mets Ishkhanasar and Geghama Mountains (Sevsar and Agusarka)). Other sub-populations are in northern Iran. The other known sites for the species are all at higher altitudes than Amulsar, at 3300-4000 masl. *Potentilla porphyrantha* grows on rock outcrops and boulders on the Amulsar massif above 2450 masl. There is no global estimate for the population of *P. porphyrantha* but its known global distribution extends from northern Iran to Yerevan. None of the sub-populations had been counted or mapped before the Amulsar population in 2012-2013. The 2012 survey suggested that the plant grew on rocky outcrops at an altitude of 2800-3000 masl. The plant was only found on large rock outcrops as shown in Figure 4.10.5, often associated with a moss, *Grimmia sp.*



Figure 4.10.5: Examples of large rocky outcrops below Arshak where *P. porphyrantha* was found in 2012

In 2013 additional plants were found on relatively small boulders down to an altitude of 2450 masl on the southwestern slopes (Figure 4.10.6), and a few individuals were observed growing on scree. The 2013 survey revealed the population of *P. porphyrantha* on the Amulsar Massif to be approximately 7,500 (± 1000) as shown on Figure 4.10.7. The distribution was further extended on the eastern side of the mountain following additional survey in 2014 (see Figure 4.10.7). In 2015, plants were found growing on tracks created by the mine exploration and on boulders searched previously. These plants must be less than 4 years old.

The population includes a large number of plants on the southern end of Amulsar mountain, which are now included in a set-aside (see Chapter 6.11). Some areas supporting numerous plants could not be counted due to steep cliffs and inaccessible terrain. The total count for the Project-affected area is therefore a conservative estimate. The plant grows in small cracks and crevices of the boulders of various rock types and is often associated with the moss *Grimmia* which seems to provide a form of 'soil' or substrate for the plant to grow in. Plants flower in June and July and flowers are approximately 15 mm across (Figure 4.10.8). There is no obvious pattern to the aspect that the plants face, but they are often found on the top of

boulders or where they get a lot of sunlight. Access to water from cracks on the top of boulders and mosses could be an important factor in supporting the plants of *P.porphyrantha*.



Figure 4.10.6: Small boulder with 50 plants of *P.porphyrantha*



Figure 4.10.7: Amulsar Sub-Population of *P. porphyrantha*



Figure 4.10.8: *P. porphyrantha* plant

Critical habitat

Critical habitat is a category of natural or modified habitat defined under paragraph 16 of IFC PS6 as having high biodiversity value, due to the presence of CR or EN species, endemic or restricted-range species, migratory or congregatory species, highly threatened or unique ecosystems, or a number of other qualifying criteria. As required by IFC PS6, a detailed critical habitat assessment was carried out for the Project. The full report is presented as Appendix 4.10.3, and the key results are summarised within this chapter.

As described above, *Potentilla porphyrantha* is believed to meet two IUCN Red List criteria for EN status, and the sub-population discovered on Amulsar is important because it is one of only five known sub-populations globally. The Amulsar sub-population is therefore believed to meet one of the threshold for Tier 1 critical habitat - habitat with known, regular occurrences of CR or EN species where that habitat is one of 10 or fewer discrete management sites globally for that species (for further detail see Appendix 4.10.3). The Amulsar sub-population may meet a second criterion for critical habitat - if it sustains greater than 10% of the global population of the species - although this cannot be confirmed based on current information (however, Amulsar represents approximately 60% of the currently known global Area of Occupancy for the species).

The only RA Red Book plant species found in baseline surveys was *Potentilla porphyrantha* which is listed as Critically Endangered in the RA Red Book. The species has not been formally evaluated for the IUCN Red List. Therefore, in accordance with PS6 guidance, a provisional assessment was made against the latest version 3.1 criteria, by botanical experts in consultation with IUCN Red List specialists and the Missouri Botanical Garden. This assessment concluded that *Potentilla porphyrantha* meets two criteria for Endangered status (EN).

The population of *P. porphyrantha* on Amulsar is one of only five known sub-populations globally (a sixth is known from historical records) and brings the number in Armenia to three (others are at Mets Ishkhanasar and Geghama mountains – Sevsar and Agusarka). Other sub-populations are in northern Iran.

The Amulsar sub-population is believed to meet at least one of the thresholds for Tier 1 critical habitat - habitat with known, regular occurrences of CR or EN species where that habitat is one of 10 or fewer discrete management sites globally for that species.

Invasive species

Three species of plant, *Astragalus aureus*, *Verbascum laxum* and *Cirsium arvense* (Creeping Thistle), are found in the Project-affected area particularly within Sub-alpine Meadow and Montane Meadow habitats. These are not alien species, but they do have invasive properties and can return to dominate quickly if an area is cleared of vegetation.

4.10.4 Mammal Surveys and Results

Survey Methods

A review of available scientific literature provided limited specific information on the presence of mammal species and their populations in the Amulsar region. Reports from the WWF Armenian office were also reviewed along with the 2012 revised and amended Ecoregion Conservation Plan for the Caucasus.⁵

Field surveys took place in autumn 2011 along 5-7km long linear routes or transects designed to include all biotopes considered to form suitable habitat for both large and medium sized animals in the Project-affected area. Small mammal traps were also used in five areas (400m x 500m) considered likely to be inhabited by rodents and insectivores in order to determine

⁵ Available at: http://69.195.124.72/~caucasu1/wp-content/uploads/2012/11/ECP_Ecoregion_Conservation_Plan_Caucasus_2012.pdf

the species composition of small mammal populations. Further surveys were undertaken by the NAS RA Institute of Zoology and Hydroecology during 2013. Incidental sightings of mammals during surveys between 2008 and 2014 for other taxonomic groups were noted (see Appendix 4.10.2).

In 2015, a detailed survey looking at the presence and behaviour of *Ursus arctos* (Brown Bear) at Amulsar and in the wider region was undertaken by TEC, Alberta Innovates (AI), and the Institute of Zoology (IoZ) of the Armenian National Academy of Science (NAS). The survey work began in early 2015 with IoZ monitoring bear activity around Amulsar at the end of the hibernation season. Between April and October 2015, a network of 34 motion-activated, infrared camera traps established across a survey area of 733 km² was monitored continuously, and hair samples were collected from specially designed traps. Results from the camera traps have provided information on presence of suitable habitat for bears. Genetic testing of the hair samples will be completed in April 2016 and will be used together with the photographs to estimate the number, gender and age of bears. The photographs obtained also provided information on the presence of other mammals (and birds) in the area. An interim report on the survey is included as Appendix 4.10.9, and the preliminary observations and results are discussed below.

Results

Twelve species of smaller mammals were identified during the early surveys on Amulsar. These were *Erinaceus concolor* (Hedgehog), *Sorex volnuchini* (Caucasian Pygmy Shrew), *Lepus europaeus* (Hare), *Critetulus migratorius* (Grey Hamster), *Chionomys nivalis* (Snow Field Mouse), *Sylvaemus (apodemus) sylvaticus* (Forest Mouse), *Apodemus sylvaticus* (Wood Mouse), *Microtus arvalis* (Common Vole), *Chionomys nivalis* (Snow Vole), *Martes foina nehringi* (Stone Marten), *Mustela nivalis* (Least Weasel) (see Figure 4.10.9) and *Meles meles* (Badger). These species are all regarded as relatively widespread throughout the Project-affected area and the surrounding region, with stable populations.



Figure 4.10.9: *Mustela nivalis* (Least Weasel)

Larger mammal species present in the Project-affected area include *Vulpes vulpes* (Red Fox), *Canis lupus* (Grey Wolf), *Capra aegargos* (Bezoar Goat), *Lynx lynx* (Eurasian Lynx), *Sus scrofa* (Wild Boar), *Felis chaus* (Jungle Cat), and *Ursus arctos* (Brown Bear). Of these, Red Fox is widely distributed, has stable populations, and is observed regularly within the Project-affected area. The others are more rarely seen; in some cases their presence was confirmed only by the detailed Brown Bear survey undertaken in 2015.

Wolf tracks were observed in both 2011 and 2013 within the Project-affected area. The species is reported by locals as occurring regularly but relatively infrequently, particularly in winter. It was photographed by six cameras during the Brown Bear survey.

Bezoar Goat is listed as Vulnerable by IUCN and is included in Annexes II and IV of the European Habitats Directive, as well as in the RA Red Book. It is one of the species targeted for action in this part of Armenia in the recently issued Conservation Plan for the Caucasus Ecoregion (WWF 2012). It was observed twice on the northwestern slopes of the Jermuk Gorge in May 2013 (groups of 11 and 3) and in the area proposed for Jermuk National Park in June 2013 (a group of 5). Two individuals were photographed on the southern slopes of Amulsar (Arshak) on 8 September 2015 (Figure 4.10.10).



Figure 4.10.10: *Capra aegagrus* (Bezoar Goat) photographed on Amulsar in September 2015

The global IUCN Red List of Threatened species identifies six sub-species of Lynx. Those in the Project-affected area are Caucasus Lynx *L. l. dinniki*, occurring in the Caucasus Mountains south to Turkey, Iraq and Iran. In Armenia the Lynx is “thought to be a common species, especially in some protected areas but the population trend is unknown” (IUCN, 2015) and few surveys have been carried out. Numbers are unlikely to be high. Although classified as Least Concern by IUCN, it is listed in Annex IV of the EU Habitats Directive, which means that degradation of its habitat is prohibited under EU law. This is of significance to the Project because of its commitment to comply with the EBRD PRs - which assume compliance with EU law. It was photographed in five squares during the Brown Bear survey, including three times at Arshak (June 20, July 24 and July 31 2015).

Wild Boar was photographed in seven squares during the 2015 Brown Bear survey, and Jungle Cat on one occasion.

Panthera pardus ciscaucasica (Leopard) and *Ovis orientalis Gmelin* (Mouflon) were not recorded during any surveys and are not thought likely to be present in the Project-affected area. The main stronghold for *Panthera pardus ciscaucasica* in Armenia is now in the far South⁶.

Brown bear (*Ursus arctos*)

The Brown Bear (*Ursus arctos*) is a protected species in Armenia and is included in the national Red Data Book with a status of Vulnerable. Although classified as Least Concern by IUCN, it is listed in Annex IV of the EU Habitats Directive, which means that degradation of its habitat is prohibited under EU law. This is of significance to the Project because of its commitment to comply with the EBRD PR - which assume compliance with EU law.

Some of the scientific literature on bears in Armenia refers to two sub-species: Caucasian Brown Bear (*Ursus arctos meridionalis*) and Syrian Bear (*Ursus arctos syriacus*). Caucasian brown bear is considered to be restricted to the northern part of the country, tends to be larger than the Syrian subspecies and has a more uniform, darker colour. The Syrian subspecies is restricted to the South and has a greater variation of coat colours, from almost greyish to blond and even black.

The International Association for Bear Research and Management and the Bear Specialist Group (BSG) of the IUCN Species Survival Commission (SSC) do not recognize these distinct sub-species of Brown Bear, partly because there has not been sufficient genetic testing in relevant geographic areas to provide the firm evidence needed to confirm their existence. Nevertheless, communication with the IUCN SSC suggests that differences between sub-populations (in terms of level of isolation and exposure to risk) are recognised. There are three populations in the South Caucasus Region that are now considered to be effectively isolated from one another. As one of these isolated sub-populations, the Armenian population of Brown Bear is considered to be of conservation concern, with an emphasis on re-establishing historical corridors and preventing further fragmentation of habitat. Brown Bear is therefore one of the species targeted for action in this part of Armenia in the recently issued Conservation Plan for the Caucasus Ecoregion (WWF 2012).

⁶ Khorozyan, I. (2003). The Persian Leopard in Armenia: Research and Conservation. Proceedings of the Regional Scientific Conference "Wildlife Research and Conservation in South Caucasus 7-8 October, pp 161-163, Yerevan, Armenia

Initial baseline ecological surveys in 2008 noted the presence of Brown Bear but concluded that individuals were passing through the Project-affected area occasionally. Further ecological surveys carried out as part of the ESIA for Amulsar since 2011 confirmed that a breeding population of bear is present. Initial field surveys took place in autumn 2011 along 5-7 km long linear routes or transects designed to include all biotopes considered to form suitable habitat for both large and medium sized animals in the Project-affected area. Further surveys were undertaken by the Armenian Institute of Zoology during 2013.

Tracks and faeces of *Ursus arctos* were observed in the 2011 transect survey, along the banks of the Vorotan River and on the slopes of Amulsar Mountain above Saravan and Saralanj villages. Tracks and faeces were also observed frequently during the 2013 field surveys especially around the proposed mine pits on the summit of Amulsar and the mine exploration camp, but also throughout the entire Project-affected area. Tracks of a presumed female with two cubs were photographed near the mine exploration camp in April 2013 and there were sightings in 2014 of two different females with cubs (see Figure 4.10.11). A mature male bear was observed and photographed by the bird survey team on the south side of Amulsar using a cave during the day during surveys in 2013 (see Figure 4.10.12). Based on these findings, the Project-affected area is determined to be critical habitat for Brown Bear in relation to EBRD PR6 and its reference to the EU Habitats Directive.



Figure 4.10.11: Female bear with cubs, Amulsar, May 2014



Figure 4.10.12: Brown Bear observed on the south side of Amulsar Mountain, June 2013

The survey of Brown Bear was designed to enable the relative importance of the Project-affected area to be established in terms of availability of foraging and breeding habitat in a regional context. A large survey area of 733 km² (see Figure 4.10.13) was therefore used, with 34 cameras. Bear sightings in the early part of the season in 2015 are shown in Figure 4.10.14. It was also necessary to estimate the number of individuals potentially affected by the Project compared with the overall population. From mid-May to the end of September 2015, 2,422 pictures of Brown Bears were taken. Of the 34 camera sites, 28 were visited by at least one bear, 23 more than once, and 15 by more than one bear. Females with cubs were photographed in nine locations overall. Figure 4.10.15 shows where hair samples were collected.

Based on these results, a preliminary assessment of bear activity throughout the study area is presented in an interim survey report (Appendix 4.10.9) in terms of the number of “bear days” for each camera location or square. This is the number of days on which the camera took photographs of a bear (Figure 4.10.16). This statistic does not distinguish between visits on three consecutive days (a temporary visit) or three days spread over a period of several months (indicating continued presence of bears) but it does give an idea of the parts of the study area where bear activity was concentrated. Repeated bear activity was mainly found in the following areas (in order of importance):

Herher State Sanctuary (Squares 16-17, with 39 “bear days” in the latter);

- The southern slopes of Amulsar (Arshak set-aside, square 23, with 24 “bear days”);
and
- Woodlands between Amulsar and Saravan (square 22, with 17 “bear days”).

To a lesser extent, bear activity was also notable in:

- The wooded valley west of Kechut lake (squares 8 and 12, with 8 “bear days” in the latter);
- The Arpa River valley in Jermuk Hydrological State Park (square 5, with 6 “bear days”);
and
- The wooded valley along Artavan Road, and the mountains southeast of Artavan village (squares 24 and 30, with 5 “bear days” in the latter).

The above six areas also appear to be important for reproduction, as bear cubs were photographed in all of them. Cubs were also photographed around Spandaryan reservoir (squares 28 and 32), but it is not clear where they had come from. The shores of the reservoir

do not offer suitable bear habitat, and there is a lot of human activity (herders, farmers) in the mountain range to the south.

Between early June and 1 October 2015, a total of 203 hair samples were collected from 23 squares (in some squares, bears were photographed but did not leave any hairs). Most samples were collected in the wooded valley west of Kechut Lake (especially at the southern edge of square 8), in the woodland between Amulsar and Saravan, in Herher State Park, and on the southern slopes of Amulsar (Arshak set-aside). These are the areas that showed the most evidence of bear activity from the camera traps. In addition, quite a lot of samples were collected in the woodlands east of Jermuk/Kechut (e.g. 13 samples in square 14). A large number of hair samples in a square possibly signifies territorial behaviour, and therefore continuous presence of bears, suggesting that these woodlands are important habitat for the species. Likewise, the area around Shaghat village (square 38) may be more important than suggested by the camera trap results. However, until the results of genetic testing are available in April 2016, the possibility that a large number of hairs may simply have been the result of one or a few visits by a heavily moulting bear cannot be discounted.

Whilst the population size, density and exact distribution of Brown Bear in the study area cannot be determined until the genetic analysis is complete, numerous observations and photographs already demonstrate that the southern slopes of Amulsar are important for the species. Similarly, the woodland between Amulsar and Saravan (square 22) appears to be an important area for bears.

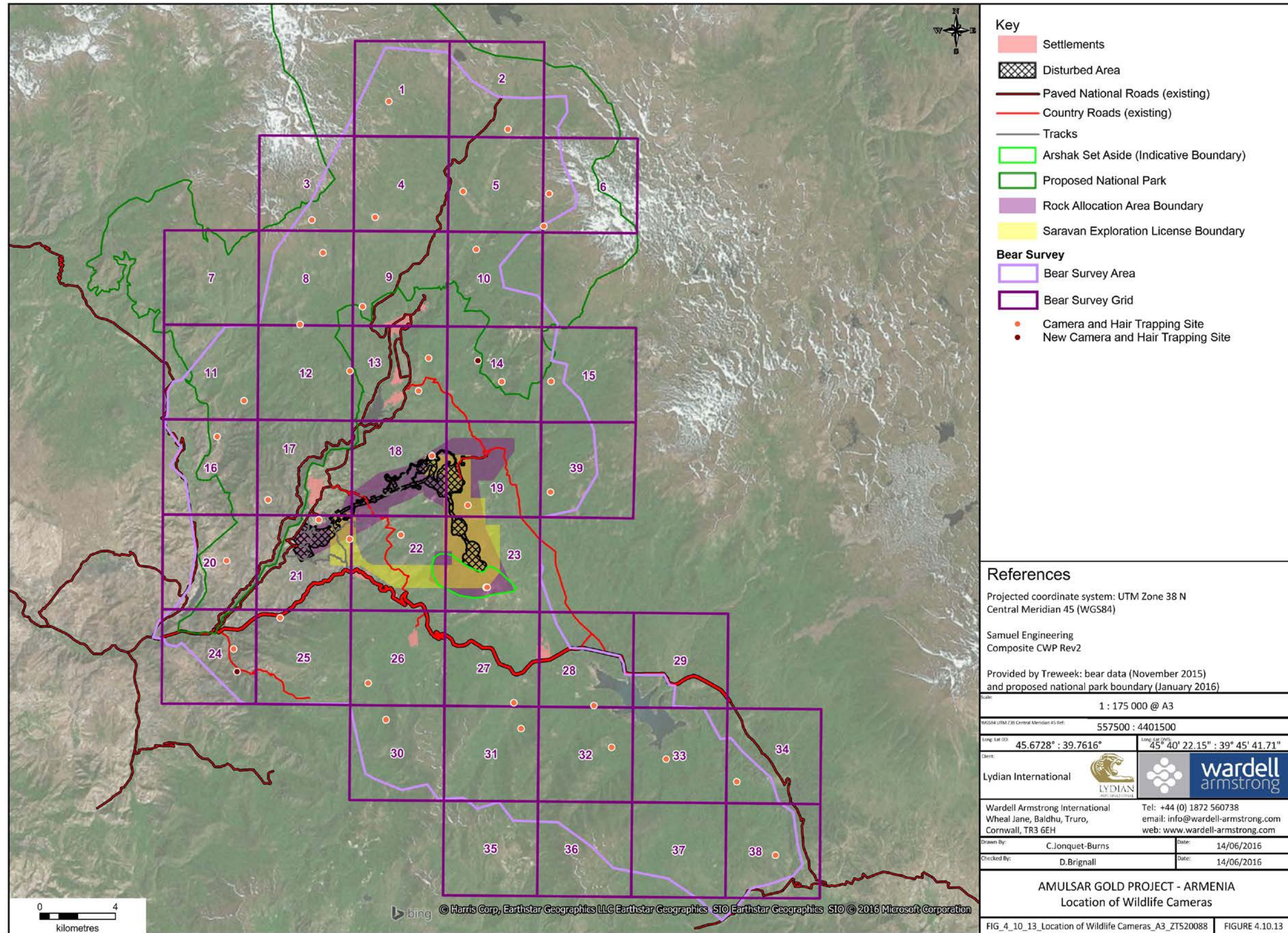


Figure 4.10.13: Location of Wildlife Cameras

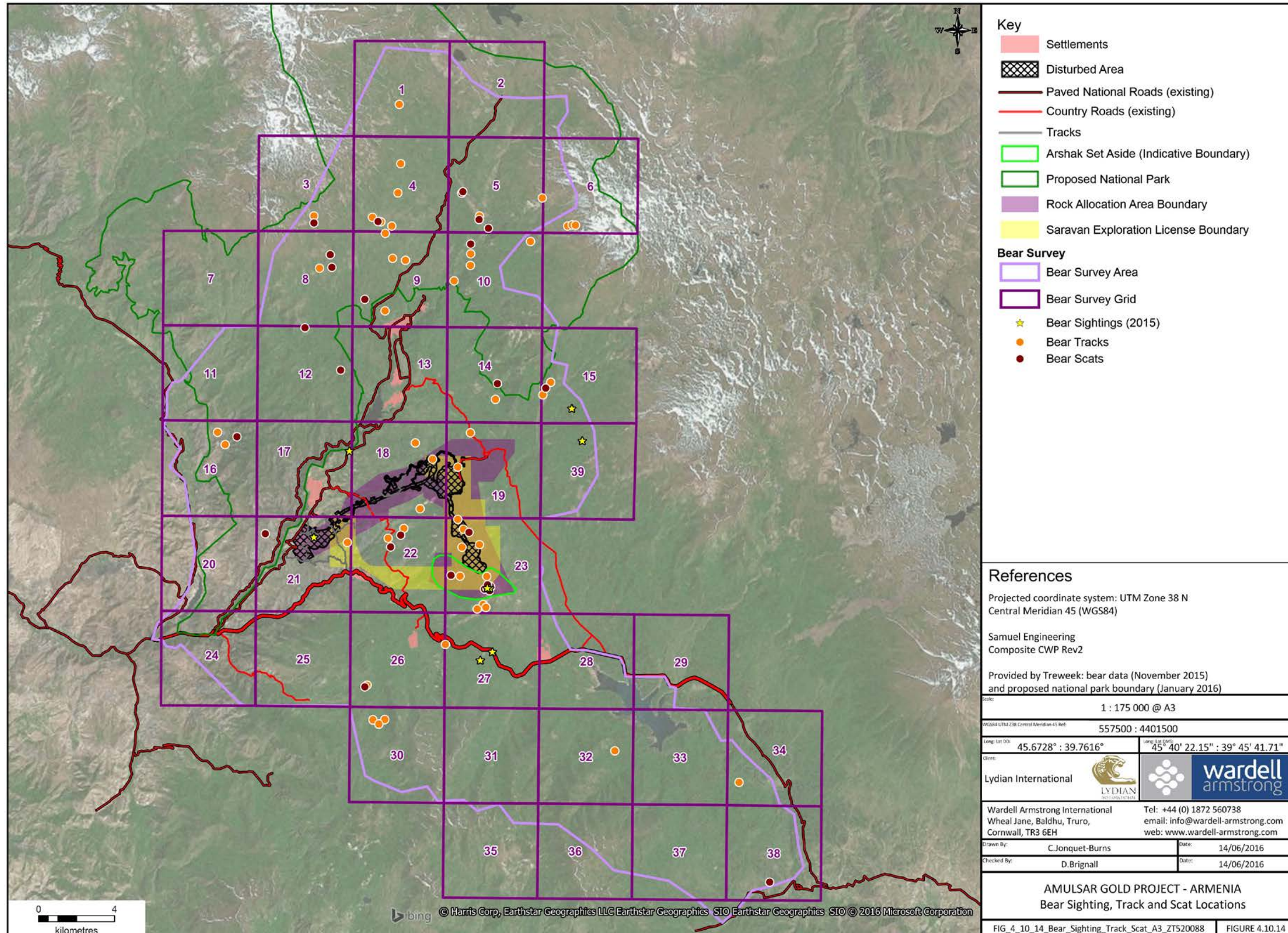


Figure 4.10.14: Bear Sightings and Tracks

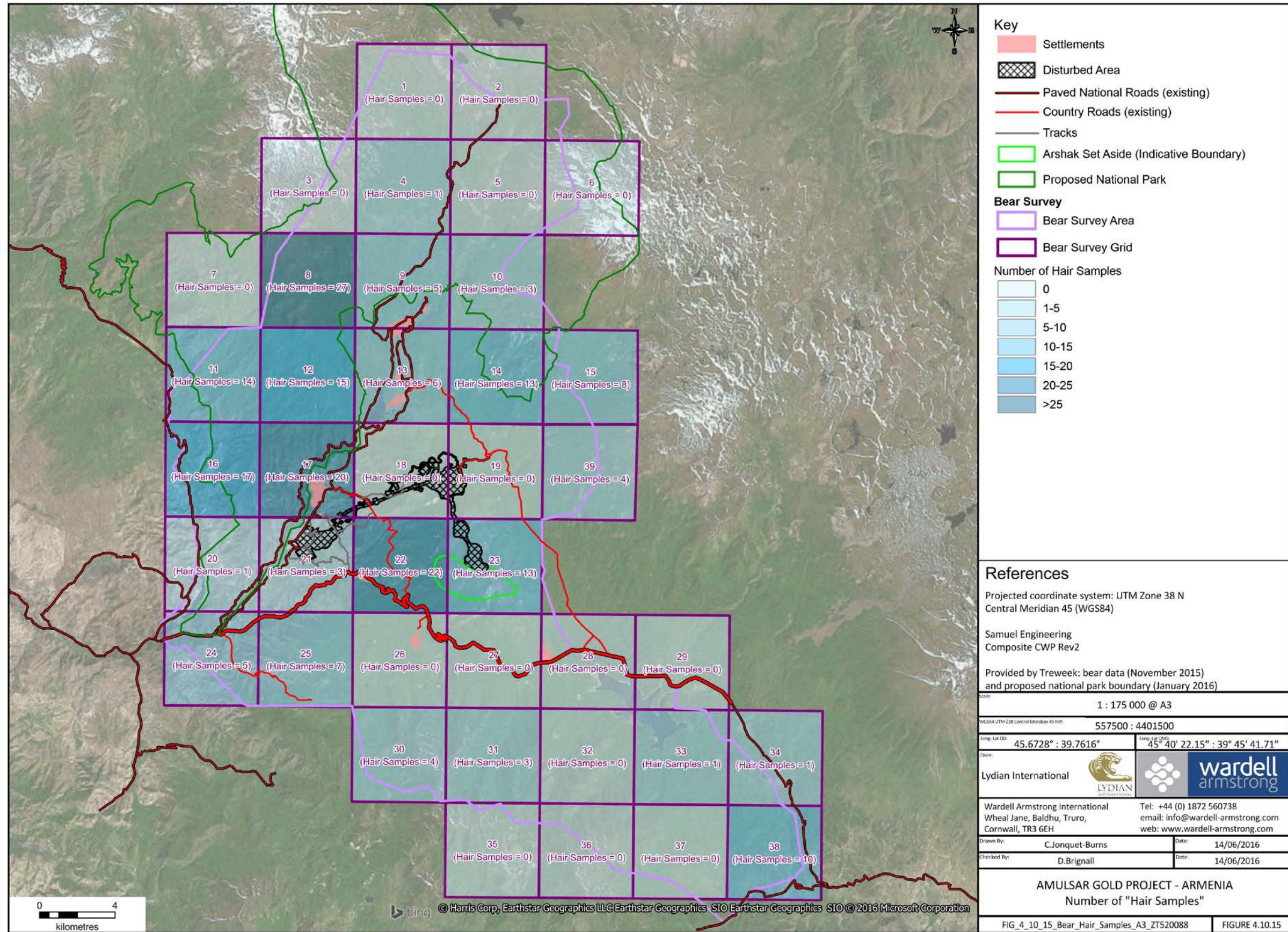


Figure 4.10.15: Bear hair Samples

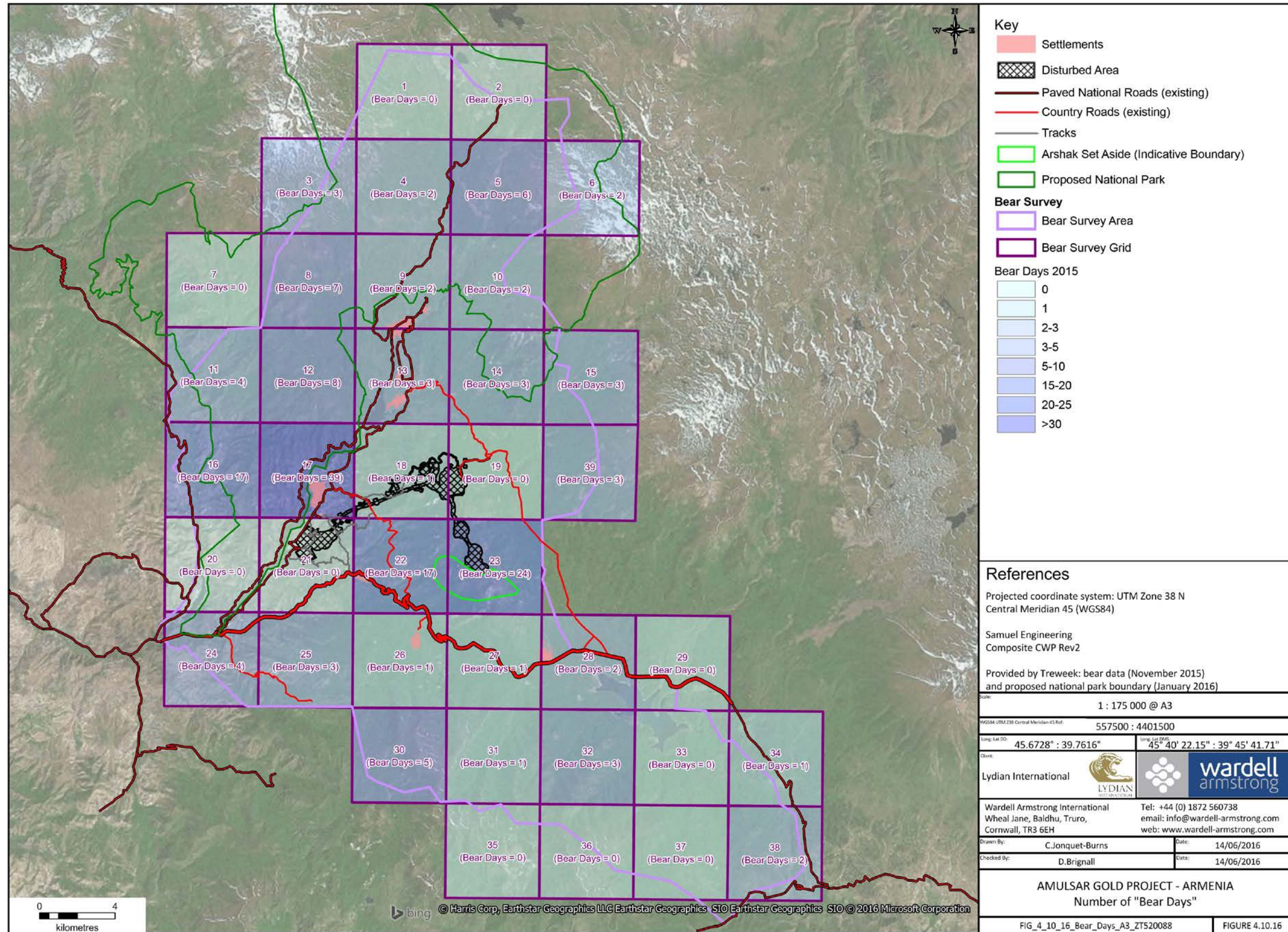


Figure 4.10.16: Bear Days

Critical habitat

Although classified as Least Concern by IUCN, and listed as Vulnerable in the RA Red Book, Brown Bear is considered to be a trigger species for critical habitat due to its status as an Annex IV species of the EU Habitats Directive, with which the Project has committed to comply in accordance with its intended adherence to the requirements of EBRD's PR6. Under the EU Habitats Directive, degradation of brown bear's resting or breeding habitat is prohibited. As IFC's PS do not require adherence to the EU Habitats Directive, this species does not trigger critical habitat requirements under PS6.

The results of genetic testing of hair samples collected in 2015 will clarify the size of the Bear population and their use of the Project-affected area and enable identification of the appropriate Discrete Management Unit (DMU) for the species (see Appendix 4.10.3 for further detail).

Small mammal species identified during baseline surveys are widespread in the region and have abundant populations. Larger mammal species include *Vulpes vulpes* (Red Fox), *Canis lupus* (Grey Wolf), *Capra aegargos* (Bezoar Goat), *Lynx lynx* (Eurasian Lynx), *Sus scrofa* (Wild Boar), *Felis chaus* (Jungle Cat), and *Ursus arctos* (Brown Bear). Both Bezoar Goat, which is listed as Vulnerable by IUCN and is included in the RA Red Book, and Eurasian Lynx, which is listed as Least Concern by IUCN but is also included in the RA Red Book, have been sighted in the Arshak area on Amulsar, albeit rarely.

On the other hand, Amulsar and particularly Arshak have been confirmed as important breeding habitats for Brown Bear. *Ursus arctos* is listed as Vulnerable in the RA Red Book and is also an Annex IV -listed species in the EU Habitats Directive, which means that degradation of its habitat is prohibited under EU law. The presence of Brown Bear is interpreted to trigger critical habitat due to its EU-protected status. Analytical work is ongoing to enable more detailed definition of the critical habitat designation.

4.10.5 Bat Survey and Results

Survey Methods

Available literature was consulted for information on bats in Armenia^{7,8}. Yavruyan, *et al.* (2008)⁹ noted that the general area within which the Project is proposed provides a rich mosaic of habitats suitable for bat species and identified 28 species for which suitable habitat might be present, including five species listed in the Armenian Red Book. Key habitat features include abundant standing water provided by reservoirs, running water offered by the Vorotan, Arpa and Darb river systems and extensive gorge and basalt batholith habitat which ensures plenty of foraging and roosting habitat.

Bat distribution is affected by air temperature and concentrations of flying insects, and tends to decline with increasing altitude, with few species in the Caucasus region occurring at altitudes higher than 1,500 masl (Yavruyan, *et al.*, 2008)⁹. Much of the Project-affected area is too high for intensive bat activity to be likely, but the potential presence of Red Book bat species in the area made further surveys necessary.

Further bat surveys were therefore conducted in May and June 2013 and 2014 by specialists from Golder Associates, Geoteam and the Armenian Institute of Zoology (IoZ). These were carried out in accordance with good practice guidance including Mitchell-Jones and McLeish (2004)⁹, Hundt (2012)¹⁰ and the Guidelines for Surveillance and Monitoring of European Bats (EUROBATS, 2010)¹¹. Golder undertook an initial field visit and habitat scoping survey from 7 to 18 April 2013, followed by a bat activity survey, static monitoring and walked transect survey from 12 May to 15 June. The IoZ undertook a bat trapping survey in June 2013 with the assistance of Geoteam. Habitat assessment, static monitoring and walked transects were undertaken by Geoteam during April, May and June 2014.

⁷ Yavruyan *et al.* (2008) Bats – Conservation Action Plan for the Caucasus:

http://www.cepf.net/Documents/bat_cons_action_plan.pdf (accessed on 25 May 2013)

⁸ Update to the National Report on the implementation of the EUROBATS Agreement in the Republic of Armenia: http://www.eurobats.org/sites/default/files/documents/pdf/National_Reports/nat_rep_Arm_2008.pdf (accessed on 10 June 2013)

⁹ Mitchell-Jones and McLeish. Bat Workers Manual (3rd Edition), 2004

¹⁰ Hundt, L. Bat Surveys: Good Practice Guidelines (2nd Edition), 2012

¹¹ The Agreement of the Conservation of Populations of European Bats (www.eurobats.org), 2010

Walked Transects

The transect routes were walked slowly with a four minute stop at each of ten 'listening stations'. The surveys began at sunset and lasted for approximately two hours. An Anabat SD1 was used to record numbers and species of bats. Any bat calls which were unidentifiable during the survey were later analysed using the 'Analook' software program.

During 2013 three walked transects were undertaken to determine how bats were using the Project-affected area. These crossed the areas proposed for mine infrastructure and also the Arpa Gorge, as shown in Figure 4.10.17. The latter was used for comparative purposes, to provide a benchmark of habitat considered to provide optimal roosting and foraging opportunities for bat species.

During 2014 two walked transects were surveyed to determine how bats were using Project-affected areas (Sites 27 and 28). In addition to these walked transects, Geoteam undertook a survey within the Arpa Gorge to provide a 'control' result for quality assurance purposes. The intention of this survey was to attempt to generate bat sonograms for calibration purposes, using *Anabat* software in a habitat that was considered to be optimal, outside of the Project-affected area.

Ground Level Static Monitoring

Locations of proposed mine infrastructure were also surveyed using static monitoring during May and June 2013 and 2014 using the methods recommended by Hundt, 2012. Locations of monitoring points are shown on Figure 4.10.17. *Anabats* were positioned at proposed infrastructure locations and adjacent to features likely to be used by bats e.g. streams, gorges, built structures etc.

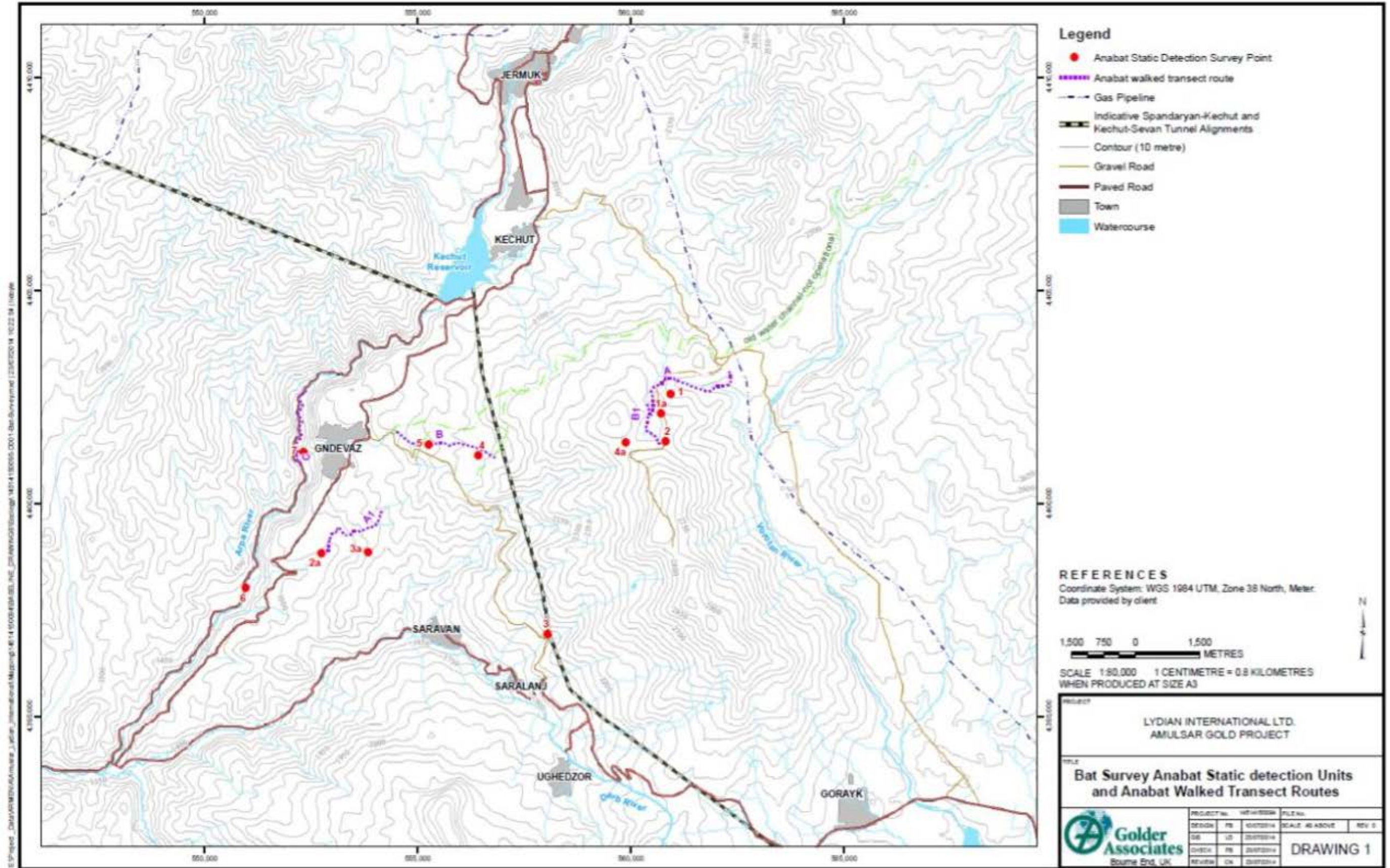


Figure 4.10.17: Bat Survey Monitoring Points

Trapping Survey

The Armenian IoZ carried out trapping surveys during June 2013, led by Eduard Yavruyan¹². Surveys focused on areas considered to represent suitable bat roosting and foraging habitat within the Project-affected area. Mist nets were used and wing tissue samples were taken from captured bats for DNA sampling. In addition, bat droppings were gathered at roost sites in order to determine the extent and seasonality of roost usage. Bat detectors (Peterson D 230 and Peterson D 240 X) were also utilised during dusk surveys.

Potential roost sites

A scoping assessment was undertaken on 6-18 April 2013 and during May 2014 to search for potential roosts such as:

- Caves and mine adits;
- Cracks and fissures within bedrock features;
- Missing roof or ridge tiles in buildings;
- Holes in the roof or gable ends of buildings; and
- Gaps under the eaves of building roofs.

Results

Detailed findings of the bat surveys are included in Appendix 4.10.4.

Eight species were recorded during the bat surveys, almost entirely in the Arpa or Jermuk Gorge. Figure 4.10.18 is an example of the *Anabat* sonogram recorded in Jermuk Gorge. This may be an important migratory feature for a number of bat species, with abundant foraging and commuting habitat as well as permanent and transient roosts providing safety for bats resting during migratory passage. Species recorded there were *Myotis blythii* (Lesser mouse-eared bat), *Myotis emarginatus* (Geoffrey's bat), *Myotis mystacinus* (Whiskered bat), *Barbastella Barbastella* (Eurasian Barbastelle), *Pipistrellus pipistrellus* (Common pipistrelle), *Tadarida teniotis* (European free-tailed bat), *Nyctalus leisleri* (Leisler's bat) and *Eptesicus serotinus* (Serotine). This number represents around 30% of the bats predicted as being 'likely' to be present in accordance with Yavruyan *et al*, 2008.

¹² Professor of Yerevan State University and Russian-Armenian (Slavonic) who co-authored *Bats, Conservation Action Plan for the Caucasus* (Yaruran *et al*. 2008)

The control results undertaken by Geoteam within the Arpa Gorge revealed the presence of a Pipistrelle species. This result and sonogram generation provides confidence and quality assurance in the negative results that were obtained within the Project-affected area.

Levels of bat activity in the immediate Project-affected area were very low. Although surveys were carried out in sometimes sub-optimal weather conditions, habitats were concluded to be generally sub-optimal for bat species, due to high altitude and lack of structural diversity, linear commuting features or roosting habitat.

None of the species of bat listed within the Armenian Red Book were recorded during the surveys of 2013 or 2014. The eight species of bat recorded are classified by IUCN as being of LC (Least Concern), with the exception of the European barbastelle which is classified as NT (Near Threatened). According to Yavruyan *et al.* 2008, this species is generally restricted to altitudes of <1,900 m in the Caucasus and as such is likely to be absent from the Project-affected area.

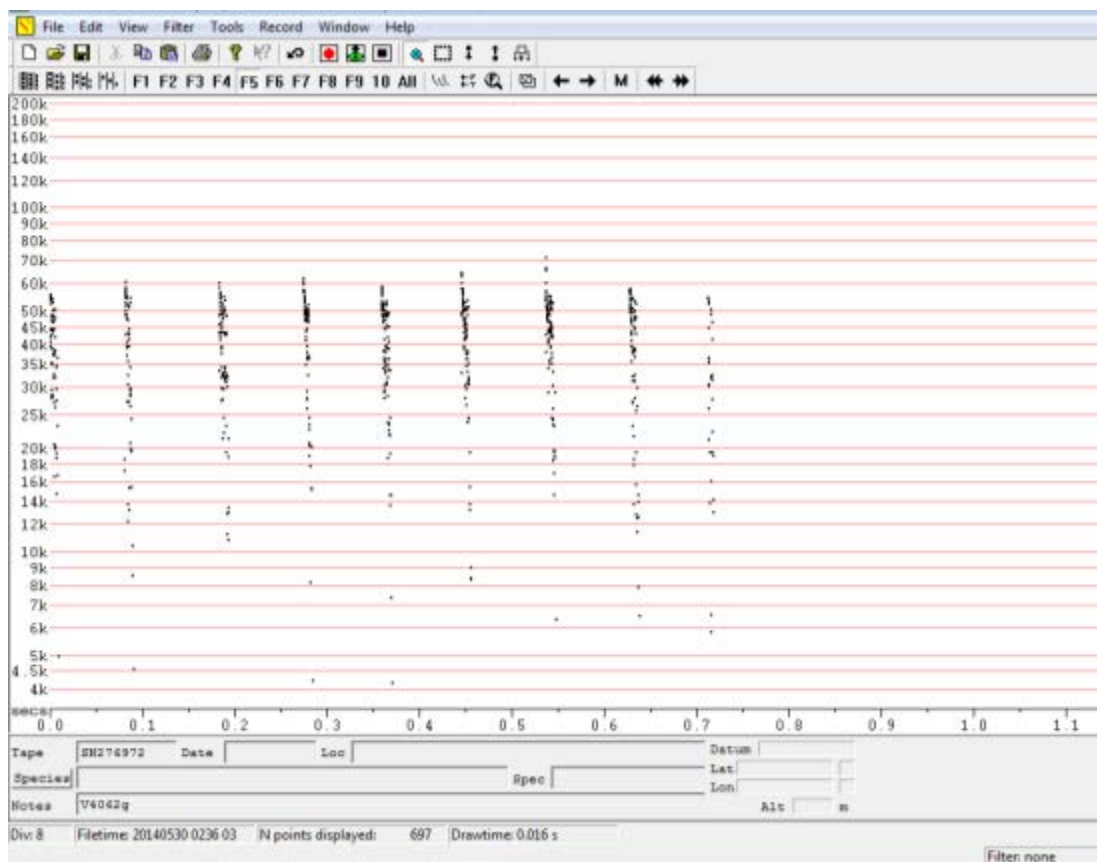


Figure 4.10.18: Anabat Sonogram recorded in Jermuk Gorge by Geoteam during 2014 baseline surveys

The Arpa Gorge and the areas proposed for inclusion in the proposed Jermuk National Park provide high quality habitat for bats and are important for maintaining regional populations of several RA Red Book species.

No bats were recorded using the immediate Project-affected area. Habitats were concluded to be generally sub-optimal for bat species, due to high altitude and lack of structural diversity, linear commuting features or roosting habitat.

The species recorded in surveys and those which could potentially use the Project-affected area, despite not being observed in 2013/2014, are 'widespread and abundant' and are not considered to be of conservation concern.

4.10.6 Bird Survey and Results

Survey Methods 2013-14

Six expeditions with a total duration of 16 days were undertaken by the Acopian Center for Environment of the American University of Armenia between February 2011 and March 2012, to collect data on both breeding and migratory birds in and around the Project area. Migratory raptors were observed but not systematically counted. Consultation with representatives of the Armenian Society for the Protection of Birds (ASPB) suggested that the Project-affected area could be important as a stop-over location for migratory raptors. This, together with the regularly observed presence of a species listed as Endangered by IUCN meant that the need for further surveys was identified. A comprehensive survey of migratory birds was undertaken between 15th April and 29th May 2013 by a team of 11 international and Armenian specialists (see Ornithological Report in Appendix 4.10.5) with 466 hours of observation. The autumn migration was also surveyed by six surveyors. The surveys attempted to ascertain the numbers of migratory raptors passing through the Project-affected area and the amount of time they spent feeding, roosting or otherwise using the proposed mine site and its immediate vicinity. Special consideration was given to Egyptian Vulture and other globally threatened raptor species. Migrant raptors were counted from fixed watch points located either side of the main Amulsar massif on hills which gave panoramic views along the Vorotan Valley, and over the western slopes of Amulsar and the Arpa Gorge (see Figure 4.10.19). Slight adjustments had to be made in autumn to observe birds coming from the opposite direction. Counts were made by teams of two to four persons between 08.00 and 17.00 or as weather permitted. Surveys of bird species breeding in the Project-affected area were carried out in

the spring of 2013 and 2014. In spring 2013, detailed searches were carried out for signs of breeding raptors, remaining in the Project-affected area after the migration period was over.

A roving two-man team surveyed the Project-affected area to assess the use of habitats within it by bird species in general or for breeding. The team included surveyors from the ASPB and international surveyors. The Project-affected area was divided into tetrads (2km x 2km survey squares) and these were surveyed to identify any bird species using it for foraging, resting or breeding (see Figure 4.10.20) Each tetrad was visited at least twice, with a minimum of three days between the two visits. For most tetrads, at least one visit was made shortly after sunrise, when bird activity is at its peak. Visits were always made on foot, in a crisscross manner, covering all of the different habitat types present in each square.

All tetrads were surveyed in Spring 2013 and a slightly reduced sub-set in Spring 2014, due to the need for reliable information about new Project-affected areas (more details are provided in Appendix 4.10.5). From 24 May to 2 June 2014 and 6 to 8 June 2014, daily searches were made in tetrads B5, B6, B7, C5 and C6 west of Amulsar ("Site 28"), as well as F7, F8, G7 and G8 south of the massif (set-aside area). In addition, a night drive was made through tetrads B5, B6 and C5 specifically to search for Corncrakes which tend to show nocturnal activity.

Species' breeding status was determined by a simplified and slightly modified version of the British Trust for Ornithology's Bird Atlas 2007-2011¹³ as summarised in Table 4.10.9. Presence of a breeding pair of Egyptian Vulture was confirmed in Jermuk Gorge in 2013. In 2014, detailed observations of feeding behaviour were made to determine whether the breeding success of the pair could be affected by development of the Project.

Table 4.10.9: Indicators of breeding status (after BTO 2007 – 2011)
Non-breeding
<ul style="list-style-type: none"> • Species flying over • Species observed but suspected to be still on migration • Species observed but suspected to be summering non-breeder
Possible breeder
<ul style="list-style-type: none"> • Species observed in breeding season in suitable nesting habitat • Singing male present in suitable breeding habitat

¹³ <http://www.bto.org/volunteer-surveys/birdatlas/taking-part/breeding-evidence>

Table 4.10.9: Indicators of breeding status (after BTO 2007 – 2011)
Probable breeding
<ul style="list-style-type: none"> • Pair observed in suitable nesting habitat in breeding season • Permanent territory presumed through registration of territorial behaviour (song, etc.) on at least two different days a week or more apart at the same place • Bird visiting probable nest site • Agitated behaviour or anxiety calls from adults • Nest building or excavating nest-hole • Courtship and display in or near potential breeding habitat
Definite breeding
<ul style="list-style-type: none"> • Nest building • Adults entering or leaving nest-site in circumstances indicating occupied nest • Recently fledged young (nidicolous species) or downy young (nidifugous species) • Adult carrying faecal sac or food for young • Nest containing eggs or young

In 2013 and 2014, surveyors noted preferred hunting locations for Lesser Kestrel from the breeding colony in Gorayk IBA and a subsidiary colony with approximately eight breeding pairs located in a disused military tower near tetrad F8.

In 2015, incidental sightings of birds were recorded during the Brown Bear survey (see Section 4.10.4) and ecological surveying of the proposed Jermuk National Park.

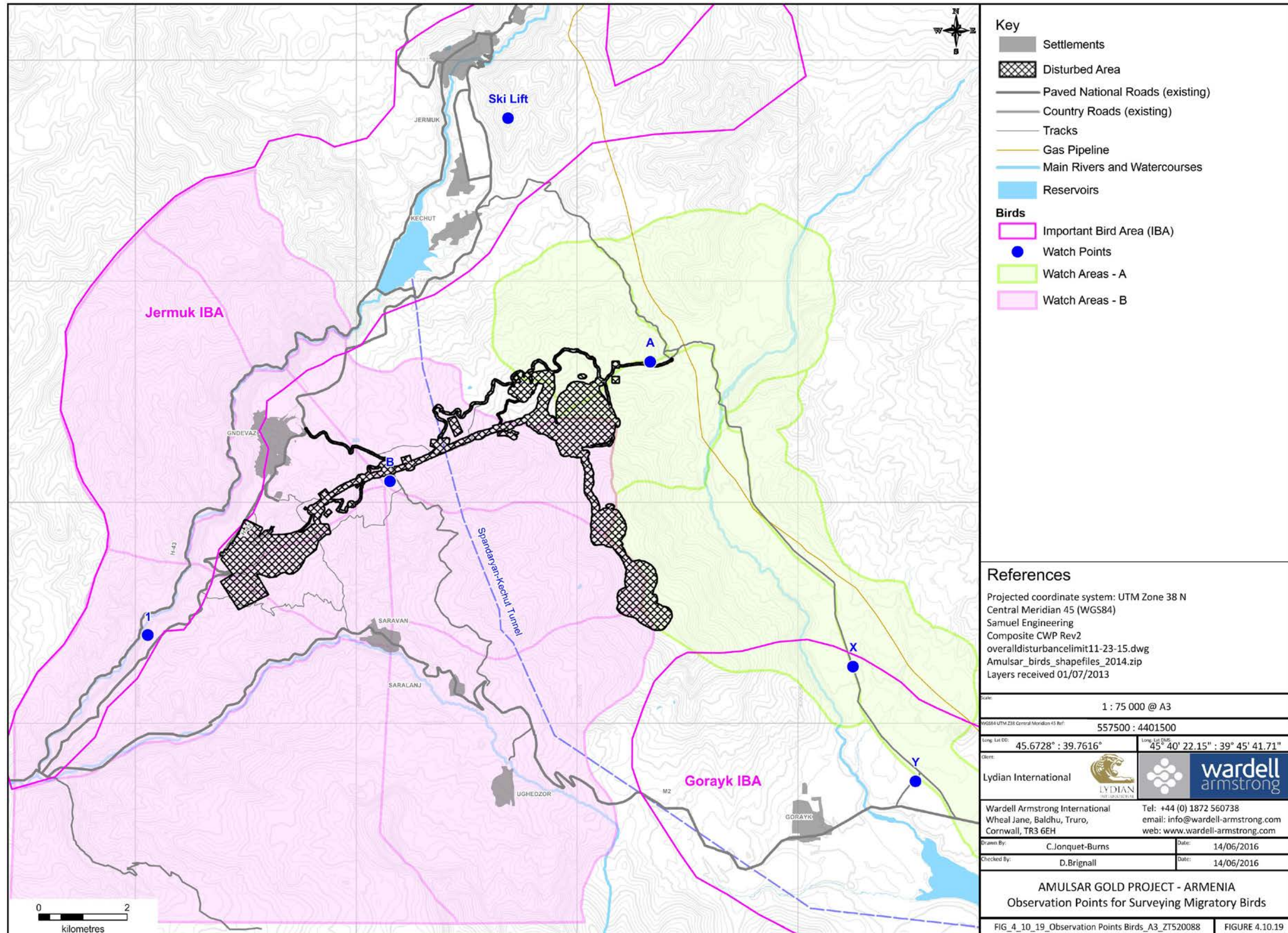


Figure 4.10.19: Observation Points for Surveying Migratory Birds

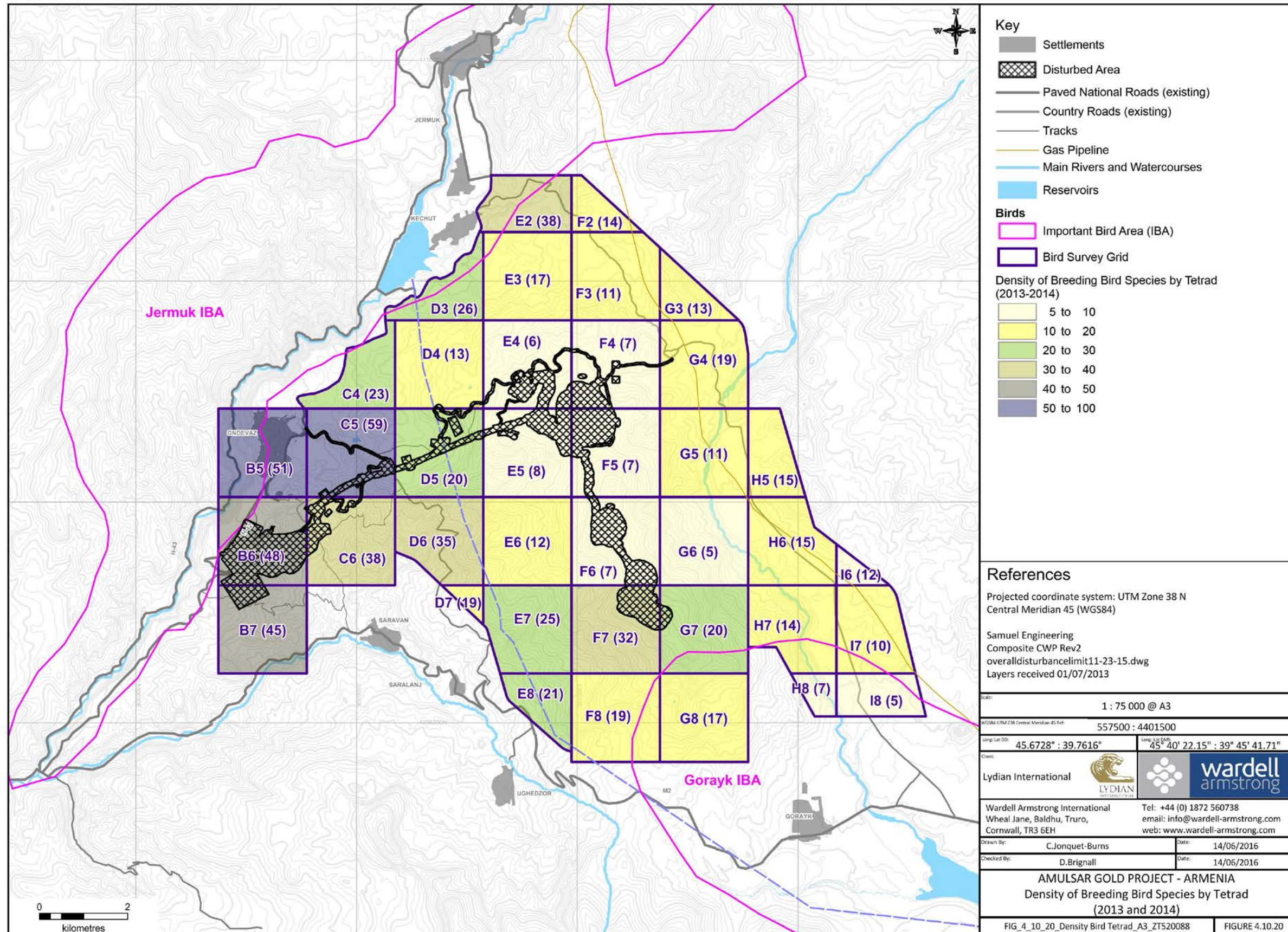


Figure 4.10.20: Density of Breeding Bird Species by Tetrad (2013 and 2014)

Survey Results 2013-14

More detailed descriptions of results can be found in the Bird Survey Reports from spring and autumn in 2013 and spring in 2014, provided as Appendix 4.10.5.

The Project-affected area has high diversity of bird species and has resident and breeding populations of several species which are threatened at national and international level (see Figure 4.10.21). The Project-affected area also provides food and resting areas for species passing through on migration.

Resident and breeding birds

Species composition

Species composition and numbers varied between surveys. A total of 102 species were observed during tetrad surveys of which approximately 85 showed evidence of breeding and 14 are listed in the RA Red Book. Based on both spring surveys, up to 23 species of raptor breed in the Project-affected area (see Table 4.10.10).

Species diversity of breeding birds is particularly high in all of the western tetrads (near the Village of Gndevaz) (see Figure 4.10.21). These include a variety of habitats such as wooded valleys, scattered Juniper shrubs, rocky gorges and small agricultural fields, as well as small water bodies. Tetrad B5 had over 50 species recorded with evidence of breeding, for example. This borders the Arpa Gorge (an Important Bird Area) and has part of another gorge in its south-eastern corner which appears to be an important landscape feature and is affected by the proposed conveyor and access road. Several species listed in the RA Red Book use this for breeding.

There are relatively fewer species breeding on Amulsar Mountain itself, but in some tetrads the assemblage of breeding birds is characteristic of particular habitats. There is a relatively species-rich assemblage of alpine species associated with the area around Arshak Peak which has been less disturbed by exploration activities, for example, and there are several raptor species which nest in a small rocky gorge in close proximity to the proposed conveyor route in tetrad C6.

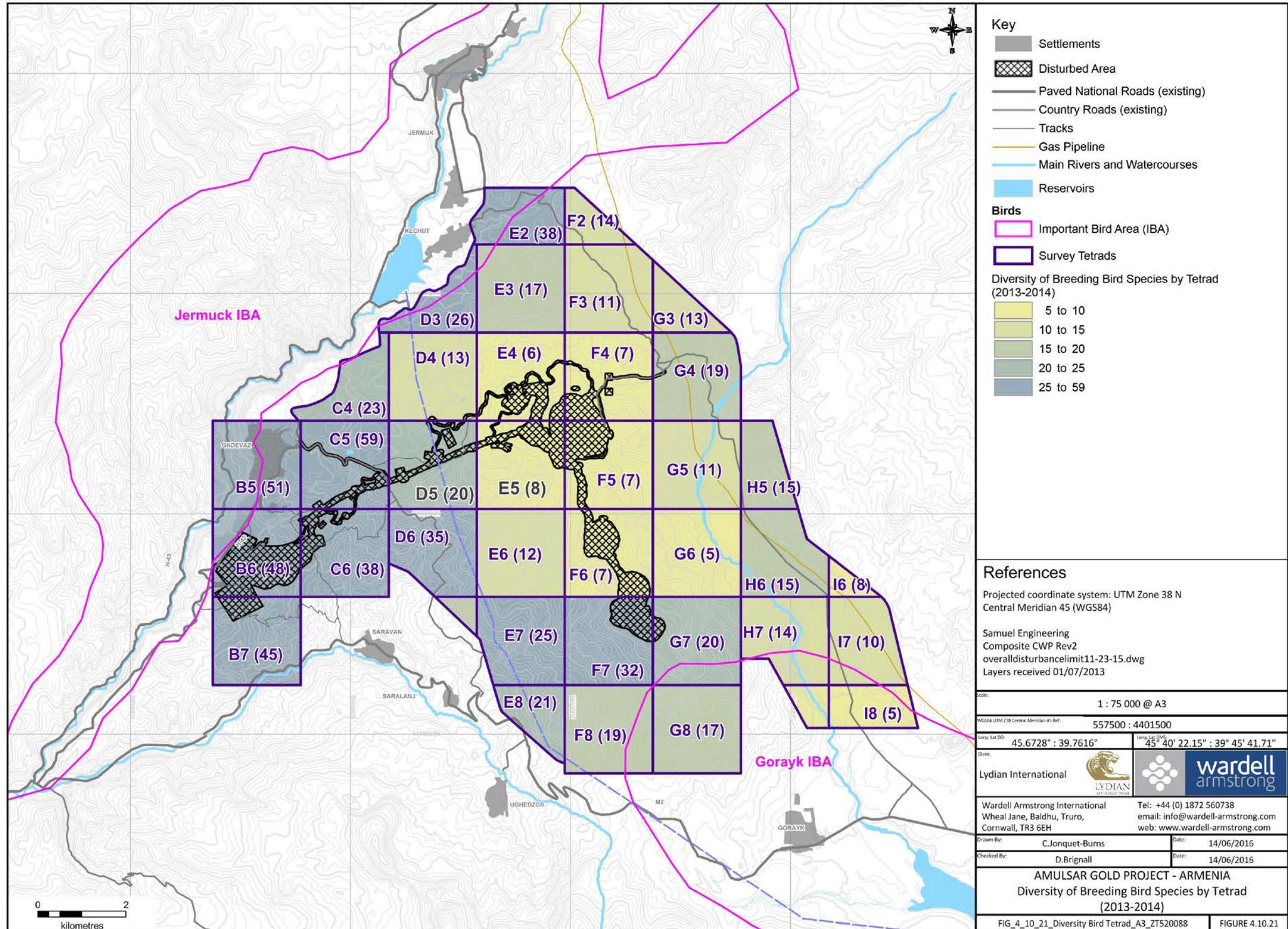


Figure 4.10.21: Diversity of Breeding bird Species recorded by tetrad

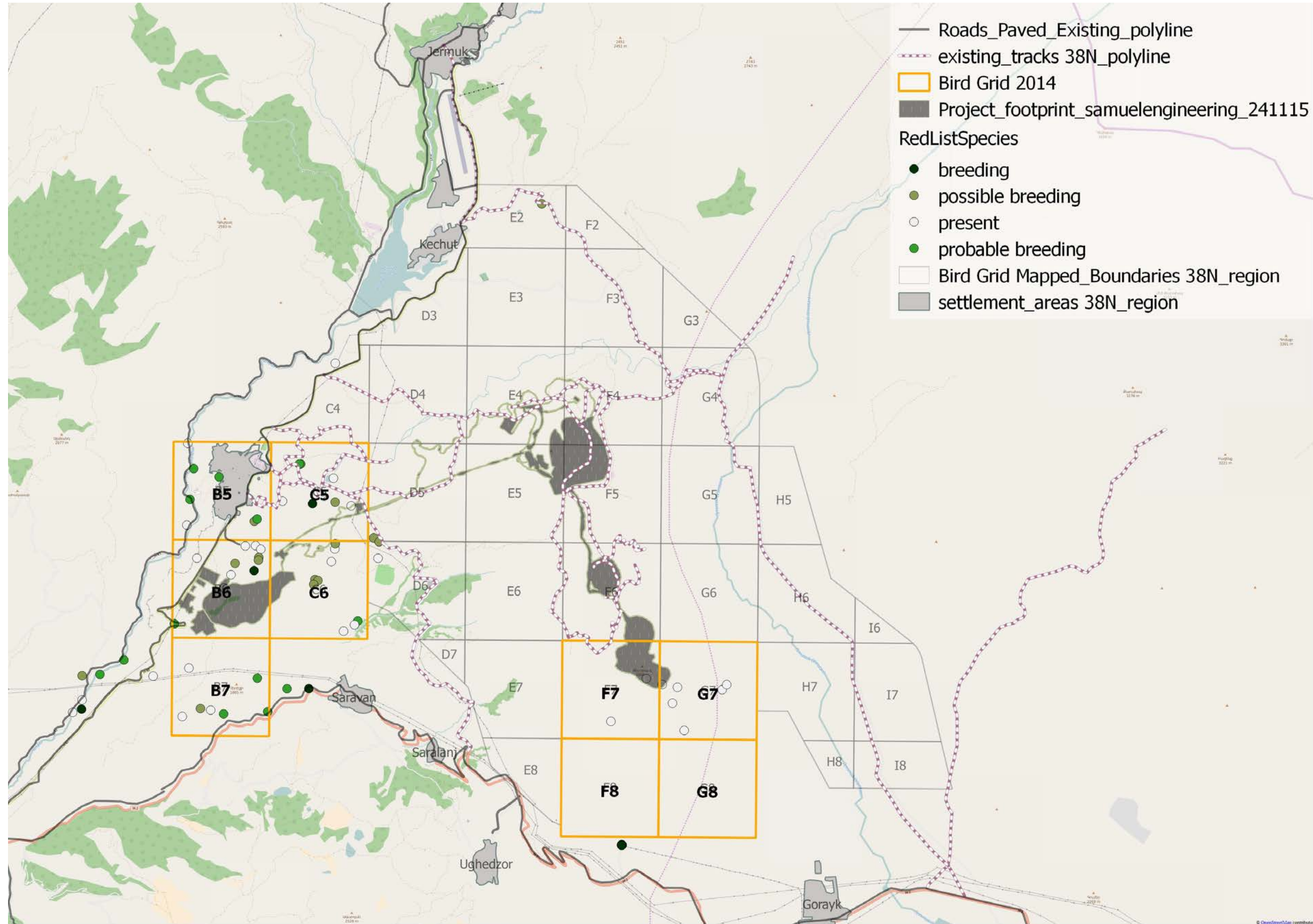


Figure 4.10.22 Point Locations of Red List species observed in Spring 2014

Table 4.10.10: Bird species recorded in the Project-affected area during breeding bird surveys 2013-14 which are included in the RA Red Book, with evidence of breeding activity
(see Figure 4.10.21 and Figure 4.10.22)

Species	Evidence of breeding
Booted Eagle (IUCN LC; RA Red Book Vu)	A paired dark phase and pale phase bird seen regularly over Watch Point B and two other pale phase birds present repeatedly suggest there were at least two pairs present in 2013: one probably breeding on steep wooded slopes near Jermuk or in Jermuk/ Arpa Gorge, and another on the wooded slopes near Ughedzor. In 2014, two pairs were probably breeding in Arpa Gorge: one in B5 just west of Gndevaz, and one along the western edge of B6. Single birds were seen hunting in C6 as well as in B6, where one was seen flying around with a snake in its talons. Single birds were also observed around the vulture watchpoint (outside of the survey squares).
Caspian Snowcock (IUCN LC; RA Red Book Vu)	No evidence of breeding in 2013 or 2014 but recorded in both years in the Set-Aside Area on Arshak Peak.
Eastern Rock Nuthatch (IUCN LC; RA Red Book Vu)	This species was found breeding in three survey tetrads: a singing pair was present on the upper slopes of Arpa Gorge just outside the village of Gndevaz (B5), a pair was found at the entrance of the craggy gorge in B6 (where it was also present in 2013), and a singing bird was near the main road in the south-eastern corner of B7. Furthermore, an occupied nest was found along the main road just west of Saravan (tetrad C7) and a family party was present in Jermuk/ Arpa Gorge just northwest of the vulture watchpoint.
Egyptian Vulture (IUCN EN; RA Red Book EN)	A single pair nest in Jermuk/ Arpa Gorge (see more detailed discussion below).
Eurasian Griffon Vulture (IUCN LC; RA Red Book Vu)	No nests found, even in Jermuk Gorge. Maximum of four birds over the western slopes of the massif suggest two pairs, but these appeared to be nesting further north in the Jermuk IBA. Further exploration of this area in 2015 failed to find any signs of breeding, however.
Golden Eagle (IUCN LC; RA Red Book Vu)	Two nests located in Jermuk Gorge in 2013. Heavy use of the north-eastern part of the Vorotan Valley suggests that a third pair were nesting somewhere in that area. In 2014, at least two pairs of Golden Eagles were breeding in Arpa Gorge: a pair was also present in square B5 just west of Gndevaz, and a displaying pair was observed just north of the vulture watchpoint. Single adult birds seen hunting in B6 and C5 probably belonged to either of these two pairs. An adult was also seen perched on a pylon between the H42 road and square B7.
Great Snipe (IUCN NT; RA Red Book Vu)	Observed during breeding bird surveys on top of Tigranes Peak in June 2014, but as the species does not breed in Armenia (Adamian & Klem 1997), concluded to be a late migrant. Several birds on migration also recorded in the Vorotan valley and the valley northeast of the mining exploration camp in spring 2013.

Table 4.10.10: Bird species recorded in the Project-affected area during breeding bird surveys 2013-14 which are included in the RA Red Book, with evidence of breeding activity
 (see Figure 4.10.21 and Figure 4.10.22)

Species	Evidence of breeding
Lammergeier (IUCN LC; RA Red Book Vu)	One nest located in Jermuk Gorge. One other pair and possibly another present in 2013 but information provided by ASPB suggests that only one pair breed in the Gorge in any given year despite the presence of multiple pairs. In 2014 single adult birds were observed in tetrads F7, G7, B6 and B7. At least in B7 the bird was using the ground, and was seen feeding (dropping a bone to shatter it on the rocks and eat the bone marrow). A pair was present in Arpa Gorge north of the vulture watchpoint. In March they were seen nesting in the Egyptian Vulture cave (M. Ghasabian <i>pers. comm.</i>), but their breeding attempt must have been unsuccessful as no juveniles were observed in spring 2014. They abandoned the nest cave when the Egyptian Vultures returned from their wintering quarters.
Lesser Kestrel (IUCN NT, RA Red Book Vu)	<p>Colony present in the old TV tower east of Gorayk (within Gorayk IBA). Further breeding pairs located in the TV tower west of Gorayk, in Gorayk itself, and in Sisian. ASPB monitors the main breeding colony in Gorayk. As in spring 2013, a small colony of probably eight pairs of Lesser Kestrels was located in a military tower just south of tetrad F8 in 2014. These birds were regularly seen flying into the tetrad and coming back with food for their young (mainly voles). In addition, 8 birds were observed hunting on the grassy slopes of Tigranes (tetrad G7) on 8 June, and a female was seen hunting over the grassy slopes on the eastern side of Arshak (G7 also) on 19 June. Clearly, this small colony uses the grassy slopes of Amulsar to hunt for voles for the young. In this survey, the craggy corrie in G7-G8 seemed particularly important, but also the grassy slopes around it.</p> <p>In 2013, Lesser Kestrels were observed near square F4 (previous location of Barren Rock Storage Facility) hunting intensively in the spring. This was not the case in 2014. The birds appear to use different grassy slopes on the Amulsar massif from year to year depending on availability of prey. In 2013, a lot of effort was made to try to establish a link between the birds feeding near F4 and the birds of the main colony, the TV tower east of Gorayk. A team of observers was posted in the Vorotan Valley to this purpose, but they failed to prove a clear link. It now seems that not enough attention was given to the other, smaller colony in the military tower between Gorayk and Saralanj. It is entirely possible that most of the birds feeding in or near square F4 in spring 2013 were from that small colony, and were also feeding on various grassy slopes on the Amulsar massif, between the colony and the previous location of the barren rock storage facility.</p>
Lesser Spotted Eagle (IUCN LC; RA Red Book Vu)	One nest located in woodland north of ski lift. In 2013 there was a strong indication of two pairs breeding in wooded valleys on south-western slopes of Amulsar (pair mating, adult carrying food into woodland) in tetrad F7; plus two pairs in display flights simultaneously and a territorial interaction between two birds in same area. Repeated presence of a pair over upper part of Vorotan Valley suggests a fourth pair present. This species seemed surprisingly scarce in spring 2014. There was a probable breeding pair in tetrad B7, and one bird was seen hunting frogs in C5. The species was also seen above the Arpa Gorge, south of the vulture watchpoint, but those were the only observations. The species was completely absent from tetrad F7 where it bred in 2013.

Table 4.10.10: Bird species recorded in the Project-affected area during breeding bird surveys 2013-14 which are included in the RA Red Book, with evidence of breeding activity
(see Figure 4.10.21 and Figure 4.10.22)

Species	Evidence of breeding
Montagu's Harrier (IUCN LC; RA Red Book Vu)	In 2013 small numbers were seen and in 2014, only one: an adult male hunting over the grassy slopes of Tigranes Peak (tetrad F7) on 7 June. The ground use and the late date suggest that this was a bird breeding somewhere in the vicinity, but the possibility of a late migrant cannot be excluded.
Northern Goshawk (IUCN LC; RA Red Book Vu)	A few present – no nests located; no estimate of breeding pairs possible but behaviour suggests the species breeds locally.
Peregrine Falcon (IUCN LC, RA Red Book Vu)	A pair of Peregrine Falcons was seen hunting in the southern part of B7 on 27 May 2014. These birds were at 3 km from Arpa Gorge, where a pair bred on cliffs south of the vulture watchpoint and produced two juveniles. Quite possibly the pair in B7 was the same as the one in the gorge as the feeding territory can extend for many miles. In Spring 2013 there was no clear evidence of breeding anywhere near the survey area. The species is a rare breeding bird in Armenia (Adamian & Klem 1997).
Ruddy Shelduck (IUCN LC; RA Red Book Vu)	While in Spring 2013 this species was found breeding in tetrads C5, F7 and G7, it was only present in square C5 in spring 2014, without indication of breeding. Only one bird was observed, near the small water reservoir in the tetrad C5.
Short-toed Snake Eagle (IUCN LC; RA Red Book Vu)	A single pair displaying and hunting regularly over the western slopes of Amulsar in 2013. In 2014, observed in tetrads C5, C6, B7, and G7. A pair was observed hunting over the green valley in the south-eastern corner of C6 and must have been breeding nearby though the nest could not be located. The arid, rocky area north and west of Saravan appears suitable breeding habitat, and there is no shortage of reptiles as a food source.
Spanish Sparrow (IUCN LC; RA Red Book Vu)	A female was seen (and videoed) just west of the H42 road in B6 on 1 June. It was also heard calling. There was no firm evidence of breeding.
White-throated Robin (IUCN LC; RA Red Book DD)	This species was much more numerous in 2014 than the previous year. While the Spring 2013 atlas work only produced three breeding pairs in the whole survey area (35 tetrads), no less than 14 were found in Spring 2014 - in only nine tetrads. Three more pairs were found just outside these tetrads: one in D5, one in D6 and one in C7. As in Spring 2013, the distribution was limited to the western part of the Amulsar region. Here, the species finds wooded valleys, rocky gorges and scattered Juniper trees that form the ideal breeding habitat. In particular, the craggy gorge winding its way through tetrads B6, B5 and C5 seems important to this species; it held four breeding pairs in 2014 and one in 2013.

- During baseline surveys for birds, 102 - 138 species were recorded in spring surveys in 2013 and 2014, with approximately 85 showing evidence of breeding.
- 14 species which are listed in the RA Red Book are believed to breed in the Project-affected area or nearby.
- The areas most important for breeding birds are Arpa Gorge, the area around the southern and western flanks of the mountain and a small rocky gorge east of Gndevaz Village. The area proposed for the HLF shows as having quite a high number of breeding bird species but these are largely concentrated in small wooded valleys towards the edges of the relevant tetrad and not within the HLF location itself.
- There are at least 23 resident raptor species, 14 of which are in the RA Red Book. Seven of these breed in the Project-affected area. Two species are listed as Endangered in the IUCN Red List: Egyptian Vulture and Saker Falcon.
- Some alpine bird species breed on Amulsar mountain, largely in the Set-Aside area on Arshak Peak.

Additional observations of Armenian Red Book bird species in 2015, with evidence of breeding

A) Project-affected area

Observations during the 2015 mammal survey confirmed the continued presence of the species listed in Table 4.10.10. However, Caspian Snowcock, Great Snipe and Spanish Sparrow were not recorded. One pair of Ruddy Shelduck successfully bred in the small gorge east of Gndevaz (bird tetrad C5) raising 10 chicks, and one pair of Montagu's Harrier was breeding close to Gorayk village. The Lesser Kestrels breeding in the TV tower west of Gorayk used the southern slopes of Amulsar for feeding and hunting as in previous years. White-throated Robins were only found in the small gorge east of Gndevaz (tetrads C5-C6): seven pairs were concentrated there. A Red-List species that is under-recorded because it is mainly nocturnal is Eagle Owl *Bubo bubo*. Occasional observations in 2013-15 indicate that this species may breed near the mining exploration camp (bird tetrad F5).

B) Proposed National Park area

The following RA Red Book species were recorded within the boundary of the proposed National Park area in 2015 and could potentially breed:

- Ruddy Shelduck: This species bred at Pokr Al Lake, Azerbaijan, just north of the park boundary. At least two pairs (with ducklings) were present.

- Saker Falcon: One adult was seen near the eastern edge of the park boundary in May 2015, and a second calendar year bird was photographed approximately 7 km north of Jermuk in June. As both observations were in the middle of the breeding season for the species and as suitable habitat is present in the park area the species could potentially breed, but it is also a wide-ranging hunter so the breeding area could be well outside the park.
- Lanner Falcon: One second calendar year bird was photographed near the eastern border of the park area in July 2015. It may have been a wandering or dispersing individual; no signs of breeding were found.
- Lammergeier: Regularly observed throughout the whole park except for the Herher area.
- Egyptian Vulture: Three birds observed together in the northeastern part of the park in June 2015. Lack of further observations suggests that these may have been wandering or dispersing birds though, rather than breeding nearby.
- Griffon Vulture: Small numbers of this species were observed throughout the whole park area in July – August. No evidence of local breeding.
- Black (Cinereous) Vulture: Occasional birds observed in Herher State Sanctuary, west of Jermuk, and approximately 7 km north of Jermuk in July – August. These may have been post-breeding wanderers from other parts of Armenia (or even further away), although suitable habitat is present in the Herher area, where the species formerly bred.
- Lesser Spotted Eagle: Small numbers present, mainly in the northern half of the park area. Probably breeds in the wooded valley west of Kechut Lake as well as in the wooded Arpa valley north of Jermuk.
- Golden Eagle: Small numbers present, especially in the northwestern part of the park. Continued presence of several birds throughout the breeding season suggests breeding somewhere in this area.
- Booted Eagle: Small numbers present. May breed in the wooded valleys west of Kechut Lake and north of Jermuk. Suitable habitat is also present in the southeastern part of the park area.
- Great Snipe: Three birds seen together in the northern part of the park area in May 2015 were probably migrants.
- Armenian Gull: Small flocks of this species were found feeding near herder's camps in the northern part of the park area. The species is not known to breed in the area

but it seems attracted to the lakes full of fish in Azerbaijan, just north of the park, and to disperse from there.

- Eurasian Eagle Owl: This species was recorded by one of our cameras west of Kechut Lake. Also, one bird was found dead just north of Jermuk town. There is a lot of suitable habitat in the park but nocturnal surveys would be needed to get an idea of the number of breeding pairs.
- Eastern Rock Nuthatch: At least one breeding pair was present, in Arpa gorge just west of Gndevaz village.

Individual species

Some individual species were considered in more detail to enable impacts on their populations to be predicted. This included Lesser Kestrels (from Gorayk IBA and a smaller colony established in a disused military tower between Gorayk and Saralanj), Egyptian Vulture and Saker Falcon.

Lesser Kestrels from the small colony between Gorayk and Saralanj appear to depend on the high, grassy slopes of the Amulsar massif for food, also using other areas on the western slopes of Amulsar in autumn. Lesser Kestrels from the main colony in Gorayk IBA appear to depend more on hunting within the Vorotan Valley and may concentrate their activity more on the eastern side of Amulsar Mountain. Birds from both colonies therefore hunt in Project-affected areas. The ASPB is exploring options to fit radio-trackers to some birds to improve monitoring ability, in partnership with Lydian / Geoteam.

Both Egyptian Vulture and Saker Falcon are classified on the IUCN Red List as Endangered and therefore need careful consideration. The ASPB estimates the population of Egyptian Vultures breeding in Armenia to be around 55-60 pairs, though reliable monitoring data are not available. Historical data suggest that 2-3 pairs of Egyptian Vultures nested in Jermuk IBA in 1995¹⁴ and 1-2 pairs in Gorayk IBA also in 1995¹⁵. Numbers of pairs breeding in the area appear to have declined since, to the point where only one pair was found in this survey. The closure of the chicken farm in Gndevaz in 2011 and the removal of this source of food (discarded carcasses) from the area may have been a factor in this decline. Increasing levels of

¹⁴ <http://www.birdlife.org/datazone/sitefactsheet.php?id=19757>

¹⁵ <http://www.birdlife.org/datazone/sitefactsheet.php?id=19755>

disturbance during mine exploration is another possible factor. The national population is currently estimated at 50-55 pairs.

A single active nest of Egyptian Vulture was located in Jermuk Gorge in May 2013. The Natural and Critical Habitat Assessment (Appendix 4.10.3) concluded that the Project-affected area was not within critical habitat for Egyptian vulture, as the affected population does not meet the thresholds in PS6. However detailed observations of feeding patterns were made to determine whether the breeding success of the pair could be adversely affected, in line with a precautionary approach, as the number of breeding pairs appears to have declined from three to one.

The breeding pair occasionally searches for food in the Project-affected area. In total, 23 “bird-days” of observations were made for this species during the Spring 2013 survey period. In addition, a single bird, believed to be a migrant, was seen low over the ground on 6th May, and single birds were seen migrating at altitude on 7th and 9th of May. In Spring 2014 detailed observations were made of the feeding patterns of the adult birds. The pair of vultures spent most of their time (71%) in the Arpa gorge, near the nest site. They only used the areas proposed for Project infrastructure for 10% of the time they were observed being active, even less than the 18% recorded in Spring 2013. In Spring 2014, the birds were seen using the ground within the survey area on only three occasions. On seven more occasions birds were seen soaring above the survey area, sometimes quite low, but never picking up food from the ground. By contrast, the birds were seen perched or landing in Arpa Gorge or in fields nearby on 26 occasions. The ground use locations and observed flight paths were mapped and are provided in Appendix 4.10.5. When looking for food, the adult birds seemed to prefer flying above Arpa Gorge or above the H42 road, although the male was also seen flying off north to northwest into the hills of Herher State Sanctuary on four occasions.

- There is one remaining pair of Egyptian Vulture breeding in Jermuk/ Arpa Gorge. The Project-affected area is not considered to be within critical habitat for this species according to the criteria in PS6. Detailed observations suggest that the birds use the areas proposed for project infrastructure a very small proportion of the time, concentrating their activity on the Jermuk/ Arpa Gorge and areas within Jermuk IBA. This was estimated as 18% in 2013. In 2014, the pair of vultures spent most of their time (71%) in Jermuk/ Arpa Gorge, near their nest site and only used the Project-affected area for 10% of the time they were observed being active.
- No nests of Saker Falcon were found. There was a small number of infrequent sightings of birds which may be resident.
- The Lesser Kestrel breeds in a main colony in Gorayk IBA and a subsidiary colony between Gorayk and Saralanj. Breeding colonies will not be affected, but birds from both colonies hunt in Project-affected areas including grassy slopes at higher elevations on Amulsar Mountain.

Significance of the raptor migration

Species and numbers of birds flying over the Project-affected area or using it to feed or rest were counted in spring and autumn of 2013.

The species observed were similar in both seasons. In terms of the national and IUCN Red Lists species observed were the same, apart from Red Kite, which was not observed in the Autumn survey. A detailed breakdown of the species observed is available in the Spring and Autumn 2013 Bird Survey Reports included in Appendix 4.10.5.

In both seasons, species migrating over the Project-affected area included several species which are included on the IUCN or RA Red Lists. Four species are listed as Endangered in the RA Red Book (*Neophron percnopterus*, *Aegypius monachus*, *Circus macrourus* and *Falco cherrug*) and two of these are also listed as Endangered in the IUCN Red List (*Neophron percnopterus* and *Falco cherrug*). Thirty-one species recorded on migration in Autumn 2013 are listed as Vulnerable in the RA Red Book (see Table 4.10.11).

Table 4.10.11: Bird Species recorded on migration in autumn 2013 and their status in the IUCN Red List and RA Red Book

	Scientific name	Common name	IUCN Status	ARDB Status
1.	<i>Phalacrocorax carbo</i>	Great Cormorant	LC	VU
2.	<i>Pelecanus onocrotalus</i>	Great White Pelican	LC	VU
3.	<i>Ciconia nigra</i>	Black Stork	LC	VU
4.	<i>Tadorna ferruginea</i>	Ruddy Shelduck	LC	VU
5.	<i>Gypaetus barbatus</i>	Lammergeier	LC	VU
6.	<i>Neophron percnopterus</i>	Egyptian Vulture	EN	EN
7.	<i>Aegypius monachus</i>	Black Vulture	NT	EN
8.	<i>Circaetus gallicus</i>	Short-toed eagle	LC	VU
9.	<i>Circus macrourus</i>	Pallid Harrier	NT	EN
10.	<i>Circus pygargus</i>	Montagu's Harrier	LC	VU
11.	<i>Accipiter gentilis</i>	Northern Goshawk	LC	VU
12.	<i>Accipiter brevipes</i>	Levant Sparrowhawk	LC	VU
13.	<i>Aquila pomarina</i>	Lesser Spotted Eagle	LC	VU
14.	<i>Aquila clanga</i>	Greater Spotted Eagle	VU	VU
15.	<i>Aquila nipalensis</i>	Steppe Eagle	LC	VU
16.	<i>Aquila heliaca</i>	Imperial Eagle	VU	VU
17.	<i>Aquila chrysaetos</i>	Golden Eagle	LC	VU
18.	<i>Hieraetus pennatus</i>	Booted Eagle	LC	VU
19.	<i>Pandion haliaetus</i>	Osprey	LC	VU
20.	<i>Falco naumanni</i>	Lesser Kestrel	LC	VU
21.	<i>Falco vespertinus</i>	Red-footed Falcon	NT	VU
22.	<i>Falco biarmicus</i>	Lanner Falcon	LC	DD
23.	<i>Falco cherrug</i>	Saker Falcon	EN	EN
24.	<i>Falco peregrinus</i>	Peregrine Falcon	LC	VU
25.	<i>Crex crex</i>	Corncrake	LC	VU
26.	<i>Anthropoides virgo</i>	Demoiselle Crane	LC	VU
27.	<i>Glareola pratincola</i>	Collared Pratincole	LC	VU
28.	<i>Glareola nordmanni</i>	Black-winged Pratincole	NT	VU
29.	<i>Numenius arquata</i>	Eurasian Curlew	NT	VU
30.	<i>Larus armenicus</i>	Armenian Gull	LC	VU
31.	<i>Bubo bubo</i>	Eurasian Eagle-owl	LC	VU
32.	<i>Coracias garrulus</i>	European Roller	NT	VU
33.	<i>Motacilla citreola</i>	Citrine Wagtail	LC	VU
34.	<i>Sitta tephronota</i>	Eastern Rock-nuthatch	LC	VU
35.	<i>Lanius senator</i>	Woodchat Shrike	LC	VU

In terms of numbers, 4,536 individual raptors of 28 species migrated through the Project-affected area between 15th April and 29th May 2013 inclusive. Between 22 August and 14 October 15, 110 birds were counted (see Appendix 4.10.5, Spring 2013 Survey Report for further details). This included 8,508 migrating raptors of 27 different species. The total number of birds migrating past the Project-affected area in Spring and Autumn was considered to be below the thresholds needed to identify the area as critical habitat, as

defined by IFC PS6 and EBRD PR6. A similar number of birds on migration passes through Batumi (a confirmed international “bottle-neck”) each day. The Project-affected area does not constitute critical habitat in terms of the numbers of migratory birds it supports or in terms of the numbers of any individual species.

The surveys also looked at the proportion of time birds spent on the ground in the Project-affected area in both migrations. Although the Project-affected area is of undoubted importance for migratory birds, it does not constitute critical habitat per PS6/ PR6 in terms of the significance of the habitat it provides for birds on migration in relation to the overall habitat available. In Autumn 2013, for example, 476 birds out of 15,110 migrating birds were noted as using the survey area to feed and rest: 3% of individuals from all species and 6% of migrating raptors. Use of the Project-affected area varied between species, however, with harriers and falcons using the area regularly, notably Lesser Kestrel, Pallid Harrier, Montagu’s Harrier, Red-footed Falcon and Merlin. Pallid Harrier (listed as Endangered in the RA Red Book) showed preferential use of the Vorotan Valley and the revised Project layout is preferable for this species.

Egyptian Vulture and Saker Falcon (IUCN Endangered) on migration spent a negligible amount of time using the Project-affected area.

Key areas for bird species

Certain key areas for birds have emerged from the ornithological survey (see Appendix 4.10.5). These are:

- An area of montane habitat about 1km south of Arshak with craggy rock outcrops and a mountain lake. This area holds an assemblage of montane species not observed anywhere else in the Amulsar area including Ruddy Shelduck, Caspian Snowcock, Asian Crimson-winged Finch, White-winged Snowfinch, Alpine and Radde’s Accentors, Red-billed Chough, Eurasian Crag Martin, Common Rock Thrush, Horned Lark, and Ring Ouzel.
- The lower slopes of the western side of the massif, below an altitude of about 2,300m. In particular, the wooded valleys and associated shrublands and flower-rich meadows support a high diversity of birds.
- A rocky gorge south east of Gndevaz Village in which a number of species listed in the RA Red Book breed.

- Pools and wetlands with birds such as Corncrake and Ruddy Shelduck breeding.
- Arpa Gorge where Egyptian Vulture and other raptor species nest.

In both Spring and Autumn of 2013, migrating raptors preferred to pass west of Amulsar Mountain, with approximately three times as many birds counted from watchpoint B to watchpoint A. Only three species were more numerous on the eastern side of the mountain: Eurasian Sparrowhawk, Northern Goshawk and Pallid Harrier. At least on a national level, the Vorotan Valley appears to be an important migration corridor for Pallid Harrier, though on a global level, the number of birds using the ground did not meet the 1% threshold for determination of critical habitat (see Appendix 4.10.3).

4.10.7 Terrestrial Invertebrate Surveys and Results

Survey Methods

Terrestrial invertebrate surveys took place in both Spring/Summer of 2011 and May/June 2013. Traditional methods of entomological surveying were used for determining the species composition of test taxons: hand collection from vegetation, collection from under stones and the soil surface, net collection, shaking out of plants, etc. In 2011, surveys were conducted to establish the presence of:

- Butterflies: 17 counts were made on nine routes following the technique known as the 'Pollard Walk' (Pollard 1977, Pollard & Yates 1993) as shown in Appendix 4.10.6 and on Figure 4.10.23;
- *Odonata* spp. (dragonflies/damselflies): three counts along three transects in July 2011 following the sampling technique of Smallshire & Beynon (2010) as shown in Appendix 4.10.7;
- *Carabidae* beetles were sampled using soil trapping (25 traps used) and additional searches under stones (see Appendix 4.10.7);
- *Cerambycidae* beetles following the same routes as used for butterflies; and
- Willow hawk-moth: quadrat sampling of five patches of the species' host plant (*Epilobium* sp.).

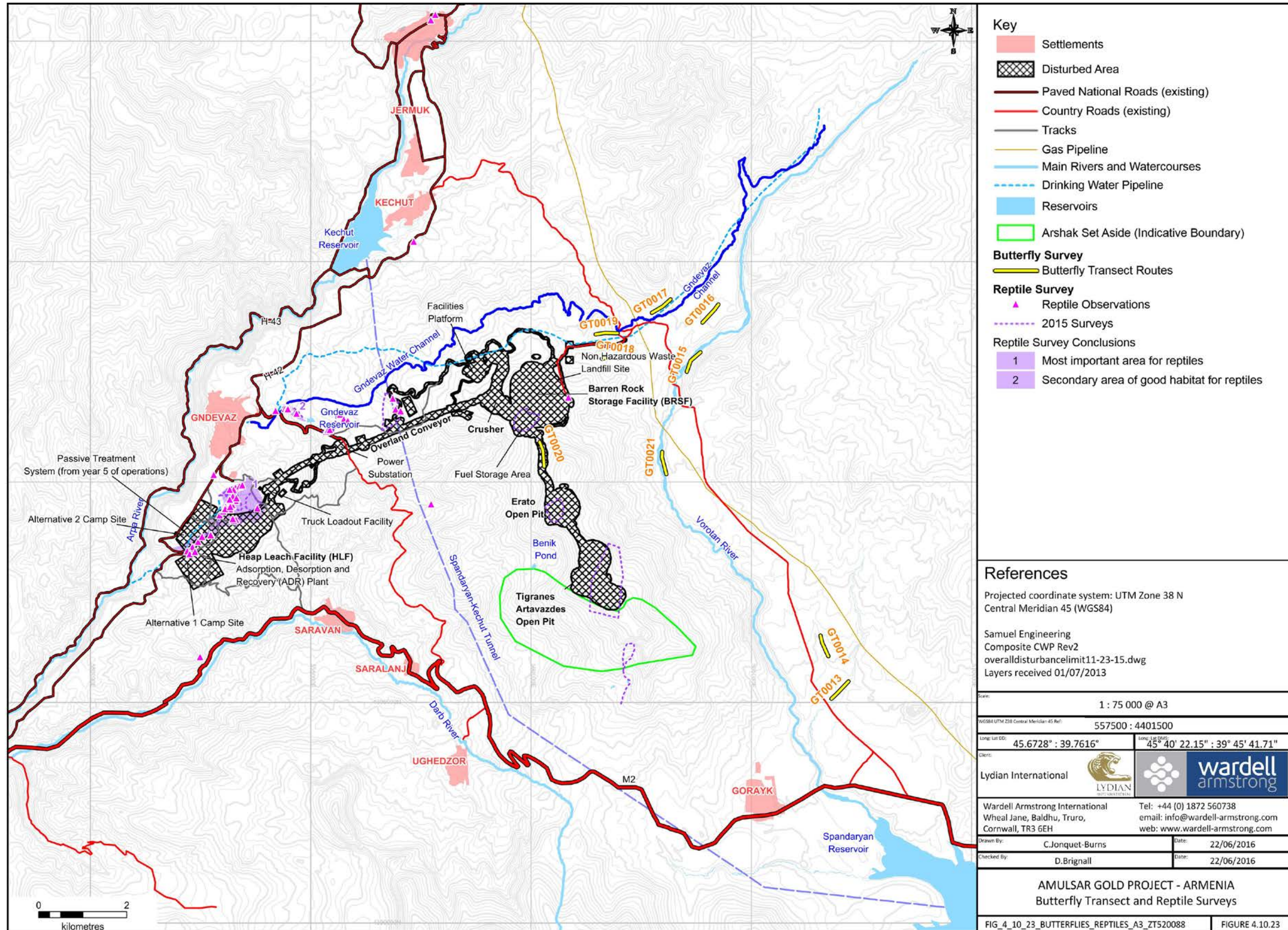


Figure 4.10.23: Butterfly Transect Routes

In 2013, the surveys focussed mainly on *Coleoptera* (beetle) spp. but also recorded butterfly species observed during the beetle surveys. These surveys were conducted in three locations:

- Near the village of Gorayk (Vorotan River basin) - N39.682095⁰ E45.77747⁰ (alt.2073 m) -> N39.722590⁰ E45.756223⁰ (alt.2328 m);
- Near Gndevaz village (Arpa River basin) - N39.75146⁰ E45.65406⁰ (alt.2140 m) N39.75011⁰ E45.66174⁰ (alt. 2225 m);
- Near Ughedzor village (Arpa River basin) - N39.70265⁰ E45.688118⁰ (alt. 2060 m) -> N39.69559⁰ E45.68208⁰ (alt. 2000 m).

Specimens of beetles were identified by comparing with the national archive collection. However, some hard-to-divide species were identified only to the genus level.

Results

Field surveys identified 60 species of butterfly within the study area, including *Parnassius apollo* (Apollo butterfly). This was the only species recorded which is listed in the IUCN Red List (as Vulnerable). Its preferred habitat was formerly affected by the BRSF location, but this has now been relocated.

Six species of *Odonata* (dragonflies and damselflies) were identified - three species of damselfly and three species of dragonfly along the surveyed transects: *Libellula depressa* (Broad bodied chaser), *Libellula quadrimaculata* (four spotted chaser), *Sympetrum flaveolum* (Yellow Winged darter), *Enallagma cyathigerum* (common blue damselfly), *Coenagrion lunulatum* (Irish damselfly) and *Lestes dryas* (emerald spreadwing).

One hundred and twenty-nine species of *Coleoptera* (beetle) species (including *Carabidae* and *Cerambycidae*) belonging to 21 families were collected during the surveys in 2013 (see Appendix 4.10.7). One species of beetle, *Dorcadion bistriatum* Motsch, listed in the RA Red Book, occurs in the area, and was recorded in the vicinity of Ughedzor (at N39.69907 E45.68325 (1986 m), N39.69547 E45.68183 (1969 m), and in the Gorayk area (at N39.68633 E45.77833 (2120 m), N39.717956 E45.76265 (2245 m)). This species was also recorded during the 2011 survey. Other recorded beetle species of significance included two Armenian endemics, six Trans-Caucasus endemics and six Caucasus Ecoregion endemics. Of these 14 species, *Dorcadion sisanum* Lazar and *Dorcadion scabricolle sevangense* (also recorded in 2011) are the most vulnerable endemics of Armenia and are a conservation priority.

Dorcadion sisianum Lazar is described from this area and has a strictly limited occurrence reaching eastwards towards the village of Sarnakunk. The second species is known from some locations on the southern slopes of the Vardenis Range. Both are known from the Gorayk area; the record points are as follows: *Dorcadion sisianum* (at N39.683740 E45.779255 (alt. 2075 m); N39.686373 E45.777553 (alt. 2115 m); N39.698805 E45.777773 (alt. 2148 m)) and *Dorcadion scabricolle sevangense* (at N39.684863 45.777996 (alt. 2091 m); N39.695689 E45.777311 (alt. 2140 m)). These species are apterygial (without wings) and spread over land: they are believed to live in the areas between the mentioned points, forming single populations. They have not been observed in the vicinity of proposed Project infrastructure.

Willow hawk moth occurs in the area, although not in as high density as usually found in other regions of Armenia (e.g. Aghababyan, Danchenko, Khanamiryan, unpublished data). This species has previously been listed on the IUCN Red List as Vulnerable (1994) but is listed as 'Data Deficient' in the latest version. It was not observed in the vicinity of proposed Project infrastructure.

The Project-affected area is important for Coleoptera - 129 species of beetle belonging to 21 families were collected during surveys in 2013, which is a very rich assemblage. One species of beetle, *Dorcadion bistriatum Motsch*, listed in the RA Red Book, occurs in the area, and was recorded in the vicinity of Ughedzor in 2011 and 2013 and in the Gorayk area. Other notable beetle species include two Armenian endemics, six Trans-Caucasus endemics and six Caucasus Ecoregion endemics. Of these 14 species, *Dorcadion sisianum Lazar* and *Dorcadion scabricolle sevangense* (also recorded in 2011) are the most vulnerable endemics of Armenia and are a conservation priority. These both occur in the Gorayk area, outside the Project Footprint.

A rich butterfly assemblage including Apollo butterfly *Parnassius Apollo* was recorded but not within the current proposed layout.

4.10.8 Freshwater invertebrates

Survey Methods

A survey of the Vorotan River and its tributaries was undertaken in 2009 to identify freshwater invertebrates, with further surveys in 2011 and 2013. In 2014, additional areas were included, giving an overall study area which is bounded broadly by the valley of the Vorotan River to the east, the Arpa River to the west and the Spandaryan reservoir to the south. Surveys focused in particular on the Vorotan, Arpa and Darb catchments both upstream and downstream of the potential Project-affected area. Relevant literature was reviewed and a

number of sampling stations were identified including 19 aquatic ecology stations and five fisheries stations within a variety of meso-habitats.

A common method for the assessment of water quality is the Biological Monitoring Working Party (BMWP) index. This gives a score to freshwater habitat based upon the number of families of macroinvertebrates found in a sample. It works on the basic principle that freshwater pollution levels affect macroinvertebrate families differently. Thus, certain families that are most susceptible to pollution score maximum points. These include many families belonging to the mayflies (Ephemeroptera), stoneflies (Plecoptera) and caddis (Trichoptera). Conversely, those families tolerant of polluted waters score the least points, and include families such as the leeches (Hirudinea), worms (Oligochaeta), chironomid midges (Diptera) and the freshwater hog-louse (Isopoda). Accordingly, high scoring watercourses are the cleanest with the highest water quality, whilst polluted watercourses score the lowest.

A standard methodology for obtaining BMWP scores was adopted. This involved one minute of hand searching (of rocks, leaf packs, and other submerged debris), followed by three minutes of kick sampling across each aquatic ecology (AE) Station. Kick sampling typically covers a distance of 10 to 20m of stream across each identified AE Station. The surveys were undertaken in general accordance with United Kingdom and European Union best practice guidelines for sampling (BS-EN 27828:1994). The net used for sampling conformed to European Union Water Framework Directive standards (1 mm mesh and 0.5 m deep). The sample was then placed into a sorting tray and all coarse debris was carefully checked and then removed prior to placing the remaining contents into a collection jar for identification by the NAS RA Institute of Zoology (IoZ) under laboratory conditions (see Figure 4.10.24).

The aquatic macro-invertebrate groups covered by the BMWP system were identified to species level where possible and all were identified to family level. The identification was undertaken by Evelina Ghukasyan, Director of the Armenian IoZ.

Total counts of all invertebrate taxa were made and abundance bandings applied for ease of interpretation. In addition, all macroinvertebrates were screened against the IUCN Red List and also the Armenian Red Book. Assessment as to the presence of any endemic species was also provided.

BMWP (original and revised) and Average Score Per Taxon (ASPT) were assigned to each AE station to give an indication of water quality. The number of scoring taxa was also determined since this provides an indication of invertebrate (taxon) richness associated with each AE location. However, it is important to note that taxon richness is not necessarily indicative of water quality.



Figure 4.10.24: Sorting aquatic invertebrate samples on the bankside

Results

The survey of water macroinvertebrates revealed mainly representatives of *Plecoptera*, *Ephemeroptera*, *Trichoptera*, *Gammarus*, *Dugesia*, and at some points – *Dugesia* and *Chironomus* (see Appendix 4.10.8).

No aquatic invertebrate species listed on the IUCN Red List or the Armenian Red Book were collected within the samples analysed. Three species of aquatic invertebrate were assessed to have endemic characteristics at the Caucasus region level as defined by the Armenian IoZ. These species were *Habroleptoides caucasicus*, from the Mayfly family and *Drusus caucasicus* and *Hydropsyche pellucidula* from the caddis family. The abundance and quality of aquatic

habitat within the Project-affected area and the broader region is likely to ensure that these species are well distributed throughout the Caucasus region. None fulfil criteria for endemic or restricted range species as defined by the guidance notes to IFC PS6 (IFC, 2012).

Aquatic invertebrates provides a useful basis for monitoring impacts of the Project on water quality in the rivers potentially affected by abstraction or discharges. As defined by Golder in its 2013 study, the aquatic ecology baseline for the sampling stations ranged from ‘Poor’ to ‘Clean’ with the majority of the stations being classified as ‘Fairly Clean’ in accordance with the table below. Waterbodies that scored lowest were generally small ephemeral feeder streams or watercourses that were subject to high mineralisation rates from groundwater influence.

Indicative Water Quality Designation of BMWP Scores

Designation	Very Clean	Clean	Fairly Clean	Moderate	Poor
BMWP score	>150	100 to 150	50 to 99	26 to 49	<25
Number of samples (out of 15)	0	2	8	2	3

Revised BMWP scores ranged from 10.6 (Vorotan River tributary) to 101.5 (Vorotan main river). BMWP scores were generally suppressed in small ephemeral feeder streams and elevated on main rivers. The fact that many of the feeder streams dry up for much of the year dictates that aquatic invertebrate life is likely to be inhibited by a lack of aquatic habitat on a seasonal basis. Low BMWP scores were, at times, aligned with high ASPT scores. This was the case for one sampling point on the Darb River, for example. This result indicates that species diversity is low, but the species that are present are ‘high scorers’ (e.g. pollution intolerant).

No freshwater invertebrate species listed in the RA Red Book or the IUCN Red List were found during hydrobiological research. Three regional endemic species were found, all of which are considered to be relatively widespread. BMWP scores are generally indicative of “fairly clean” water conditions.

4.10.9 Reptiles and Amphibians Surveys and Results

Survey Methods

A review of available literature revealed that no previous herpetological field studies have been undertaken to identify species of reptile and amphibian in Amulsar. Incidental sightings

were recorded during the course of other field surveys undertaken between 2008 and 2011, and again in 2013.

In 2015, an additional baseline survey was undertaken for reptiles and amphibians at Amulsar by TEC. The survey focused on the proposed Project footprint plus nearby areas considered potentially favourable for vipers (see Appendix 4.10.10).

Results

Two amphibian species were recorded as present: *Bufo viridis* (Green Toad) and *Rana macronemis* (Long Legged Wood Frog). Both are widespread in mainly wetlands. Neither are included in the RA Red Book.

Based on field activities and review of the literature, the following species of reptiles have either been observed or are considered likely to be present in the Project-affected area: *Hemorrhois (Coluber) ravergieri* (Ravergier's (multicolor) Whip Snake), *Coronella austriaca* (Smooth Snake), *Platyceps (Coluber) najadum* (Dahl's Whip Snake), *Natrix tessellata* (Dice Snake), *Elaphe sauromates/quatuorlineata* (Blotched Snake/Eastern Four-lined Rat Snake), *Dolichophis schmidti* (Schmidt's Whip Snake), *Eirenic modestus* (Ring-headed Dwarf Snake), *Eirenis punctatolineatus* (Dotted Dwarf Snake), *Telescopus fallax* (Cat Snake), *Pelias (Vipera) eriwanensis* (Armenian Mountain-steppe Viper), *Montivipera raddei* (Armenian Viper or Radde's Viper), *Macrovipera lebetina* (Levantine Viper), *Eryx jaculus* (Western Sand Boa), *Pseudopus apodus* (European Glass Lizard), *Lacerta vivipara* (Average Lizard), *Darevskia valentini* (Valentine's Rock Lizard), *Lacerta media* (Eastern Three-lined Lizard), and *Laudakia caucasia* (Caucasian Rock Agama).

Three reptile species (Armenian Mountain-steppe Viper, Radde's/Armenian Rock Viper, and Cat Snake) are listed in the RA Red Book as Vulnerable, and the two viper species are listed on the IUCN Red List as Vulnerable and Near Threatened, respectively.

The greatest diversity of reptiles associated with Amulsar Mountain is between 1600 and 1700 masl, where diverse habitats occur, including stony slopes with open bushy vegetation and rocky outcrops. 12 species were observed in this zone during the 2015 survey, including the three protected species.

Amphibians in the Project-affected area are generally widespread species, not included in the RA Red Book. However their biomass is high and they are an important food source for several raptor species.

The Project-affected area also provides good habitat for several species of reptile, particularly at lower elevations. Three species which are listed in the RA Red Book have been observed in the Project area: Armenian Mountain-steppe Viper, Radde's/Armenian Rock Viper, and Cat Snake. These species, however, also appear to have suitable habitat in the wider landscape.

4.10.10 Fish Survey and Results

Survey Methods

Incidental observations of fish were carried out in 2011 during the freshwater ecology survey. A survey of fish species present in watercourses was conducted in 2012 by the Sevan National Park and in 2013 by the NAS RA Institute of Zoology and Hydroecology with inputs from Golder. In the 2013 survey, fish were caught by hand net and fixed by 4% formaline solution. The surface of the net was 8.65m², with a mesh size of 1.5x1.5 cm² and pocket sections 1x1 cm². In 2014, further survey points were introduced.

Results

Eleven species of native fish were recorded during the 2012 – 2013 surveys in the Vorotan River and other surface waters of the catchment. These were *Salmo trutta* (Brown Trout), *Alburnoides bipunctatus* (Riffle minnow or Spiril), *Barbus lacerta* (Kura), *Pseudorasbora parva* (Topmouth gudgeon), *Capoeta capoeta*, *Barbus capito culd* (Barbel), *Barbus mursa guld* (Barbel), *Carassius gibelio gibelio* (Silver Prussian carp), *Varicorhinus capoeta* (Seven Khramulya), *Chondrostoma nasus* (Nase) and *Nemachilus brandti* (Kura loach). The non-native *Oncorhynchus mykiss* (Rainbow trout) was also recorded in 2012.

During the 2013 survey period, six species of fish were recorded: *Pseudorasbora parva* (Topmouth gudgeon), *Alburnoides bipunctatus* (Riffle minnow), *Salmo trutta* (Brown Trout), *Varicorhinus capoeta* (Seven Khramulya), *Carassius gibelio gibelio* (Silver Prussian carp) and *Capoeta capoeta*. The Kechut Reservoir was the richest in the species diversity of the fish assemblage. Relatively large individuals of riffle minnow were caught from Kechut Reservoir, and relatively small individuals from the Vorotan River. All the individuals of riffle minnows caught from the Kechut Reservoir were infected with *Ligula intestinalis* parasites of *Ligula* family. In the Vorotan River, larvae of caddisflies and dayflies were the main component for the feed of trouts. During the survey period all the individuals of stone morocco and

khramulya caught from the near shore area were male due to the migrations to spawning areas during the reproduction period (during the reproduction period the male individuals are the first to make spawning migrations).

None of the species observed during surveys are listed within the Armenian Red Book or the IUCN Red List. *Nase Chondrostoma nasus* is listed under the Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention) Annex III – ‘species that are in need of protection but may be hunted or otherwise exploited in exceptional instances’. This species is listed as of ‘least concern’ on the IUCN list.

During the survey period, Kechut Reservoir was the richest water body sampled in terms of fish species diversity. No species of fish were found at the waypoints at the Kechut dam, the Kechut aqueduct, Arpa waypoint, Gndevaz Lake, or the waypoint near the bridge of Vorotan River or at the waypoint on the River Darb. The main reasons were (i) impassable barriers on both the rivers Vorotan and Darb limit the movement of fish; (ii) unfavourable conditions in areas such as the Kechut aqueduct; (iii) flood conditions at the time of the surveys; and (iv) in the case of Gndevaz Lake, the lake is fed by snowmelt and dries up completely in summer.

None of the fish species recorded during the desk and field studies are listed within the Armenian Red Book or the IUCN Red List.

There are no endemic fish species present in the Project area and fish biomass and species diversity is relatively low. Non-native species encountered in surveys were Topmouth Gudgeon and Rainbow Trout.