

**Ecosystem Services Baseline and Impact Assessment
Dundee Precious Metals Ada Tepe Deposit
Krumovgrad Project, Bulgaria**



Submitted to

Dundee Precious Metals Krumovgrad EAD



Submitted by

AMEC Earth & Environmental (UK) Ltd.



ECOSYSTEM SERVICES BASELINE AND IMPACT ASSESSMENT REPORT
 SUPPLEMENTARY LENDER'S INFORMATION PACKAGE (SLIP)
 DUNDEE PRECIOUS METALS - ADA TEPE DEPOSIT
 KRUMOVGRAD PROJECT- BULGARIA
 NOVEMBER 2014

REPORT SUBMISSION FORM

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Appendix A: Screened-out Ecosystem Services.

1.0 INTRODUCTION

Dundee Precious Metals (DPM) has negotiated an amended financial package with a consortium of banks for which the European Bank for Reconstruction and Development (EBRD) acts as environmental agent. According to the EBRD's Environmental and Social Policy (2008), and its associated Performance Requirements (PRs), a project of this type and scale requires a full Environmental and Social Impact Assessment (ESIA). The Project undertook a local national environmental impact assessment (EIA) to Bulgarian standards in 2010 and an environmental permit No. 18-8, 11/2011 was issued. Following an independent review of the local EIA reports, the EBRD required a number of supplementary environmental and social studies and documents to fill the gaps necessary to meet the EBRD PRs and international good practice. In addition to the EBRD PRs, some of the consortium banks refer to the Equator Principles and therefore the Project also references the IFC's Performance Standards (2012). The package of supplementary environmental and social documents as well as the local EIA reports together form the Project ESIA. The Project ESIA is summarised in a Non-Technical Summary.

The purpose of this report is to present the key findings of the impacts on Ecosystem services for the Krumovgrad Project Area. This chapter also interlinks with the other studies where ecosystem services have been assessed.

Ecosystem Services are benefits that ecosystems provide to people, businesses, plants and animals as well as transporting materials (e.g. water, carbon) and energy (heat) around the planet (GRI, 2011).

The Millennium Ecosystem Assessment (2005) provides a classification scheme of these services:

Provisioning Services – these are goods or products obtained from ecosystems, such as food, water, timber and other products from plants such as fibre.

Regulating Services – these include benefits obtained from an ecosystem's control of natural processes, such as climate regulation, disease control, erosion prevention, water flow regulation, and protection from natural hazards.

Cultural Services – are the nonmaterial benefits obtained from ecosystems, such as recreation, spiritual values, and aesthetic enjoyment.

Supporting Services – are the natural processes such as soil formation, nutrient cycling and primary productivity that maintain other ecosystem services.

In line with the IFC Performance Standards (2012), this chapter identifies and classifies Ecosystem services in the mine study area, establishing how these services are of relevance to local communities and are likely to be impacted by the Project. Such services can cover both spatial and temporal parameters, e.g. community fishing



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activities (which will usually occur locally) or soil formation processes (which will happen over many years and over a large spatial area).

In order to compile the Ecosystem Services Baseline and Impact Assessment, this report draws on the following key documents:

- Krumovgrad EIA Report (Petkov, 2010)
- Krumovgrad Socio-Economic Survey Results
- DenkStatt Social Baseline Report.

2.0 APPROACH

2.1 Overview

The approach adopted for the Krumovgrad Gold Project Ecosystem Services Assessment has closely followed a recently published working paper covering ecosystem service reviews for impact assessments produced by the World Resources Institute (WRI, 2011).

This assessment consists of the following phases:

- **Defining Study Area** – in relation to ecosystem service spatial requirements for all four categories;
- **Preliminary Assessment Stage** – an initial stage to identify priority issues within the project study area;
- **Baseline** – provides a description of the current baseline conditions at the proposed mine site and presents the findings of the prioritisation exercise;
- **Impact Assessment** – provides the assessment of impacts on ecosystem services;
- **Mitigation and Management Measures** – provides the mitigation measures and residual impacts and includes proposals for Management of ecosystem services of the mine.

2.2 Defining the Study Area

Geographical coverage and extent of the study area was defined on the basis of the following factors:

- the likely distance at which the proposed mine will impact the availability and functionality of ecosystem services;
- the likely distance that people are willing to travel to utilise natural resources on a regular basis;
- water catchment areas likely to be affected by the mine project.

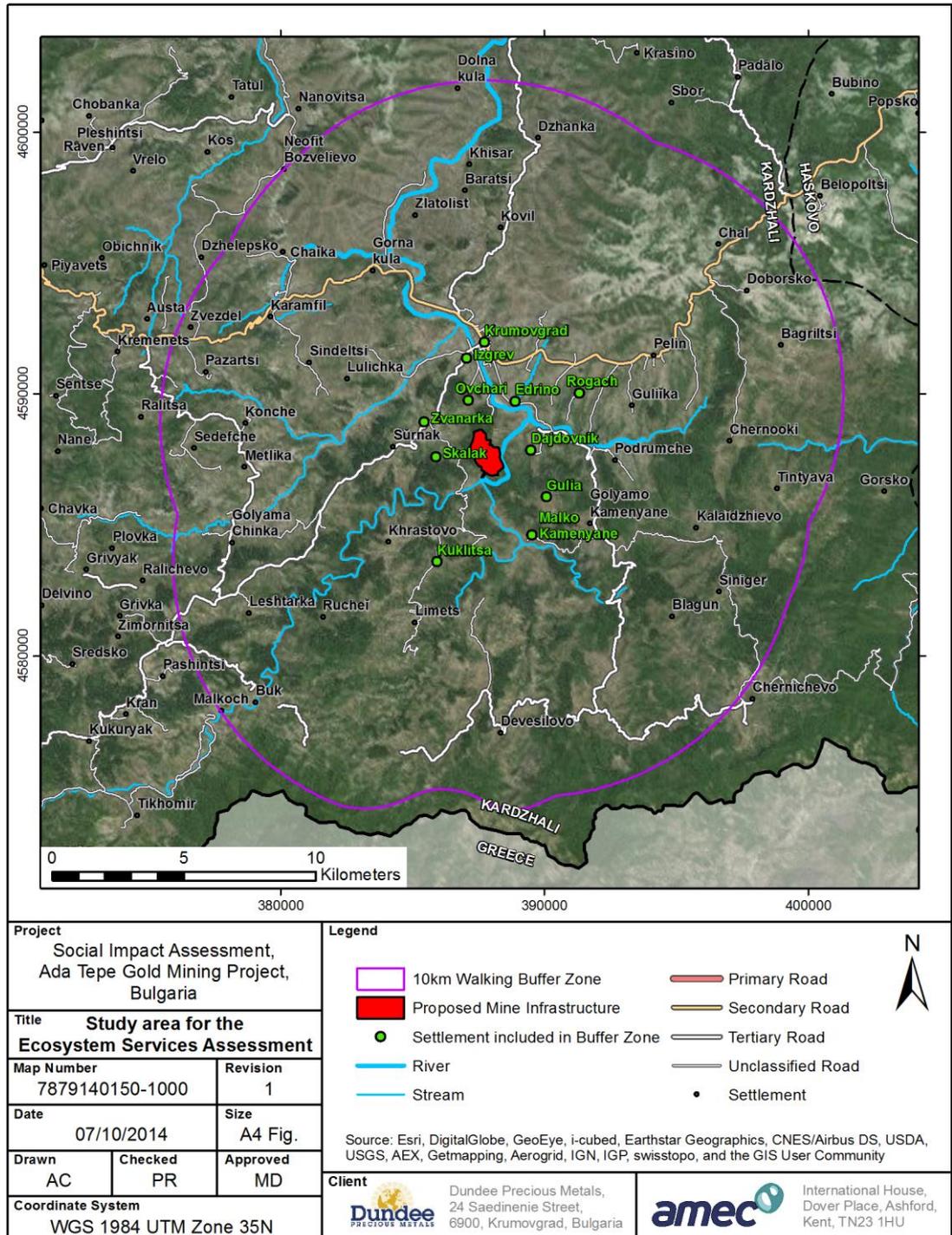
People and communities access natural resources dependent upon a) supply availability; b) distance to acquire and ability to transport the goods. Supply availability is governed by a number of factors, for example, demand level of the resource, seasonality, weather etc. In addition, land and resource ownership will also govern collection of products, as well as local laws possibly preventing the collection of, for example, wild flowers, plants (herbs) or firewood.



The mode of transport will govern the quantity that can be acquired, the distance travelled, and the number of trips taken, for example, travel and collection of firewood by foot would equate to significantly less than if acquired by a vehicle.

Figure 2-1 shows a map of the ecosystem service study area based on, a) the communities where Household Surveys took place and, b) buffer zone drawn less than 10 km) around those centres defined as the furthest point certain communities will go for provisional services.

Figure 2-1: A map showing the study area for Ecosystem Services in the Krumovgrad Project Area. The buffer zone is based upon the settlements where the socio-economic survey took place.



2.3 Defining the Ecosystem Services

Ecosystem services applicable to the Project were identified through existing literature review and as part of the Social Impact Assessment Study. The following ecosystem services are applicable to the Project:

2.3.1 Provisional Services

A developing mine project can potentially lead to the removal of interconnecting ecosystems and habitats. Removal of these could impact on availability of natural resources and products. The following provisional services are applicable to the Project:

- Construction materials (timber)
- Food (fruits, berries, mushrooms, hunting opportunities etc.)
- Water for drinking purposes obtained from wells, streams, springs or smaller dams;
- Water for livestock purposes from wells, streams and smaller dams;
- Water for irrigation purposes from streams and rivers

2.3.2 Cultural Services

Cultural Services are important in terms of recognising practices currently undertaken, for example, recreation, sport, hunting, ecotourism together with sites of sacred or religious meaning or historical context (archaeological).

2.3.3 Regulating Services

Ecosystems also provide regulatory services the role that vegetation plays in reducing air pollution (e.g. dust and other particulates) and soil erosion.

Provisioning and Regulating Services associated with freshwater and erosion regulation is covered by the Hydrological and Hydrogeological EIS Chapters. Here, influences may extend downstream of mine activity. Both the Hydrology and Social EIS Chapters provide more detailed information on the impact of basins and the communities relying upon them.

2.3.4 Supporting Services

Supporting Services are ecosystem services which are natural processes such as soil formation, nutrient recycling and primary productivity that maintains other services. Supporting services also include storage systems such as soil, carbon and water (groundwater and surface water catchment areas) and formation systems such as the development of soil

2.4 Preliminary Screening

The purpose of the Preliminary Screening stage is to predict potential priority impacts on ecosystem services and also identify interlinked drivers of ecosystem change. Priority Services were identified by field staff visits to the Project area by experienced Social Impact assessors. In addition, from existing Project related materials, potential priority impacts were identified.

The predicted priority impacts were categorised into **moderate** or **higher, minor** or **not significant**. These categories simply acted as *potential* impact categories used to determine the level of impact on a service which could occur at construction, operation and closure stage and should not be confused as final determined impact status.

The drivers of ecosystem change either involve direct, indirect or secondary drivers. The most significant direct drivers identified by the WRI (2011) are as follows:

- Changes in local land use and land cover;
- Harvest and resource consumption;
- Pollution;
- Introduction of invasive species;
- Climate change.

Significant indirect drivers were identified by the WRI and include:

- demographic;
- economic;
- sociopolitical;
- religious or scientific, technological factors.

In relation to the specific mine activities at Krumovgrad, the above lists have been focused on the key sources of potential impacts on ecosystem services:

- **Occupation of land during mine construction and operation** – this may result in habitat loss, degradation and fragmentation, reduced access to resources for beneficiaries;
- **Disturbance to habitats and species** – including activities that cause disturbance or habitat degradation as well as introduction of invasive species
- **Impacts on groundwater and surface water** – due to pollution, level of resource use (e.g. mine abstractions and land use change)
- **Impacts on availability and quality** – of resources due to demographic and economic changes relating to the influx of people seeking potential employment at the mine.

Table 2-1 presents the results of the preliminary screening stage incorporating provisional impacts and drivers. The list only includes impacts identified provisionally as moderate or higher. Ecosystem services deemed non-significant have been screened out and are not addressed in this chapter. Instead, these are examined in the relevant bio-physical baseline chapters and in Appendix A.

Minor ecosystem service impacts include:

- Timber (provisioning service)
- Honey harvesting
- Forest habitats acting as disease and pest regulators (regulating service).

Those identified as **Not Significant** in terms of ecosystem impacts include:

- Forest habitats as regulators of air quality (regulating service).

The purpose of the screening assessment is to identify activities associated with the Project which may impact on ecosystem services within the direct and indirect (outer perimeters) of the Project. Potentially significant impacts resulting from the screening assessment will be further assessed during the impact assessment based in the baseline information and the outcome of the household survey data. The outcome of the impact assessment is included in Section 4.0.

Table 2-1: Preliminary Screening Assessment

| Category of Service | Service | Service Detail | Examples | Drivers of Change associated with the mine |
|---|---|---|---|---|
| <i>Predicted Potential Impact within Project Area: Moderate or Higher</i> | | | | |
| Provisioning | Non-Timber Forest Products (NTFP) | Various consumable food products | Wild fruits and vegetables, nuts, mushrooms, herbs, medicinal plants, honey. | Occupation of land Disturbance to habitats and species Demographic and economic change |
| Provisioning – direct footprint | NTFP | Wood | Collect and use for firewood. | Occupation of land Disturbance of habitats and species Demographic and economic change |
| Provisioning – outer boundaries | Food | Crop cultivation | Agricultural activities practised as a primary livelihood by households. | Potential Impact on surface water quality and quantity Disturbance to habitats and species Demographic and economic change |
| Provisioning – outer boundaries | Food | Livestock rearing | E.g. Poultry, Cattle, | Occupation of land Potential Impacts on surface water quality Demographic and economic change |
| Provisioning – outer boundaries | Water | Domestic, agricultural, construction use sourced from groundwater wells or streams and rivers | Water use for consumption | Impacts on surface water quality Demographic and economic change |
| Cultural – direct footprint and outer boundaries | Spiritual or religious value, aesthetic value | Archaeological Sites of importance, Landscape (aesthetic value) | Cultural landmarks, and potentially historic (forts) and religious sites (ancient temples) are often associated with rivers, rock formations, and natural features (including aesthetic landscape values where cultural value is placed on landscapes or landmarks. | Occupation of land Impacts on surface water quality Access to religious sites Disturbance to habitats and species Demographic and economic change |
| Provisioning – direct footprint and outer boundaries | Food | Hunting of animals and birds | Wild game hunted for food and sale | Occupation of land by Mine |
| Provisioning – outer boundaries | Food | Wild fish caught | Inland fishing in rivers, streams, | Potential Impact on surface water quality and quantity Disturbance to habitats and species Demographic and economic change |
| Cultural | Traditional Practices | Activities | Cultural value placed on traditional practices such as hunting, fishing, hiking, crafts and use of natural resources | Occupation of land Disturbance to habitats and species Impacts on surface water quality and quantity Demographic and economic change |
| Regulating | Erosion regulation | Forest and other vegetation systems | Forest and riparian habitats regulate erosion and sediment delivery to streams and are particularly important on steep slopes where erosion potential is high | Occupation of land Demographic and economic change Impacts on surface water quality and quantity |
| Supporting | Nutrient cycling processes | Forest and other habitat types | Forest and surface vegetation are significant components of nutrient cycling processes acting as a storage and release mechanisms. | Occupation of land Disturbance to habitats and species Impacts on surface water quality and quantity |
| Supporting | Soil formation processes | Forest and other habitats | Organic matter in forests and other surface vegetation are key components of soil formation through the breakdown and recycling of decaying organic matter, development and storage. | Occupation of land Disturbance to habitats and species |
| Supporting | Water cycling | Precipitation/ground and surface water | Hydrological and hydrogeological transportation and storage systems are important in terms of the water cycle and recycling | Occupation of land Impacts on surface water quality and quantity |

2.5 Baseline methodology

The information and data sources for the ecosystem service baseline have been sought from other EIS chapters, e.g. culture, soils, water etc. and specifically from work undertaken by the Social Team including the stakeholder engagement and the socio-economic survey (Denkstatt, 2014).

The various EIS Chapter data include bio-physical data collected through field studies conducted in 2010. These studies provide quantitative and qualitative information which was used for the ecosystem service baseline. In some cases, this information has been insufficient in order to complete the analysis and therefore expert judgement has been utilised together with further engagement with the ESIA specialists concerned in order to generate an accurate characterisation.

The main output of the ecosystem service baseline has been to produce qualitative information and the assumptions made have been based upon ecosystem service importance as well as their sensitivities. The baseline produced is to a certain degree a dynamic assessment which will change over the development and lifetime of the project and can therefore be refined to advise the project further.

Prior to the first round of stakeholder engagement and more specifically the socio-economic survey, subject areas and questions were devised in order to identify priority ecosystem services. In addition, opportunities were given to review the standard socio-economic survey subject areas and further requests were made to refine the survey in order to address more specific areas relating to priority systems.

Ongoing stakeholder engagement and possibly specific ecosystem service surveys (if required) may assist in refining understanding of ecosystem services in the vicinity of the project area.

2.5.1 Ecosystem Service Importance and Replaceability

Importance of ecosystem services to beneficiaries, is assessed (Table 2-2) according to the following criteria and assigned a rating from low to essential:

1. Intensity of use – e.g. daily, weekly, seasonal use of a provisioning service; number of downstream villages reliant on erosion or flood control services;
2. Scope of use – e.g. household level vs village level; subsistence use, trade or both;
3. Geographic proximity (where possible), and
4. Degree of dependence: e.g. contribution of self-caught fish or game to total protein in the diet, rating from low – high.

Replaceability of ecosystem service is assessed according to the following criteria and assigned a rating from low – high:

1. The existence of spatial alternatives (other sites where the same ecosystem service is also provided and that are close enough to be utilised by affected communities); and
2. The sustainability of spatial alternatives given the potential for increased resource use, including a consideration of other users and the existing status and threats to the resource.

Table 2-2: Assessing the value of Ecosystem Services

| | | Replaceability / Resilience of Service | | |
|--|-----------|--|---|---|
| | | High (many spatial alternatives) | Moderate (some spatial alternatives) | Low (few to no spatial alternatives) |
| Importance of service to beneficiaries | Low | Low | Low | Medium |
| | Moderate | Low | Medium | High |
| | High | Medium | High | Critical |
| | Essential | High | Critical | Critical |

2.5.2 Ecosystem Services Prioritisation

Prioritisation of ecosystem services is an important part of the assessment and is also required to meet IFC standards regarding impacts and mitigation measures for ecosystem services. IFC PS 6 requires the following:

With respect to impacts on priority ecosystem services of relevance to Affected Communities and where the client has direct management control or significant influence over such ecosystem services, adverse impacts should be avoided. If

these impacts are unavoidable, the client will minimize them and implement mitigation measures that aim to maintain the value and functionality of priority systems.

The first step in the prioritisation process has been to scope out ecosystem services according to the potential significance of Project impacts.

The second step in the prioritization process is undertaken as part of the baseline analysis. Through the analysis of baseline data and stakeholder feedback on ecosystem services, each service is assigned a value rating reflecting the importance to beneficiaries and availability of alternatives (replaceability) of the service.

Ecosystem services of **high – critical** value that are expected to be impacted by the proposed mine are considered 'priority' ecosystem services. For these services, the project will design mitigation measures to maintain or restore the value and functionality of the service.

Ecosystem services of **medium** value are still considered of relevance to beneficiaries and are included in the impact assessment in less detail. Ecosystem services of **low** value to beneficiaries are scoped out of the assessment.

2.5.3 Impact Assessment Approach and Methods

The assessment of ecosystem services impacts has followed the overall impact assessment methodology described in Chapter 7 of the ESIA. These steps include: assigning the sensitivity / value of a receptor; prediction of the magnitude of impacts; evaluation of their significance; development of mitigation measures; and assessment of residual impact.

The significance of the impact is assessed according to the value / sensitivity of the receptor and the magnitude of the impact (Table 2-3).

In the case of ecosystem services, the baseline analysis has produced a list of priority ecosystem services for which the mine must design mitigation measures that aim to maintain or restore the value and functionality of the service for beneficiaries. Compensation or replacement services are provided in the interim or where full restoration is not possible (e.g. some landscape or cultural impacts). For non-priority ecosystem services that are nonetheless adversely impacted by the project, standard mitigation measures are proposed that are designed to avoid, or where this is not possible, reduce or compensate for the impact.

Table 2-3: Evaluating Significance of Impacts on Ecosystem Services

| | | Magnitude of Impact | | | | |
|--------------------------|-------------------|--|---|--|---|-----------------|
| | | Negligible | Small | Medium | Large | |
| | | Impacts are within the normal range of variation. | Impacts result in a small reduction in the availability or functionality of ecosystem service and/or has implications for a small number of people relative to the population within the area of influence. | The impact results in a moderate reduction in the availability or functionality of the ecosystem service and/or has implications for a substantial number of people relative to the population within the area of influence. Does not threaten the long-term viability of the service. | The impact results in the loss of all or significant proportion of the availability or functionality of an ecosystem service and/or has implications for the majority of people within the area of influence. The long-term viability of the service is threatened. | |
| Value of Receptor | Negligible | Ecosystem service is of negligible importance to beneficiaries. | Not significant | Not significant | Not significant | Not significant |
| | Low | Ecosystem service is of low importance to beneficiaries (local, regional and global) or is of moderate importance but with many spatial alternatives available. | Not significant | Not significant | Minor | Moderate |
| | Medium | Ecosystem service has moderate importance to beneficiaries and moderate replaceability (some spatial alternatives), high importance to beneficiaries and many spatial alternatives, or low importance and few to no spatial alternatives. | Not significant | Minor | Moderate | Major |
| | High | Ecosystem service is of high importance to beneficiaries and has moderate replaceability (some spatial alternatives); is of moderate importance to beneficiaries and has few or no spatial alternatives; or is essential to beneficiaries but has many spatial alternatives. | Not significant | Moderate | Major | Critical |
| | Critical | Ecosystem service is of high importance to beneficiaries and has few to no spatial alternatives; or the service is of high to essential importance and has moderate to low replaceability. | Not significant | Major | Critical | Critical |

3.0 BASELINE CHARACTERISATION AND ANALYSIS

3.1 Introduction

The following tables (Table 3-1 to Table 3-4) provide an overview of the ecosystem services identified through the earlier screening exercise as potentially impacted by the mine and then assessed against the socio-economic survey results and other information sources. Each ecosystem service is assessed for the importance of the service to beneficiaries and the availability of spatial alternatives.

The analysis of ecosystem services uses the descriptions of habitat categories (REF: EIS report) in order to provide an assessment of impacts on human beneficiaries of the ecosystem services interlinked with the different habitats located around the project site:

- **Forest** – and woodland areas are a source of provisioning services such as collection of firewood and charcoal, construction timber, non-timber forest products such as natural medicines, oils and nuts and hunting for leisure or for meat consumption.
- **Freshwater** – including marshes and wetlands, streams and rivers and riparian forests and woodlands. These areas are likely to be used for drinking water, fishing, bathing and washing clothes.
- **Semi-natural** – including hay and grazing meadows, agricultural fields for growing crops,

The settlements which are most at risk from losses in natural resources, due to close proximity to the proposed mine development include:

- Skalak
- Ovchari

Emphasis is placed on these locations in terms of the impact assessment as they are linked to the Household Survey. However, other smaller communities (or even individual homes) may also be impacted upon, for example, the village of Synap which may maintain agricultural land at the foot of the mine.

Table 3-1: Provisioning Services in the Mine Area of Influence

| Service | Description | Additional Information (including status, threats and availability of alternatives to the service) | Relevant Habitats | Importance to beneficiaries | Replaceability |
|-------------------------------|--|---|----------------------|--|---|
| Collection of mushrooms/fungi | Collection of mushrooms/fungi provides additional nutrition and protein which is important for overall health and well-being. This activity may be undertaken by older generations with greater knowledge of edible species available around them. | <p>While removal of some areas currently available for collection of mushrooms/fungi will decrease availability, current surrounding forested areas provide sufficient supply to maintain a relatively high percentage of Ecosystem Service (ES) provisional demands.</p> <p>From the two settlements close to the proposed mine development, Ovchari and Skalak villages the results from the socio-economic survey show that the number of people undertaking mushroom/fungi collecting as part of an economic activity is minimal (one person from Skalak; no one from Ovchari). The one person from Skalak does consider this to be an important activity contributing towards their annual income. More people in Kuklitsa village undertake mushroom picking, but this village is further south and the project will not likely impact on their activities.</p> | Forest, Semi-natural | Low – This is a seasonal activity undertaken in the spring and autumn months in close-by forested areas. It is an activity that is undertaken for trade, however, dependence is low as other foods may provide the same or similar source of nutrition. The socio-economic survey indicates that extremely low numbers of people undertake this activity within the ecosystem service study area. | <p>Moderate - spatial alternatives are dependent upon availability and demand. People undertaking this activity may increase but the sustainability is low due to the nature of the season and natural availability.</p> <p>The individual from Skalak would still be able to access forested lands immediately south of the village where no project related impacts will occur, while the individual from Ovchari will still be able to access sufficient forested land to the north of their village.</p> |
| Collection of herbs | Collection of herbs possibly for nutrition or for medicinal purposes may be important for overall health and well-being. | <p>This activity may be undertaken in forested as well as semi-natural areas (meadows etc.). Removal of some places due to mine development could decrease locations where herbs can be collected. Some species may be uncommon and only found in certain areas.</p> <p>No one in Ovchari undertakes collection of herbs. In Skalak village, one person considers this an important activity which contributes towards their annual income.</p> <p>This is also an important activity especially in Edrino and Kuklitsa villages. It is possible that villages from Edrino are accessing forest in the proposed mine footprint while Kuklitsa lies further south and would require more effort to collect from the proposed mine footprint, thus is more likely they collect locally to their village.</p> <p>For one person in Edrino village this is a significant contributor towards their income but is not likely to be affected by the project. Six respondents from Zvanarka also collect herbs but do not consider it to be an important economic activity but again are less likely to be affected.</p> | Forest, Semi-natural | Low – This is a seasonal activity undertaken in the spring, summer and early autumn months. While it is an activity undertaken for trade, dependence is low as only 20 people collect herbs. | <p>Moderate - spatial alternatives are dependent upon availability and demand. People undertaking this activity may increase but the sustainability is low due to the nature of the season and natural availability.</p> <p>The individual from Skalak would still be able to access forested lands immediately south of the village and could access lands south of the river in spring and summer months.</p> |
| Fishing | Fishing is a source of free food and does provide a minor income for a small number of people and could provide a recreational activity near to the Project Area. | <p>Availability of suitable fishing habitats is quite high in terms of streams and river water courses, however, seasonality may mean that flow occurs only in autumn, winter and early spring months. This may severely restrict which fish species use these local rivers, especially medium to large fish which are more suitable for the human diet.</p> <p>Response from the socio-economic survey indicates that this activity is not undertaken by many people (nine respondents in total). Only one person in Ovchari village fishes and no one in Skalak. Four people fish in Kuklitsa but overall no one considers it to be an important economic activity.</p> | Freshwater | Low – Fishing is not an extensive activity undertaken by many people. Instead, a few people undertake which may supplement their income. There are a number of rivers where fishing can take place, for example along the main river of Krumovitzza. Dependence is low, maybe due to sufficient supplies of fresh fish from coastal towns or from preserved fish available in supermarkets. | High - Other nearby streams and rivers remain available for fishing. Rivers like Arda and Kesebir dere. |

| Service | Description | Additional Information (including status, threats and availability of alternatives to the service) | Relevant Habitats | Importance to beneficiaries | Replaceability |
|------------------|--|--|----------------------------------|--|--|
| Hunting | Hunting is a recreational activity with the added advantage to serve as source of food and may provide a minor income in the Project Area. The Household Survey indicates that limited dependence exists on any income derived from hunting. | <p>Development of the proposed project area will remove a large expanse of forest/woodland which may be habitat to game such as, rabbit, pigeon, hog etc. and cover licensed hunting areas.</p> <p>The socio-economic survey, however, reveals that this activity is only undertaken by a small number of people who do not obtain a significant level of income. Three respondents replied, one from Ovchari and no one in Skalak. Two people from villages further afield.</p> | Forest, Freshwater, Semi-natural | Low – This maybe seasonal activity undertaken in the summer and early autumn months. While it is an activity undertaken for trade, dependence is low as less than five people hunt. | <p>Moderate - spatial alternatives are dependent upon availability and demand. People undertaking this activity may increase but the sustainability is low due to the nature of the season and natural availability.</p> <p>Hunting by the individual in the affected area may require additional membership of other hunting groups in order to hunt elsewhere due to the licensing system in place.</p> |
| Crop cultivation | Crop cultivation is practiced at a subsistence or commercial scale, providing various food products for consumption and/or trade. Crops include tobacco, peppers, onion, potatoes, tomatoes etc. | <p>Direct impacts on farming livelihoods are not likely as the proposed mine is currently situated within an area of forest/woodland.</p> <p>Crop cultivation is practiced by 63 respondents who were interviewed out of 396 in total (or 15.9%) and stated their occupation as farmers. Of these, only four in Ovchari village and one in Skalak village are farmers, however, 33% in Ovchari and 36% in Skalak village practice crop cultivation.</p> <p>The most common crop grown is tobacco and vegetables representing 128 respondents out of 396 or 32%.</p> <p>Land is used for various purposes. Across the region, 119 respondents representing 83% of 143 households questioned, use their land for arable purposes. 49 or 34% use land for pasture, 8 respondents or 5.59% use it for forestry.</p> <p>In relation to directly affected or areas very close to the proposed mine development, 13 respondents or 93% in Ovchari and 11 respondents or 100% in Skalak use their land for arable purposes. Seven respondents or 50% from Ovchari and 2 respondents or 18% from Skalak use land as pasture. Regarding, land used for forests, 2 respondents or 14% are from Ovchari and no one in Skalak.</p> <p>Another important factor is the distance of land owned from their homes. While the socio-economic data does not precisely identify where land is owned, the question asked is the distance from their home, therefore it could be possible that land is owned away from the proposed impact area. Focusing on the two villages closest to the proposed development, most respondents stated that land is owned within less than 1 km (Ovchari, 92% and Skalak, 45%). While only two respondents from each village own land further afield (1.1-5 km) and one person owns land between 5.1 and 10 km (in Skalak) and one person in Ovchari owns land beyond 10 km.</p> | Semi-natural | High – a traditional activity that may require daily or weekly attention. Cultivation of crops provides fresh vegetables and fruits which may be consumed by the household or traded. | High – However, not applicable as no farms are within the proposed development area |

| Service | Description | Additional Information (including status, threats and availability of alternatives to the service) | Relevant Habitats | Importance to beneficiaries | Replaceability |
|----------------|--|---|----------------------|--|--|
| Livestock | <p>Land in and around settlements is currently used for grazing for animals.</p> <p>Obviously some settlements and livestock owners will also have space set aside for keeping animals safe with secured areas. These could potentially be impacted by vehicle movements, noise etc.</p> <p>Communal grazing areas and land owned for grazing also occur close to the project development zone, these grazing places may be subject to potential mine-related impacts, such as air pollution and noise. This is especially the case for Ovchari and Skalak villages where livestock owners use free grazing areas on nearby hills and mountains for grazing.</p> | <p>Across the region, 99 respondents out of a total of 396 from the social-economic survey own livestock. Animal husbandry and keeping livestock is practiced throughout the Project Area, however is more prevalent in the smaller communities</p> <p>In Ovchari, eight respondents and in Skalak, five occupants keep livestock. To the south, Kuklitsa village, sixteen respondents have livestock while in Guliya village, 15 respondents do.</p> <p>In terms of economic importance, four occupants of Ovchari village declare that it provides an income while in Skalak, three respondents do. One person in Skalak owns more than 16 cattle. Similarly, other villages also declare that it is an important economic activity; however, these are further away from the proposed project site.</p> <p>People also retain animals for subsistence purposes with 124 respondents replying they own cattle, 112 poultry and 32, sheep.</p> <p>The socio-economic questionnaire also asks whether livestock are allowed to roam on free grazing pasture land on hills and the mountain. In Ovchari village, 15 respondents answered yes, while in Skalak village, 6 respondents said yes.</p> | Forest, Semi-natural | <p>High - as indicated, in some settlements, animal husbandry is a traditional activity requiring daily attention. Livestock provide a fresh source of protein. Most animals will remain close to a settlement or household, foraging for food within a vicinity of 1 km. Others may be led to common pasture lands to graze.</p> | <p>High - surrounding land can be used for grazing.</p> |
| Drinking water | <p>The availability and access to reliable and clean drinking water is one of the fundamental services required by communities. Poor quality water is often the cause of the spread of disease.</p> | <p>Many of the communities in the Project Area do have access to a piped water network from a safe and secure centralised supply. However, some individuals still obtain water from wells, rain harvesting or pumped from the river. In the two villages close to the proposed project development, one person in Ovchari obtains water from a well, while eight respondents do in Skalak and only one by rain harvesting. No one from these villages obtains drinking water from the river. However, in Edrino, Malko Kamenyane, Kuklitsa and Guliya more people access water through wells. Studies show that groundwater pollution will be unlikely, surface water run-off will however need to be managed correctly to ensure no surface water run-off does not contaminate surface water resources</p> | Freshwater | <p>Essential - water is required on a daily basis and needs to be obtained from a nearby clean source. Water is used at both household and village level. People within the Project Area will be highly dependent upon a local supply.</p> | <p>Moderate - spatial alternatives are dependent upon availability of water bodies and courses and settlements are dependent upon close proximity. The sustainability of use will be dependent upon the new size and the level of requirement per head.</p> <p>Villagers at Skalak and Ovchari that continue to use wells are positioned at a higher elevation than the project thus no impacts are likely to occur to shallow wells.</p> <p>Villagers from Edrino, Malko, Kamenyane, Kuklitsa and Guliya are further afield and positioned on different hydrological basin unlikely to be impacted by the project.</p> |
| Firewood | <p>Local communities may make use natural resources where they are readily available in the Project Area. Collecting of firewood for heating is the most common use of natural resources in all of the communities within the ES area assessed.</p> | <p>Collection of firewood is undertaken by 80 respondents from a total of 385 spread across 11 communities. Six occupants from Ovchari village and seven occupants from Skalak village collect wood. This is comparatively low with people who buy firewood and others that collect it from nearby villages e.g. Kuklitsa (19), Guliya (16) and Zvanarka (16). All of these latter settlements are a further distance from the mine development with other alternative areas available. The fact that some people collect wood could indicate economic vulnerability in that they are unable to afford to purchase wood.</p> | Forest | <p>Essential – firewood is required on a regular basis in order to provide heat and to cook food.</p> | <p>High – other nearby spatial alternative areas exist which do not overlap with other communities needs.</p> |

Table 3-2: Cultural Services in the Mine Area of Influence

| Service | Description | Additional Information (including status, threats and availability of alternatives to the service) | Relevant Habitats | Importance to beneficiaries | Replaceability |
|--------------------------------|--|--|--------------------|---|---|
| Cultural heritage | Cultural Heritage in the Krumovgrad area is steeped in a long and rich history spanning multi-ages from ancient times (Thracian), through the middle ages and Bulgarian Revival. As a result, the cultural landscape features many links to the past. In addition, local inhabitants celebrate and remember these cultural links through festivals and song and dance. | Archaeological remains of buildings such as ancient temples, fortresses, cemeteries and tombs remain in the area and vicinity of the project. They are of current interest to local inhabitants, national as well as international historians and archaeologists. It is possible that some locations maybe impacted. | N/A | High – links to important eras in the past are still celebrated today. Local festivals are held and history is kept alive in song and dance. | Low – Archaeological remains as well as current historical links to such sites remains high. |
| Traditional cultural practices | The socio-economic survey underlines that now only a few occupants participate in traditional cultural practices and values such as hunting, fishing, crafts and use of natural resources. | Removal of habitat which supports such cultural activities will impact on a minority of individuals. However, suitable nearby areas remain where these activities can still be practiced. | Forest, Freshwater | Low – requirement for provisional ecosystem services is low and will not affect the day-to-day activities of local communities. | High – locations to the north, south-east and west of the proposed development area may provide new opportunities. |

Table 3-3: Regulating Services in the Mine Area of Influence

| Service | Description | Additional Information (including status, threats and availability of alternatives to the service) | Relevant Habitats | Importance to beneficiaries | Replaceability |
|----------------|--|---|----------------------|---|---|
| Soil formation | Soil formation occurs through natural erosion processes and the build-up of organic material together with the processes of micro-fauna. Loss of soil or a reduction in soil formation processes) is extremely costly to any operation, and is generally only evident at closure or when rehabilitation operations are compromised, but plays an ever increasing role in the water quality and utilisation potential of streams and rivers that are of primary concern to many of the rural communities in and around the mining project. Vegetation cover binds soil and prevents soil loss thus acting as a regulating measure. | Uncontrolled erosion of soils into streams and rivers will have an impact on community use in terms of utilisation of water Project development and installation of infrastructure will lead to removal of vegetation, thus increase vulnerability to erosion with potential for pollution of streams and rivers. Controls include Soil Management Plan, Biodiversity Management Plan (vegetation buffers etc.) Water Management Plan | Forest, Semi-natural | High - vegetation buffers and other installed mitigation measures are especially important during seasonal periods when rainfall quantities increase, duration and intensity can all increase and thereby mobilise soil. | Moderate - certain catchment areas will be affected where attention needs to be focused. |

Table 3-4: Supporting Services in the Mine Area of Influence

| Service | Description | Additional Information (including status, threats and availability of alternatives to the service) | Relevant Habitats | Importance to beneficiaries | Replaceability |
|--------------------|---|--|--------------------|--|---|
| Nutrient retention | Woodlands and forests are extremely efficient at retaining nutrients (closed-systems) which are stored either in soil, bacteria and other primitive life forms, vegetation (e.g. Leaf, woody materials etc.) and fauna components (e.g. animals and released through dying or dead organic matter and are transported via water and erosion processes). Natural changes e.g. fire, wind and human influences e.g. clearances, logging, disturbances to the surface will lead to an outflow of nutrients from the ecosystem. | Increases in nutrients in water courses will lead to changes in flora and fauna composition as natural community compositions are distorted due to an over-stimulation of nutrients favouring some species over others that prefer steady-state or oligotroph (low nutrient) environments. As a result, key species or species sensitive to chemical changes can be lost. Eutrophication of water courses leads to a detrimental change in water chemistry increasing primarily Nitrates and Phosphates, over-stimulating certain algae (phytoplankton and macroalgae), leading to a depletion of oxygen causing a further reduction of aquatic flora and fauna. | Forest | Medium - the area where mining is going to take place is relatively small therefore nutrient loss will be minimal. | Moderate - removal of forest habitat will lead to a loss of nutrients captured in the soils in this specific area of mining infrastructure. |
| Hydrological cycle | The hydrological cycle describes a supporting system whereby water is in a state of continuous motion above and below the surface of the Earth. It is an exchange of energy closely integrated with the climate of the planet. On a local scale within the Project Area, removing moisture (evaporation) and receiving moisture (condensation and precipitation) is experienced. Water is stored (ponds, wetlands/swamp) and soaks into the ground) and is also transported off the surface via streams and rivers. | Changes to the ground surface can greatly influence the water cycle of the site. Removal of vegetation reduces evaporation and affect local temperatures | Forest, Freshwater | Essential - water is available to people as well as flora and fauna on a local scale within the Project Area. It is required on a frequent basis (daily) and a local basis due to its weight in transportation. | Low - modifications to the surface will potentially lead to localised impacts, however, not all areas are affected and potential remains for areas to continuing operating without change. |

3.2 Ecosystem Services Prioritisation

Table 3-5 summarises the importance and replaceability assigned to potentially impacted ecosystem services in the baseline assessment.

An additional evaluation is added in terms of 'value rating' (column 3). This is a final screening exercise and the list of priority ecosystem services is evaluated in terms of whether these services represent an unsustainable use of available resources. Only value ratings of High and Critical will be taken forward into assessment of impacts.

Table 3-5: Ecosystem Services Prioritisation

| Ecosystem Service | Importance to affected community ¹ | Replaceability ² | Value Rating ³ |
|---------------------------------------|---|-----------------------------|---------------------------|
| Provisioning Services | | | |
| Food: Collecting mushrooms/fungi | Low | Moderate | Low |
| Food: collection of herbs | Low | Moderate | Low |
| Food: Fishing | Low | High | Low |
| Food: Hunting | Low | Moderate | Low |
| Crop cultivation | High | High | Medium |
| Livestock rearing | High | High | Medium |
| Drinking water | Essential | Moderate | Critical |
| Cultural Services | | | |
| Cultural heritage sites of importance | High | Low | Medium |
| Traditional practices and activities | Low | High | Medium |
| Regulating Services | | | |
| Erosion control | High | Moderate | High |
| Supporting Services | | | |
| Nutrient cycling processes | High | Moderate | High |
| Soil formation processes | High | Moderate | High |

See Table 2-2 – Col. 1 Importance of Service to Beneficiaries, Col. 2 Replaceability / Resilience of Service.

3.3 Mine Dependencies on Ecosystem Services

Mine activities can also place pressures on ecosystem services and with some services the mine will be highly dependent, e.g. freshwater. Design measures will be in place to reduce some of these Project induced pressures (Table 3-6), for example, maximising Project water recycle and introducing protocols such as a no hunting policy for all staff.

Table 3-6: Ecosystem services dependencies of mine project

| Service | Description | Additional information (incl. status, threats and availability of alternatives) | Relevant Habitats | Importance to Project* | Replaceability* |
|--|--|---|--|------------------------|-----------------|
| Freshwater (Provisional Service) | Mine requirement for plant water supply, haul road dust suppression, construction water, potable water, vehicle wash | Increased availability during autumn/winter months and decreases in supply during spring/summer months | Surface water bodies (streams, rivers, wetlands), ground water | Essential | Moderate |
| Soil (Provisional Service) | Mine reliance on soil as a medium to close project areas of development. | Failure to remove or protect soil prior to project construction will lead to soil requirements at project closure | Terrestrial habitats | Essential | Moderate |
| Erosion processes (Regulating Service) | Mine reliance on vegetation areas to provide natural erosion control measures to protect roads and mine infrastructure | Removal of vegetation will potentially increase erosion | Forest, surface water bodies (streams, rivers, wetlands) | High | Moderate |

3.3.1 Mine Ecosystem Services Prioritisation

A summary of the importance and replaceability of ecosystem services that relate to the mine dependency is presented in Table 3-7. The same process has been adopted as in Table 3-5 and follows the same process carried out for potentially impacted ecosystem services, i.e., services with a high – critical value rating are considered priority services for the mine.

Table 3-7: Ecosystem Prioritisation Table – Mine site

| Ecosystem Service | Importance to affected community ¹ | Replaceability ² | Value Rating |
|------------------------------|---|-----------------------------|--------------|
| <i>Provisioning Services</i> | | | |
| Freshwater | Essential | Moderate | Critical |
| Soil | Essential | Moderate | Critical |
| <i>Regulating Services</i> | | | |
| Erosion processes | High | Moderate | High |

See Table 2-2 – Col. 1 Importance of Service to Beneficiaries, Col. 2 Replaceability / Resilience of Service

4.0 ASSESSMENT OF POTENTIAL IMPACTS

4.1 Introduction

Over the lifetime of the mine, it is expected that there will be a range of impacts on ecosystem services in the mine area of influence, with implications for the livelihoods, health, culture and wellbeing of communities within this area.

4.2 Potential Impacts on Provisional Services

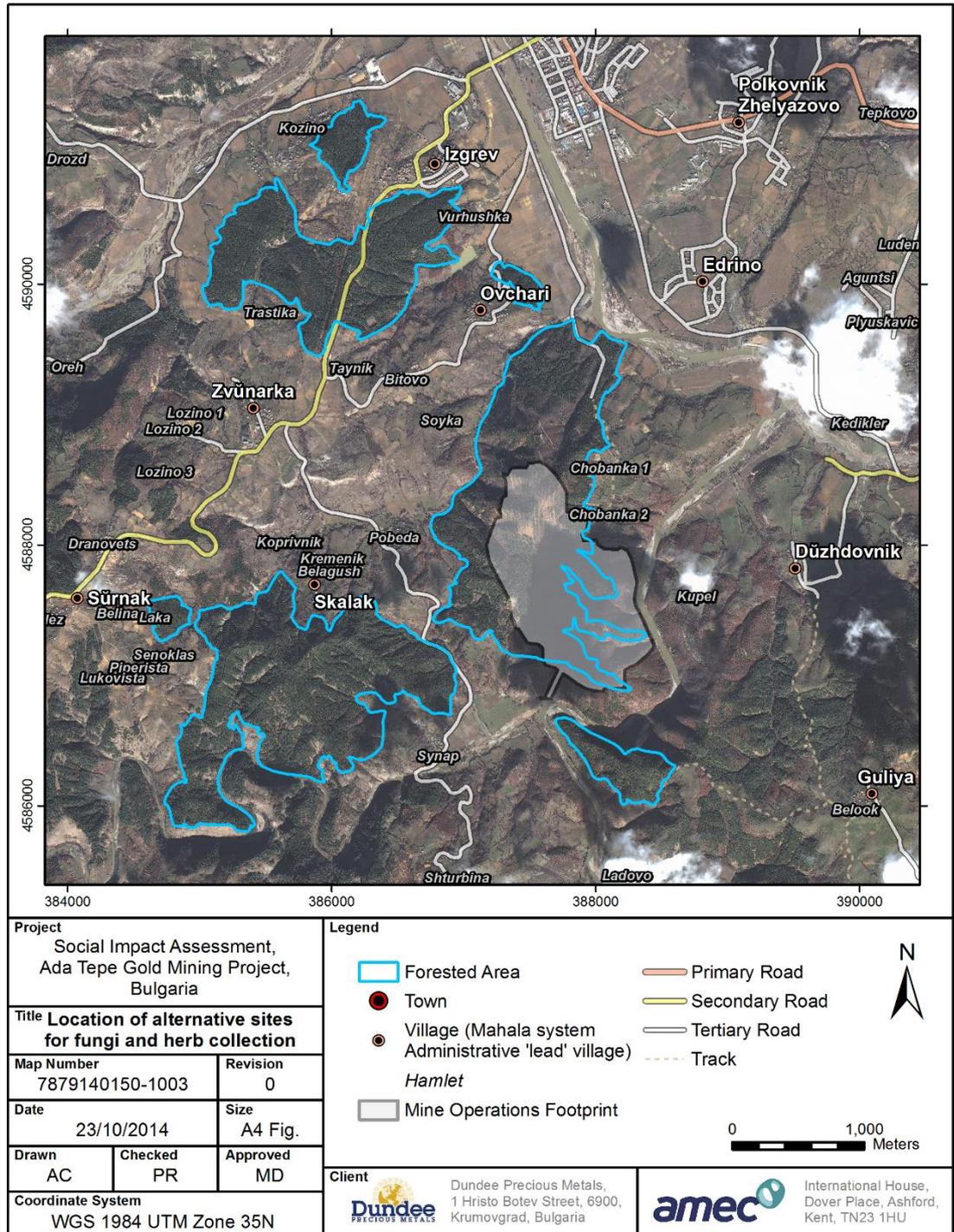
4.2.1 Mushroom/Fungi collection

While the overall impact assessment for this activity is deemed not significant, the household survey indicated that one individual from Skalak village close to the proposed mine development area will be potentially affected. While this is an important economic activity for this one individual, other nearby areas are available (Figure 4-1). More details on this activity are to be found in the SIA report.

Given the very low numbers of people undertaking mushroom/fungi collection, it is not anticipated that this activity will impact on nearby biodiversity (fungi) or ecosystems (forest ecosystem) or other peoples collection areas as there is sufficient coverage of nearby forested land.

The resulting potential impact is **Not Significant**.

Figure 4-1: Map showing the location of alternative forest areas where mushroom/fungi and collection of herbs could occur.



4.2.2 Collection of herbs

Herb collection may supplement nutrition as well as provide medicines from a host of plant species found in the wild. Knowledge on these species may be restricted to older generations. Collection of herbs may occur in a number of habitats including woodland/forest, meadows, river corridors etc.

In the immediate project vicinity and proposed development area, few people undertake collection of herbs, however, those that do consider it to be an important economic activity. While only one person in Skalak collects herbs and no one in Ovchari, others in villages further afield do, for example, Edrino and Kuklitsa villages. However, in order to access the proposed project development area, more physical effort would be required than other suitable areas close by.

Areas of forested land (Figure 4-1) remain south-east of Skalak and north and south of Ovchari which are not expected to be impacted by the project. These areas are sufficiently large enough in order to offset specific loss from the Project impact area.

The resulting potential impact is **Not Significant**.

4.2.3 Fishing

Similar to mushroom/fungi collection, only one individual from Ovchari village fishes in nearby rivers/streams and for them, this is not an important activity.

Four villagers from Kuklitsa village also fish but again, for them this is not an important economic activity and they are further away from the proposed mine impact area, however, are downstream of the mine.

The resulting potential impact is **Not Significant**.

4.2.4 Hunting

Only one individual hunts from Ovchari village and for them this is not an important economic activity. Two others also hunt from Kuklitsa village which is further south of the proposed mine development. The SIA report contains more specific information on hunting activities by local people which is specifically licensed by area.

The resulting potential impact is **Not Significant**.

4.2.5 Crop cultivation

Crop cultivation covers a range of crops that are grown for personal as well as for trade in local communities and major nearby settlements. A range of crops are grown from tobacco, peppers, onion, tomatoes and many other fruits and vegetables. Indeed, many

respondents are involved in one or more crop cultivation, for example, 328 respondents from a total of 396 questioned grow onions. The majority of farmers grow crops close to their homes, with only a few farmers owning land further afield.

In relation to direct impacts, the proposed development is currently located on natural forest and/or woodland. Most if not all grazing and agriculture areas will not be directly impacted, though some areas may be exposed to indirect impacts such as air pollution (dust and other particulates).

Appropriate mitigation measures to address indirect impacts could include using existing forest trees beside tracks as dust suppressants as well as use of water tanker, consideration of road/track materials in order to reduce particulate matter and dust.

The resulting potential impact is **Not Significant**.

4.2.6 Livestock

Livestock is kept and maintained by many villagers for subsistence and economic purposes, including those in close proximity to the proposed project area (Ovchari and Skalak villages). It is an important economic activity for some with larger herds and/or stocks of animals. Some villagers also use additional areas in the hills and mountains to graze their animals. The proposed mine project will likely impact on this activity requiring these livestock owners to seek alternative areas for grazing. This is especially the case for villagers in Skalak. However, existing forested land will still remain south of this village which will not be impacted by the Project. In addition, the river does not act as a barrier in late spring and summer months when river flows are significantly reduced, therefore allowing livestock to cross and access forest.

The Project will also need to include assessing risks to local livestock in terms of straying animals, road/track access points, animals in roads, animals used for transportation (horse and cart) together with Project related vehicle movements. Use of warning signage, staff Safety, Health and Environment inductions to warn vehicle drivers of the potential for animals will need to be considered. In addition, fencing and fence maintenance may be necessary. Further information can be found in the Framework Traffic Management Plan.

The resulting potential impact is **Not Significant**.

4.2.7 Drinking water

The availability of sufficient and clean freshwater is critical to sustaining human life, preventing water related diseases, irrigating crops, sustaining livestock and maintaining habitat for freshwater fish.

Mine activities may have a potential direct impact on freshwater supply due to consumption of water resources by the mine and changes in water quality in catchments downstream of mining activities.

A small amount of individuals still obtain drinking water through either collecting supplies from either shallow wells or from the river. In total eight respondents use wells in Skalak which is close to the proposed development but only one person uses a well in Ovchari, however, these villages are located higher than the proposed project area, therefore impacts on shallow wells are not envisaged. Further afield (Edrino, Malko-Kamenvane, Kuklitsa and Gulia more people use wells but these are not likely to be affected as these villages are located on different water bodies.

It does not look like people use the river to collect sources of water for drinking. One individual from Kuklitsa does but it is not known which river. This is also further upstream from the project site.

Implementation of the Mine Water Management Plan will also address surface water run-off and mobilisation of soil through suitable methods located throughout the Project area thus avoiding impacts on running waters (rivers, streams).

In terms of sensitivity and that a small number of people continue to use wells to source their drinking water from, the resulting potential impact is **Minor**.

4.3 Potential Impacts on Cultural Services

4.3.1 Spiritual, religious and aesthetic values

Spiritual and religious sites may include current cultural ties with churches, cemeteries and other places of remembrance. It may also include archaeological and historic features in the landscape which should be surveyed in detail prior to removal or deconstruction. The main Social Impact Assessment (SIA) report provides more detailed information on spiritual and religious sites and it is proposed not to replicate that assessment in this report. Refer to the Cultural Heritage and Archaeological Resources and Cultural Values section of the SIA for a full list of proposed mitigation measures.

The Project site also holds aesthetic value in terms of local recreational and leisure use though not to a significant degree. Access to other nearby areas will also continue to be available. As above, refer to the SIA report for full details on cultural, aesthetic and recreational values.

Residual impact after mitigation will reduce to **Not Significant**.

4.3.2 Cultural traditional practices

Only a small number of individuals still practice traditional activities in the area of the proposed mine site, impacting on hunting, herb collection etc. Other suitable nearby areas remain where these activities will still be able to be practiced. As above, refer to the SIA report for full details on cultural, aesthetic and recreational values.

The resulting potential impact is **Not Significant**.

4.4 Potential Impacts on Regulating Services

4.4.1 Erosion regulation

This section discusses potential impacts on erosion regulation services provided by natural vegetation. As an intermediate service, natural vegetation contributes to freshwater quality, erosion-related impacts on TSS and water quality in catchments utilised by local communities (Rio Tinto, 2012). Other potential impacts not captured in the freshwater quality analysis may include decreases in slope stability and soil quality in the mine area. Erosion regulation does not have natural replacements but restoration of vegetation can return the service to its original function. Vegetation in the area is generally fast growing and resilient to change. Replaceability of the service is therefore considered medium and the service is considered of high value overall.

Activities during the construction and operation phases will result in clearing of vegetation on catchment slopes in the mine area, resulting in a moderate reduction in erosion regulation provided by these habitats. Given the potential for high rainfall, the loss of natural regulation services in addition to any erosion directly caused by mine activities would be a concern. Ground disturbance during construction and pit excavation may increase the potential for erosion. Activities include pre-stripping within the open pit areas, haul road construction, mineral waste emplacement preparation and general construction activities.

The resulting potential impact on water supplies is anticipated to be **High**.

4.5 Potential Impacts on Supporting Services

4.5.1 Potential impacts on soil formation processes

Forest and other habitats contribute to soil formation processes with natural vegetation providing a source of organic matter which is broken down and recycled. Soil is critical for agricultural activities and once vegetation is removed, is quickly lost. Mining activities may lead to compaction, blending of top-soil with sub-soils, and de-nitrification leading to infertile soils. Mining dusts may also change the constituents of soil, increasing contaminants as well as changing the texture of soil. Pollutants may also inhibit soil-forming processes (Wong, 2003). Impacts from run-off also reduce the fertility of soil.

However, the most important factor is the removal of vegetation that protect soil and enrich it with additional organic material.

The resulting potential impact on soil formation is anticipated to be **High**.

4.5.2 Potential impacts on water cycle

Watersheds have a big impact on the water cycle, and mining developments and activities cause significant change to the water cycle. Potential impacts include reduced flow in nearby rivers from watercourse removal which could lead to further impacts such as sedimentation and erosion, and changes in riverbed could lead to impacts on freshwater flora and fauna. Impacts to groundwater through lack of recharge could impact on communities dependent upon wells. Changes to the natural vegetation cover (e.g. forests) will lead to impacts on evapotranspiration affecting spatial and temporal rainfall variations. Paving of land also reduces the ability for water to soak away and thus can overload watercourses in flood situations. Other impacts to local communities may include alterations to irrigation practices (Conradin, 2012).

The resulting potential impact on water cycle is anticipated to be **High**.

5.0 MITIGATION MEASURES AND RESIDUAL IMPACTS

5.1 Introduction

The following section provides a description of mitigation measures and predicted residual impacts on ecosystem services in the mine study area, including mitigation of impacts on the following:

- Drinking water supply;
- Erosion control;
- Nutrient cycling processes;
- Non-priority ecosystem services (see Appendix A).

Due to the cross-cutting nature of the subject area, mitigation of impacts on ecosystem services will be captured in the Environmental and Social Management Plans. In some cases, mitigation measures are common across several impact topics.

5.2 Drinking water supply

Mitigation against impacts to community water supplies will be covered in the Mine Water Management Plan and updates, following monitoring and regular review. This provides for the following:

- Ensuring that existing water requirements of high value ecological and / or community receptors are met before operational requirements;
- Mitigating impacts on existing water users, including communities and ecosystems;
- Complying with standards for all discharges to the environment; and
- Minimising large fluctuations in dewatering rates.

Residual impact after mitigation will reduce to **Not Significant**.

5.3 Erosion control, Nutrient cycling and soil formation processes

Mitigation measures for erosion control will include those set out in the Hydrology and Soils Sections but in general include:

- Avoiding unnecessary disturbance of stable surfaces;
- Protection of soils outside work areas from damage by prohibiting
- the movement of construction vehicles and equipment outside designated areas;

- Locating temporary construction areas to avoid ground at risk from erosion wherever possible;
- Scheduling works with high erosion potential during the dry season wherever possible; and
- Rehabilitating all disturbed land as soon as practical after completion of works.
- Minimising works in areas where there is the potential for slope instability;

Residual impact after mitigation will reduce to **Not Significant**.

5.4 Water cycling

Mitigation against impacts on water cycling will be covered in the Mine Water Management Plan and updates, following monitoring and regular review. This provides for the following:

- Ensuring that existing water requirements of high value ecological and / or community receptors are met before operational requirements;
- Complying with standards for all discharges to the environment; and
- Minimising large fluctuations in dewatering rates.

Residual impact after mitigation will reduce to **Not Significant**.

Table 5-1 lists the revised final rating after mitigation and residual impacts.

Table 5-1: Ecosystem Prioritisation and final rating values after mitigation and residual impacts.

| Ecosystem Service | Importance to affected community ¹ | Replaceability ² | Value Rating ³ | Final Rating after mitigation and residual impacts |
|---------------------------------------|---|-----------------------------|---------------------------|--|
| <i>Provisioning Services</i> | | | | |
| Food: Collecting mushrooms/fungi | Low | Moderate | Low | Not Significant |
| Food: collection of herbs | Low | Moderate | Low | Not Significant |
| Food: Fishing | Low | High | Low | Not Significant |
| Food: Hunting | Low | Moderate | Low | Not Significant |
| Crop cultivation | High | High | Medium | Not Significant |
| Livestock rearing | High | High | Medium | Not Significant |
| Drinking water | Essential | Moderate | Critical | Not Significant |
| <i>Cultural Services</i> | | | | |
| Cultural heritage sites of importance | High | Low | Medium | Minor |
| Traditional practices and activities | Low | High | Medium | Not Significant |
| <i>Regulating Services</i> | | | | |
| Erosion control | High | Moderate | High | Not Significant |
| <i>Supporting Services</i> | | | | |
| Nutrient cycling processes | High | Moderate | High | Not Significant |
| Soil formation processes | High | Moderate | High | Not Significant |

6.0 CONCLUSION

The Ecosystem Service Impact Assessment has identified that a number of provisional services are used by the local human population but that these remain low with only a few individuals concerned using a number of natural resources in the immediate Project impact area. The Project is located adjacent to other alternative areas of similar natural habitat which therefore provides alternative solution within a comparatively small distance. It is not envisaged that any displacement will occur of people seeking natural resources in areas where existing other villages or towns are also collecting, thereby potentially increasing competition and possibly tension.

Cultural, Archaeological, Aesthetic and recreational values are all addressed in depth in the SIA and the reader should refer to this report for a final statement. In addition, in reference to mine Provisioning (Freshwater, Soil) and Regulating (Erosion) services other Project documentation details full mitigation approaches and residual impacts (e.g. Mine Water Management Plan, Closure Plan etc). Further information is also available in the Traffic Management Plan in reference to people and animal (cattle, sheep, goats etc.) crossings.

7.0 REFERENCES

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APPENDICES



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APPENDIX A

Screened-out Ecosystem Services

Preliminary Assessment – screened out ES

Minor Ecosystem Service impacts include two provisional services and one regulating.

Table A-1: Screened out minor Ecosystem Services.

| Service provided | Ecosystem Service type | Description |
|---|------------------------|---|
| Timber | Provisioning | Practiced by artisanal loggers and by local communities requiring timber for construction of buildings. |
| Honey harvesting | Provisioning | Practiced by individuals in local villages requiring rural areas consisting of woodland and semi-natural habitats but not economically important to anyone. Bee hives can be relocated with little trouble and would often be moved to new areas. |
| Forest habitats acting as disease and pest regulators | Regulating | Areas of high value forest habitat types assist in reducing disease and pests e.g. bats feeding on mosquitoes. |

Those identified as **Not Significant** in terms of ecosystem impacts include one regulating service.

Table A-2: Screened out non-significant Ecosystem Services.

| Service provided | Ecosystem Service type | Description |
|--|------------------------|---|
| Tortoise harvesting | Provisioning | Tortoise have been targeted for collection by some local people. It's a prohibited activity by Bulgarian Law. Specific actions to protect these threatened species have already occurred with off-setting of an area with semi-protection and monitoring. A Tortoise Action Plan has also been prepared which will include developing educational plans and working with volunteers in order to steer existing users away from this activity. |
| Forest habitats as regulators of air quality | Regulating | See main SIA and report on Forests and Greenhouse gases (e.g. CO ₂). |