Biodiversity Action Plan for Amulsar, Armenia

Prepared for:

Lydian International

By:

Chancery Cottage, Kentisbeare, Cullompton, Devon, EX15 2DS, UK. Tel. +44 (0)1884 266694. www.treweek.co.uk.

CONTENTS

APPENDICES

GLOSSARY OF ACRONYMS

Amulsar	Amulsar Open Pit Gold Mine Project
BAP	Biodiversity Action Plan
BBOP	Business and Biodiversity Offset Programme
BMP	Biodiversity Management Plan
BOMP	Biodiversity Offset Management Plan
EBRD	European Bank for Reconstruction and Development
ESIA	Environmental and Social Impact Assessment
ESMS	Environmental and Social Management System
IFC	International Finance Corporation
Lydian	Lydian International Ltd
NCHA	Natural and Critical Habitat Assessment
NNL	No net loss (of biodiversity)
PR	Performance Requirement (of EBRD)
PS	Performance Standard (of IFC)
TEC	Treweek Environmental Consultants

1 Introduction

1.1 Purpose of this document

This Biodiversity Action Plan (BAP) is one of several documents that have been produced as an outcome of the Environmental and Social Impact Assessment (ESIA) for Lydian International Ltd's (Lydian) Amulsar Open Pit Gold Mine Project in Armenia (hereafter referred to as "Amulsar" or "the Project"). The BAP describes the actions to be taken by Lydian to ensure that the Project complies with financial lender requirements related to biodiversity and ecosystem services as well as its own Biodiversity Policy.

The BAP is designed to adhere to the definition provided by the International Finance Corporation (IFC), and sets out "*biodiversity-related actions that need to be carried out by a company to fulfil the needs of a particular requirement, request or expectation (e.g., Lender compliance, legal requirement, stakeholder concerns). BAP are often developed when there are information gaps in a project's ESIA or its ESMS*"[1].

In the case of the Amulsar Project, the BAP includes actions to be taken before, during and after the main phases of Project implementation on the ground, including several actions needed to address information gaps relating to priority biodiversity features affected by the Project.

1.2 Goals and objectives

Lydian aims to achieve no net loss (NNL) of biodiversity and to ensure that biodiversity and ecosystem functions are not systematically degraded or lost from the landscape as a result of the Amulsar Project. This means that species occurring in the Project's area of influence should have the same chances of long-term survival with the Project in place as without it, and have access to similar amounts of suitable habitat as in the baseline situation.

Lydian is also committed to compliance with the International Finance Corporation's Performance Standards on Environmental and Social Sustainability (IFC PS) and the European Bank for Reconstruction and Development's Performance Requirements (EBRD PR), as a result of which the Project also aims to achieve net gain of biodiversity with respect to impacts on critical habitat.

[1] From Annex A to Guidance Note 6 to the IFC Performance Standards on Environmental and Social Sustainability, 2012

The approach to achieving the above objectives is based upon application of the mitigation hierarchy, which seeks preferentially to avoid impacts, or if this is not possible to reduce them and/or restore the baseline afterwards. The final option, when application of these measures is insufficient to deliver NNL or net gain as appropriate, is to compensate for the loss or deliver net gain by establishing an offset.

The measures required to meet the Project's objectives related to biodiversity and ecosystems are defined in the ESIA. This BAP describes how the measures will be implemented to comply with national laws and policies and lender requirements relating to biodiversity and ecosystem services.

1.3 Legislative, Regulatory and Policy Framework

The Amulsar Project must comply with several laws, regulations, and policies and standards relating to biodiversity. These include the national laws of the Republic of Armenia (RA); the requirements and policies of potential financial lenders to the Project including the IFC and the EBRD; and Lydian's own policies.

1.3.1 Armenian Law

The main legislation relating to biodiversity and ecosystems in RA is as follows:

- Law on Conservation and Use of Fauna, 1981
- Law on Protected Areas, 1991
- The Forest Statute, 1994
- Law on Environmental Impact Assessment, 1995
- Law on Nature Protection and Payments for Use of Natural Resources, 1998
- The Law of the RA “On specially protected natural areas”, 2006
- The Law of the RA "On flora”, 1999
- The Law of the RA "On fauna” 2000
- The RA Mining Code enacted in 2012
- The Decree № 781-N “On Establishing the Procedure for Conservation of Facilities of Flora of the Republic of Armenia and Their Use for Reproduction Under Natural Conditions", issued in August 2014.

The implications and requirements of these laws and regulations are discussed in the Amulsar ESIA.

1.3.2 Lender Policies, Requirements and Standards

The Project is committed to compliance with IFC PS6 and EBRD PR6, both titled "Biodiversity Conservation and Sustainable Management of Living Natural Resources". The main implications for the Project's adherence to PS6 and PR6 are addressed in the ESIA, and particularly in the Natural and Critical Habitat Assessment (NCHA), which is appended to the ESIA as Appendix 4.10.3. IFC PS6 and EBRD PR6 are broadly equivalent in aim but have some differences, notably the fact that EBRD PR6 requires the Project to comply with the spirit or intent of the European Union (EU) Habitats Directive, the implications of which are discussed in the NCHA.

1.3.3 Lydian Policy

Lydian and its Armenian subsidiary Geoteam aim to achieve "no net loss" (NNL) of biodiversity and to ensure that biodiversity and ecosystem functions are not systematically degraded or lost from the landscape as a result of the Amulsar Project. This means that species occurring in the Project's area of influence should have the same chances of long-term survival with the Project in place as without it; and have access to similar amounts of suitable habitat as in the baseline situation.

1.3.4 Other Guidelines and Standards

Reference has been made to guidance on BAPs produced for the mining and oil and gas sectors (ICMM and IPIECA, 2005) and the Guidance Notes accompanying IFC PS6 (IFC, 2012). The Business and Biodiversity Offset Programme (BBOP) standard (www.forest-trends.org) will be used as the basis for design and implementation of offsets required to compensate for residual adverse effects.

1.4 Overview of Biodiversity Affected by the Project

The ESIA identifies the following biodiversity components that will be affected to some degree by the Project and for which mitigation and/or monitoring is required:

- Extensive areas of natural habitat including Sub-alpine Meadows, Sub-alpine Meadows with Alpine Elements, Montane Meadows, Montane Meadow Steppes and Vegetation with Shrubs. There are also several animal species associated with this natural habitat, notably Brown Bear, several species of bird and some species of reptile that are included in the RA Red Book. In addition to restoration planning, the Project is taking the precautionary approach of committing to establish an offset to compensate for the loss and degradation of natural habit as a result of the Project.

- Tier 1 critical habitat for the RA-designated Critically Endangered endemic plant *Potentilla porphyrantha*. The Project mitigation strategy aims for net gain with respect to this species.
- Critical habitat for *Ursus arctos* (Brown Bear), which is included in the RA Red Book and is a protected species under the EU Habitats Directive, the spirit of which is being followed by the Project. The Project mitigation strategy aims for net gain with respect to this species.
- Breeding, foraging or hunting habitat for several bird species, some of which are listed in the RA Red Book and some of which are also threatened at a global level (the latter include Egyptian Vulture and Saker Falcon).
- Habitat for nationally important reptile species.

In addition, the Project will affect land providing a variety of ecosystem services, including some considered to be "Priority Services". These include freshwater for drinking, domestic use and crop irrigation, and production of meat, milk and dairy products from livestock. Much of the Project area has been used traditionally for grazing livestock and production of hay, and the Project affects land traditionally used by seasonal and local herders, as well as being used for collection of mushrooms, herbs and medicinal plants by local communities. Residents of Gndevaz are particularly affected.

1.5 The BAP and its Relationship with Other Documents

The BAP describes the actions to be taken by Lydian to ensure that the Project complies with financial lender requirements as well as its own Biodiversity Policy and Armenian legislation. It comprises a summary table (Section 2) and the following appended documents:

- **Species Action Plans (SAPs)** - these have been produced for two threatened species, *Potentilla porphyrantha* and *Ursus arctos* (Brown Bear), which have critical habitat affected by the Project and for which further research work is needed before the Project mitigation strategy can be finalised.
- **Biodiversity Offset Strategy (BOS)** - this develops the outline strategy as described in Chapter 6.11 of the ESIA. The strategy will form the basis for a Biodiversity Offset Management Plan (BOMP), setting out management actions needed to implement the Project's Natural Habitat Offset, offsets for impacts on *Ursus arctos,* and further offsets if needed for *Potentilla porphyrantha*.

There are two other documents, related to the BAP, that cover elements of the Project's approach to biodiversity and ecosystems management:

- Biodiversity Management Plan (BMP) - this describes all the biodiversity-related actions to be undertaken by Lydian and its contractors as part of the design, construction, operation and closure of the Project. It details the practical actions to be undertaken during the implementation of the mining operation, along with responsibilities, timeframes and monitoring requirements. It is designed mainly for use on site during construction and operations, although it also covers a number of commitments that relate to the pre-construction, detailed Project design stage.
- Biodiversity Monitoring and Evaluation Programme (BMEP) - this will set out the plan for monitoring biodiversity to ensure and demonstrate that the Project's commitments - to NNL in natural habitat and net gain in critical habitat - are met. Details of the BMEP depend on the results of the further research to be undertaken as part of the BAP, and therefore it will be produced at a later date.

There is necessarily some overlap between some of the documents - notably the BMP and SAPs - and also between the above documents and others produced as a result of the ESIA, notably the Commitments Register and Environmental Monitoring Plan.

2 Biodiversity Action Plan

The BAP comprises the following table and a set of supporting appendices. It is a "live" document that will be enhanced and revised as appropriate throughout the Project.

ID	Topic/Aspect	Action	Completion Indicator(s)	Timeframe	Completion Status	Reference
Natural Habitat						
1	Avoidance of impacts	Set-aside includes good quality Sub-alpine Meadow habitat supporting critical habitat trigger species (see below) and other species including alpine birds. Also includes hibernation/breeding dens used by Brown Bear associated with natural habitat.	Set-aside established with commitment not to mine or disturb.	Throughout mine life unless and until it can be proved that the set-aside is not essential to achieve net positive impact on Tier 1 critical habitat for *P.porphyrantha* or critical habitat for Brown Bear.	Nominal boundary - to be confirmed with stakeholders	ESIA BMP
2	Avoid and minimise impacts	Implement a suite of measures during detailed Project design, construction and operation via the Biodiversity Management Plan (BMP) to avoid incidental damage during construction and operation to natural habitats remaining in and around working areas. This will include careful marking and signposting of sensitive areas and will be supported by training, awareness-raising and toolbox talks.	Reporting as per BMP BMP includes provision for avoiding damage to natural habitat. Training materials prepared Training and awareness-raising, toolbox talks and site initiations refer to sensitivity of natural habitat	Throughout mine life	Open	BMP

ID	Topic/Aspect	Action	Completion Indicator(s)	Timeframe	Completion Status	Reference
3	Avoid and minimise impacts associated with traffic and transport	Make provision within the Transport Management Plan to minimise and manage off-road driving and control vehicle speeds throughout the Project-affected area and on State and Community lands visited by Project personnel. Ensure that provision is made for toolbox talks, awareness raising and training for drivers.	Transport Management Plan makes provision for management of off-road driving. Training is given to new drivers to alert them to sensitivities Reporting as per BMP	Throughout mine life when new drivers are recruited	Open	BMP Transport Management Plan
4	Restore natural habitat types	Progressive on-site restoration of vegetation to the extent possible, with supporting field trials and development of protocols. This will include definition of reference communities so that restoration targets are clearly established. Final restoration at mine closure.	Annual restoration reports	Throughout mine life	Open	BMP pMRCMP
5	Topsoil stripping, storage and management to support restoration of natural habitat types	Strip topsoil to a depth of 10cm and store separately from remaining topsoil to retain a soil seed bank for use in progressive restoration of natural habitats. Develop procedures for topsoil stripping and storage for inclusion in the Footprint Management Plan (FMP) that ensure maintenance of a viable seedbank. Store appropriately, in accessible locations.	FMP specifies requirements for natural habitat restoration			BMP FMP
6	Adequate seed of native species for restoration	Collect seed annually for storage in the seed bank facility.	Annual restoration reports	Ongoing	Open	BMP pMRCMP
7	Surveys needed to design natural habitat offset	Surveys of potential offset locations in proposed Jermuk National Park to establish gains potentially achievable and to provide data on habitat types and condition needed for loss/gain calculations. This will include surveys for Red Book Birds affected by the Project to establish whether suitable conservation actions are possible as part of the planned restoration activities for natural vegetation types.	Survey report	February 2016	Initial baseline surveys completed	BOS
8	Credible metrics and loss/gain calculations underpin offset	Complete loss/gain calculation for natural habitat offset and an associated Net Positive Impact forecast.	Final BOS	Q2 2016	Open	BOS

ID	Topic/Aspect	Action	Completion Indicator(s)	Timeframe	Completion Status	Reference
9	Suitable offset location identified	Identify alternative offset options and select a preferred option, taking account of ecological suitability (e.g. in terms of ecological equivalence) and practical implications for implementing suitable management.	Interim brief report on alternatives submitted for lender review	Q4 2016	Open	BOS
10	Finalise Offset design	Develop a Biodiversity Offset Management Plan (BOMP) based on loss/gain calculations, including detailed offset design and preliminary management recommendations.	Draft BOMP submitted to lenders for review Final submitted to lenders for review	Q1 2017 Q2 2017	Open	BOMP
11	Offset implementation	Implement natural habitat offset.	BOMP	2016	Open	BOMP
Critical Habitat						
12	Avoidance of impacts on critical habitat	Project design avoids natural and critical habitat to the extent possible, including avoidance of impacts on Gorayk IBA and some confirmed supporting habitat. Some impacts on natural habitat and on 30% of *Potentilla porphyrantha* plants are unavoidable due to overlap with mine pits.	ESIA reflects adherence to the mitigation hierarchy.	Pre-construction	Closed for preliminary design Open for detailed design	ESIA ESIA addendum
13	Set-aside to maintain viable proportion of *Potentilla porphyrantha* sub-population	Set-aside includes part of the *Potentilla porphyrantha* sub-population, considered likely to remain viable for the duration of the Project, plus Brown Bear dens.	Set-aside established with agreement not to disturb or mine.	Throughout mine life unless and until it can be proved that the set-aside is not essential to achieve net positive impact on Tier 1 critical habitat for *P.porphyrantha* or critical habitat for Brown Bear.	Nominal boundary - to be confirmed with stakeholders	ESIA BMP SAPs
14	Permitting for translocation of *Potentilla porphyrantha*	Obtain necessary permits or approvals for translocating Potentilla porphyrantha from Amulsar to research facilities and botanic gardens in collaboration with the Institute of Botany.	Letter of approval obtained from MNP	Q2 2015	Closed	SAP for *Potentilla porphyrantha*

ID	Topic/Aspect	Action	Completion Indicator(s)	Timeframe	Completion Status	Reference
15	Translocation procedures	Develop detailed translocation protocols in partnership with the Institute of Botany.	Translocation protocols developed and agreed with the MNP.	Q2 2015	Closed	SAP for *Potentilla porphyrantha*
16	Translocation of plants from mine pits	Remove plants at a suitable season under supervision by Lydian botanist and the IoB according to the agreed procedure. Transport to agreed locations with suitable growth medium and in temperature controlled conditions. Survival to be monitored through the SAP	Programme completed.	To be confirmed	Closed	SAP for *Potentilla porphyrantha*
17	Develop Species Action Plans (SAPs)	Develop SAPs for *Potentilla porphyrantha* and *Ursus arctos* (Brown Bear), detailing additional work required to complete mitigation strategy and achieve Net Positive Impact.	SAPs published	Early 2015	Closed	SAPs
18	Update SAPs	Update SAPs based on new information and progress in implementation	SAPs Updated	Annually	Ongoing	SAPs
19	Implement SAP for *Potentilla porphyrantha,* adaptive management	Implement actions in *Potentilla porphyrantha* SAP in line with programme. SAP to be reviewed based on monitoring results, in place initially till 2018.	SAP completion indicators are met	2015 - 2018	Ongoing	SAP for *Potentilla porphyrantha*
20	Implement SAP for *Ursus arctos*	Implement Brown Bear SAP.	SAP completion indicators are met	2015 -onwards	Open	SAP for *Ursus arctos*
21	Review impacts on *Ursus arctos*	Impacts on *Ursus arctos* will be reviewed following completion of baseline surveys. Actions needed will be discussed with lenders. The BMP will be amended accordingly and offset proposals developed for inclusion in the BOMP as appropriate (see below)	Update to lenders	Q1 2016, with final results and interpretation due April 2016.	Closed	BMP BOS/BOMP
22	Minimise impacts	Implement a suite of measures during detailed Project design, construction and operation via the Biodiversity Management Plan (BMP).	Reporting as per BMP	Throughout mine life	Open	BMP

ID	Topic/Aspect	Action	Completion Indicator(s)	Timeframe	Completion Status	Reference
23	Restore *Potentilla porphyrantha* post-impact and increase numbers of plants on Amulsar	For *Potentilla porphyrantha*, establish a research programme in partnership with RA NAS Institute of Botany and Cambridge University Botanic Garden to test techniques for propagation and improve knowledge of ecological requirements. This is needed to underpin restoration plans and will provide the basis for restoring plants to suitable habitat on mine closure. Brown Bear requirements TBC following further surveys.	Detailed restoration plan developed based on research	2015 - 2019	Open	*Potentilla porphyrantha* SAP pMRCRP Brown Bear SAP
24	Offset for *Potentilla porphyrantha* and *Ursus arctos*	Based on survey and monitoring proposed in this BAP, review the need for offsets for these species and develop proposals for inclusion in the BOS/BOMP as needed to ensure NPI. These will be submitted for lender review and discussion.	Update to lenders	2015 - 2019	Open	SAPs BOS/ BOMP
Ecosystem Services						
25	Ecosystem services	The Project's impact on ecosystem services is uncertain and is to be addressed through continued stakeholder engagement and monitoring, with actions taken if necessary depending on the results. Further focus group meetings planned to discuss suitable monitoring arrangements and review concerns	SEP makes provision for ongoing engagement	Throughout mine life	Open	SEP BMP
Stakeholder engagement						
26	Set-aside for *Potentilla porphyrantha* and *Ursus arctos*	Provisional boundaries have been established. The boundary of the set-aside and implications for access by communities need to be confirmed with local government and land-users, particularly villages that have traditionally used that area. Local communities and other land users also need to be made aware of the purpose of the set-aside and its sensitivities. This will be done with the assistance of Lydian's Community Liaison Officers.	Set-aside agreed and established SEP makes provision for community engagement and awareness raising	Initial consultation Mid-2015; follow-up consultation Mid-2016	Open	SEP
27	Natural habitat offset: new National Park at Jermuk	Consultation and engagement with the Ministry of Nature Protection is needed to ensure that a new National Park can be established at Jermuk. Engagement will also be needed with the municipality and potentially with local tourism operators. Consultation on establishing the offset as part of Jermuk National Park is required with the Ministry of Nature Protection, local government, local communities and herders, and NGOs.	Final BOS SEP makes provision for necessary engagement	Q2 2016	Open	BOS

ID	Topic/Aspect	Action	Completion Indicator(s)	Timeframe	Completion Status	Reference
28	Capacity building, awareness raising and collaboration with Armenian scientists and institutions related to restoration activities, translocation methods.	Ongoing interaction will be sought with the NAS RA Institute of Botany, Yerevan Botanic Garden and other scientific institutions in Armenia with an interest in vegetation management, habitat restoration and plant translocation.	Records of meetings and events	Ongoing	Open (initiated)	SEP, SAP for *Potentilla porphyrantha*
29	Red listing process *Potentilla porphyrantha*	Following the further surveys in the area to establish whether the species is under-surveyed in Armenia, it is intended to liaise with IUCN to undertake a formal assessment of the conservation status of the species.	Formal assessment submitted to IUCN	To be confirmed	Open	SAP
30	Capacity building and engagement on biodiversity offsets	A programme of capacity building will be developed to ensure that the Government of Armenia is aware of the purpose of offsets and relevant standards and requirements.	Final BOS SEP makes provision for necessary engagement	2015	Open	SEP
31	Independent oversight and advice	Lydian is considering the establishment of an independent biodiversity advisory group and will work with Project lenders to develop possible terms of reference.	Options discussed with lenders	2017	Open	
32	Ecosystem services	Continued engagement with local herders and communities, particularly Gndevaz, is necessary to monitor any impacts on ecosystem services and to identify any unforeseen impacts on benefits from ecosystem services.	Included in SEP	Ongoing	Open	SEP LALRP
Resources and facilities						
33	Restoration of natural habitat	Establish a plant nursery and develop a seed bank for native species to develop stocks of propagules for use in restoration. This will be located in local villages which already have tree nurseries established	Nursery & seed bank facilities established	Q2 2016	Open	BOS BMP

ID	Topic/Aspect	Action	Completion Indicator(s)	Timeframe	Completion Status	Reference
34	Supporting effective translocation	Establish suitable facilities for translocation including any staging or temporary housing for plants following removal from the Mountain and pending transport to other facilities, due to large numbers of plants, possibility of unsuitable climatic conditions and challenge of coordinating transport to avoid damage or mortality of plants.	Facilities in place and approved by the MNP	Q2 2015	Closed	SAP
35	Capacity Building for science, research and public engagement in conservation of Caucasian Plants	Contribute to development of research facilities, glasshouses, botanic gardens and public gardens and collaborate with the IoB to design and construct them	Facilities in place and approved by the MNP	Q4 2015	Closed	SAP for *Potentilla porphyrantha*
36	To implement BMP + BAP	Maintain sufficient staffing in the company or through consultancy support to implement the BMP and BAP and monitor their implementation. Staff should be suitably qualified to oversee site activities and support an adaptive management approach to activities such as progressive restoration.	Staff or consultancy support in place	Ongoing	Open	BMP BAP

Species Action Plan for *Potentilla porphyrantha* – Appendix 1 of the Biodiversity Action Plan for the Amulsar Gold Project

Prepared for:

Lydian International

By:

Treweek Environmental Consultants

CONTENTS

GLOSSARY OF ACRONYMS

AOO	Area of Occupancy
BAP	Biodiversity Action Plan
BMP	Biodiversity Management Plan
BOMP	Biodiversity Offset Management Plan
EBRD	European Bank for Reconstruction and Development
ESIA	Environmental and Social Impact Assessment
ESMS	Environmental and Social Management System
Geoteam	Geoteam CJSC (an Armenian mineral exploration and development company)
IFC	International Finance Corporation
IoB	Institute of Botany of the National Academy of Sciences, RA
IUCN	International Union for the Conservation of Nature
Lydian	Lydian International Ltd
masl	metres above sea level
NCHA	Natural and Critical Habitat Assessment
NPI	Net Positive Impact
Project	Amulsar Open Pit Gold Mine Project
SAP	Species Action Plan
TEC	Treweek Environmental Consultants
UCBG	University of Cambridge Botanic Garden
WAI	Wardell Armstrong International
WWF	World Wide Fund for Nature - Armenia

SUMMARY

This Species Action Plan (SAP) for *Potentilla porphyrantha* Juz. forms part of the Amulsar Gold Project's Biodiversity Action Plan (BAP). It summarises the actions pertinent to the species to be implemented to comply with the outcomes of the Project Environmental and Social Impact Assessment (ESIA). A summary table of actions is provided with responsibilities and completion indicators identified.

P. porphyrantha is listed as Critically Endangered in the Armenian Red Book. Amulsar Mountain supports one of only five known sub-populations globally, and has Tier 1 critical habitat for this species based on the criteria included in IFC Performance Standard 6 (IFC PS6). As such, the Project is required to demonstrate a net gain in the population of the species to be compliant with Project lender standards.

Despite measures to avoid or minimise damage to plants, the Project will remove approximately 21% of the total number of plants at Amulsar. Further impacts may occur due to fugitive dust and changes in microclimate. Specialists consider that even without a reintroduction programme a viable population would remain on Amulsar; but conservation actions are needed to achieve a net gain, whether in numbers of plants or the area occupied by the population.

For *P. porphyrantha* to retain a viable population on Amulsar Mountain, recover to its 2013 population size and increase beyond this in a 'reasonable' time after the mining has been completed, the SAP includes the following measures:

1. Protect plants within a set-aside around Arshak Peak and those growing on rocks around the mine pits.

2. Develop a detailed plan for on-site monitoring during Project construction and operation, to be included as part of the Project Biodiversity Monitoring and Evaluation Programme (BMEP).

3. In partnership with the Institute of Botany of the National Academy of Sciences of the Republic of Armenia (IoB), establish growth facilities for experimental work on the ecology of the species and on propagation methods at the Sevan Botanical Garden and on Amulsar.

4. Translocate plants that would otherwise be destroyed by mining for purposes of rescue and research

5. Develop stocks of propagules needed for re-introduction to restored conditions on Amulsar or to support ongoing research as outlined in (6) below.

6. Implement a research programme between the IoB, and the University of Cambridge Botanical Garden (UCBG) to explore the ecological characteristics of the species.

7. Develop a detailed net positive impact (NPI) forecast for *P. porphyrantha* based on the validated population model developed as part of (6) above. This will include estimates of likely recovery times for the Amulsar population under different scenarios.

8. Develop a detailed restoration plan, to include design or specification of habitat conditions needed for the plant to be reintroduced post-mining, specification of numbers and type of propagules, a reintroduction programme, and protocols for follow-up monitoring.

9. Create required habitat conditions on the back-filled mine pits.

10. Undertake further searches for other populations of the species in Armenia in case offsets are needed as part of a precautionary approach.

11. Undertake stakeholder engagement and capacity building for research, education and public awareness-raising with regard to Caucasian plants, through collaboration between the IoB and UCBG.

1 Introduction

1.1 Purpose and content of this document

Lydian International (Lydian) commissioned Treweek Environmental Consultants (TEC) to develop a Species Action Plan (SAP) for the population of *P. porphyrantha* that will be affected by Lydian's Amulsar Open Pit Gold Mine Project (the Project).

The SAP for *P. porphyrantha* (this document) forms part of the Amulsar Project's Biodiversity Action Plan (BAP), which is an output of the Project Environmental and Social Impact Assessment (ESIA) and details all the actions needed to comply with potential Project lender requirements relating to biodiversity. Specialist input has been provided by Dr Peter Carey (University of Cambridge) and Professor George Fayvush from the Institute of Botany (IoB) of the National Academy of Sciences of the Republic of Armenia (NAS RA).

The alpine plant species *P. porphyrantha* Juz. is listed as Critically Endangered (CR) in the Armenian Red Book (criteria D 1 ab(iii) + 2 ab(iii)) based on an area occupied in Armenia of less than 10 km^2. Assessment against International Union for the Conservation of Nature (IUCN) criteria suggests it would be listed as Endangered (EN) by IUCN, though the species has not yet been formally assessed. In 2012 Amulsar Mountain supported one of five known sub-populations of the species globally, three of which were in Armenia, and has Tier 1 critical habitat for the species based on criterion 1b included in the International Finance Corporation's Performance Standard 6 (IFC PS6), i.e. "*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*". Amulsar Mountain is also critical habitat for the species according to the European Bank for Reconstruction and Development's Performance Requirement 6 (EBRD PR6).

In the event of significant residual impacts, IFC PS6 and EBRD PR6 require a net gain to be demonstrated for those biodiversity features which will lose critical habitat. Based on specialist advice, the Project ESIA concluded that a sustainable and viable population of *P.porphyrantha* was likely to remain on Amulsar, but that there would be at least a temporary decline in numbers of individuals due to their coincidence with the mine pits. The Project intends to create suitable conditions to reinstate plants to the mine pits post-mining, but because a restoration programme has not been attempted for this species before, the SAP includes research and experimental work to confirm the best approach for achieving a net gain in population size within a "reasonable timeframe".

The remainder of Chapter 1 provides background information on *P. porphyrantha* (Section 1.2) and the legislative, regulatory and policy framework for the SAP (Section 1.3).

The rationale for actions to be taken to achieve a Net Positive Impact on the species in Armenia is presented in Section 2.

The SAP is presented in Section 3.

1.2 *Potentilla porphyrantha*: background on conservation status and habitat requirements

1.2.1 Description

P. porphyrantha is a small alpine plant with grey-green, hairy, toothed leaves and purple/pink flowers (see also Appendix A for a more detailed botanical description and a summary of its taxonomy). At Amulsar, plants flower in June and July and are approximately 15mm across (Figure 1).

Figure 1 *Potentilla porphyrantha* plant (50mm lens cap for scale)

1.2.2 Conservation Status in Armenia

P. porphyrantha is a restricted range endemic plant listed in the Armenian Red Book of Plants (2010) as Critically Endangered for the categories 1 ab (iii) + 2 ab (iii), which means:

> *The extent of occurrence of the species in Armenia is less than 100 sq. km. It is strongly fragmented. Continuous reduction of the area, length and/or quality of habitat has been identified based on the observations, conclusions or forecasts.*
>
> *The habitat of this species in Armenia is less than 10 sq. km. It is strongly fragmented. The likelihood of continuous reduction of the area, length and/or quality of habitat has been identified based on observations, conclusions or forecasts*.

The Armenian Red Book of Plants includes another species, *Potentilla cryptophila,* which may be synonymous with *P. porphyrantha*. The geological and ecological requirements of both plants appear identical and the "USSR Flora" (Kaomarov 1985) suggests they are likely to be the same species, but this has not been confirmed through genetic testing. There is one known population of *P. cryptophila* in the Geghama Range (Figure 2), very close to one of the documented populations of *P. porphyrantha* in Armenia. The research programme to be undertaken through the SAP therefore includes review of the taxonomic status of *P. cryptophila*, and if *P. cryptophila* and *P. porphyrantha* are found to be synonymous, their status in the Armenian Red Book of Plants can be updated accordingly.

Factors affecting the future of *P. porphyrantha* in Armenia, mentioned in the Red Book of Plants are:

- Limited area of occurrence and habitat;
- Loss or degradation of habitats; and
- Global climate change, as they only occur in alpine conditions.

Necessary measures mentioned in the RA Red Book include searching for new habitats, monitoring the state of known populations and cultivation in botanic gardens as an ornamental plant. These actions all form part of this SAP.

1.2.3 Geographic Range and Distribution

The plant's status in the Armenian Red Book of Plants reflects records from two locations in northern Iran and two in Armenia (on the Geghama Range and on Mount Ishkhanasar) as well as an historic record from Nakhijevan. The new population of *P.porphyrantha* found on the ridge of Amulsar during baseline surveys in 2012 increased the number of populations in Armenia to three, as indicated on Figure 2. It also increased distribution of the species in

Armenia to 28 sq. km (based on the number of 2x2 km grid cells occupied). The two populations in northern Iran are assumed to occupy one 2 x 2 km square each, making the global Area of Occupancy (AOO) 32 km square.

In 2012 surveys of Amulsar, over 150 individuals of *P.porphyrantha* were found on rock masses and pillars between 2800-3000 metres above sea level (masl), a large proportion of plants being on the southern end of Amulsar Mountain, with a few outliers in the areas proposed for mining.

A second, more detailed survey was carried out in 2013 and 5,500 individuals were recorded, occurring down to a minimum altitude of 2450 masl (see Figure 3). More plants were also found in proposed mining areas. The population is considered to be over 7,500 plants in total, as some occur on inaccessible parts of the Mountain which are impossible to access without specialist climbing equipment and skills. The population includes plants of different ages, including seedlings and mature plants.

No population studies of *P. porphyrantha* had been undertaken in Armenia until the Amulsar surveys were carried out. The discovery of plants on Amulsar growing at 2450masl increases the altitudinal range and habitat that the species can be considered to potentially inhabit: previously, the lower altitude limit of the species was thought to be 3300masl. Based on this knowledge, other potentially suitable sites were identified and searched for the first time and additional plants were found on other mountain ridges in the Vayots Dzor Region of Armenia during further field investigations in 2013. These may form part of the Amulsar population. Two new sub-populations of *P.porphyrantha* were found during expeditions in Armenia in 2015 at previously unsurveyed locations. Poor weather made it impossible to carry out a detailed survey of all of the highest mountains where the species was recorded in the 20th Century (Figure 4,). Where surveys were possible at the 20th Century locations no plants were found. Further expeditions will take place in 2016 to improve knowledge of the distribution of the species in Armenia as it may be under-recorded.

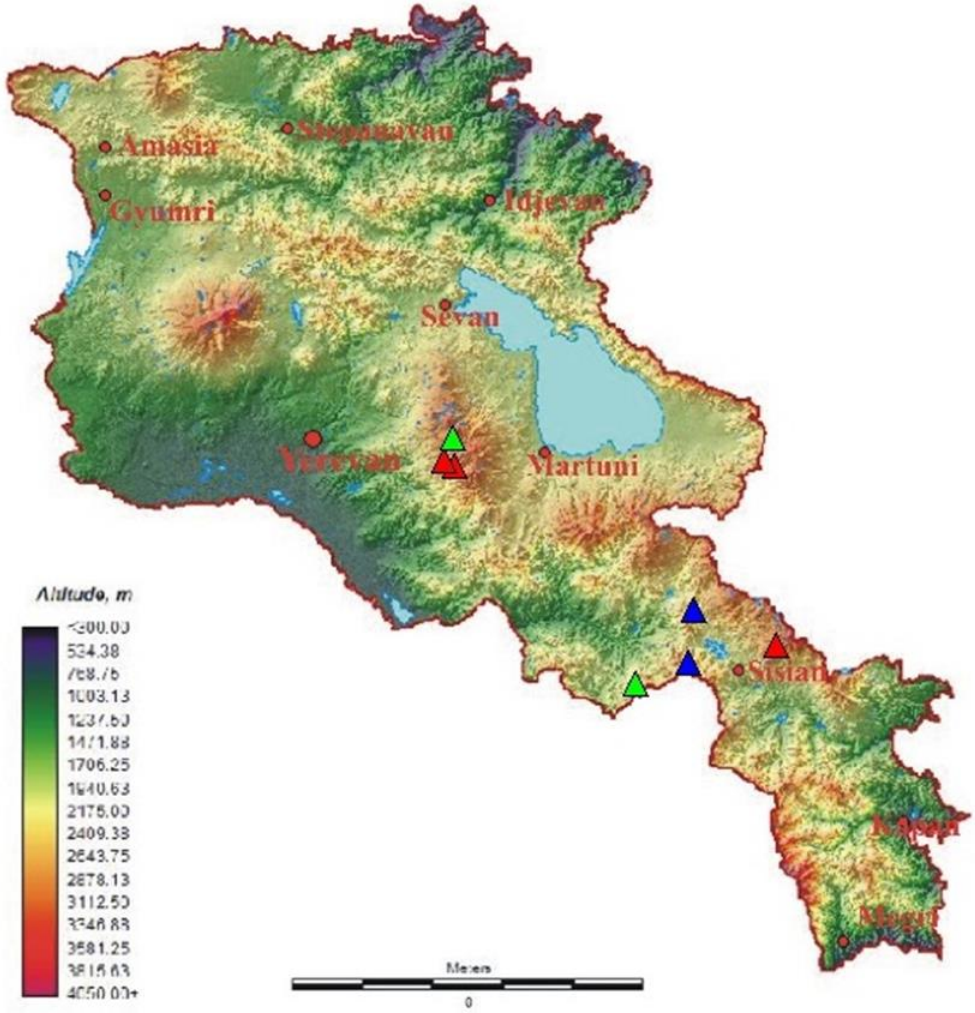

Figure 2 Occurrence of *Potentilla porphyrantha* and *Potentilla cryptophila* in Armenia. Red triangles – two populations of *P.porphyrantha*, previously known and listed in the Red Book of Plants of Armenia (2010), Blue triangles – two new populations identified during 2012 and 2013, Green triangles – known populations of *P. cryptophila (source IoB, Yerevan)*.

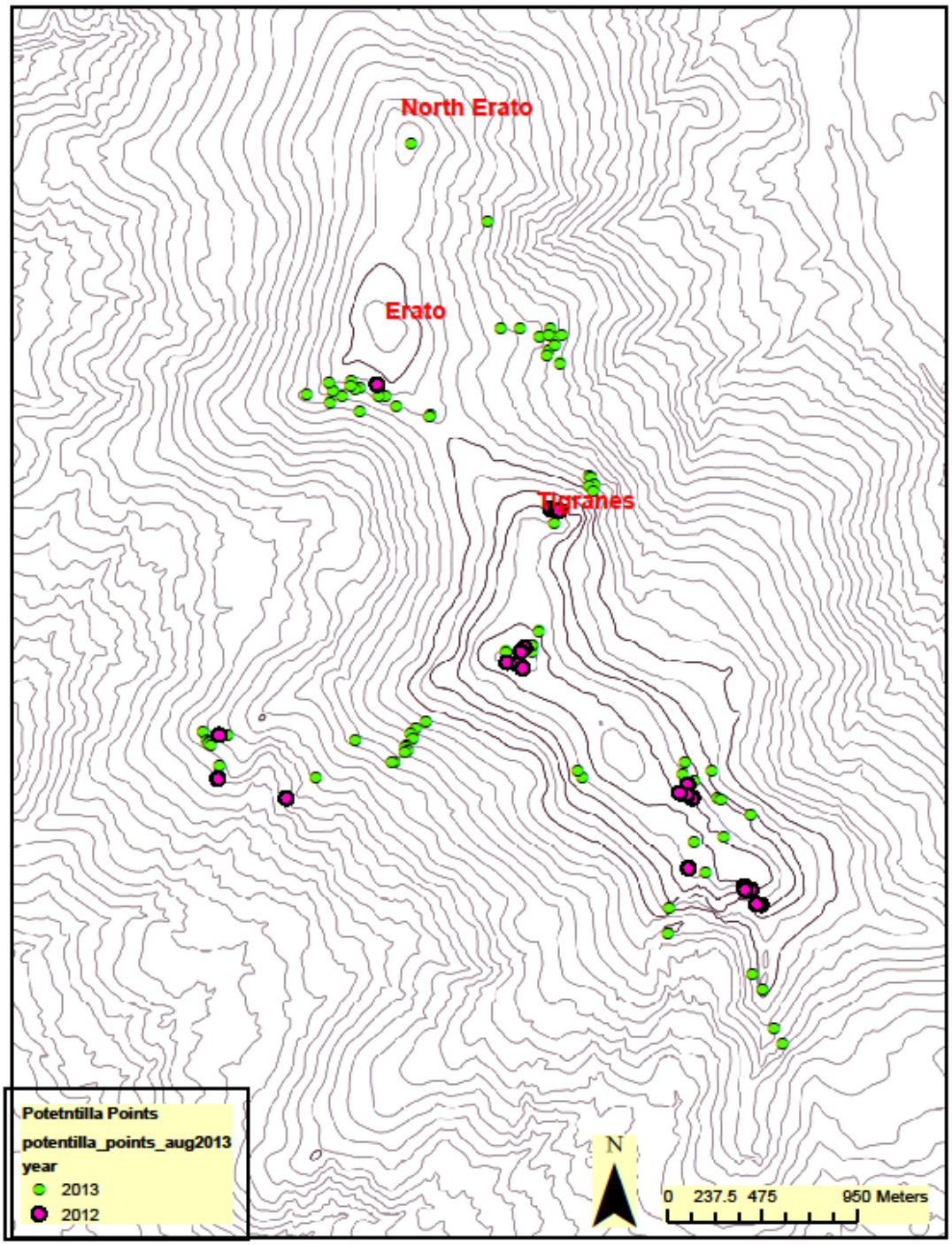

Figure 3. Distribution of *Potentilla porphyrantha* on Amulsar Mountain

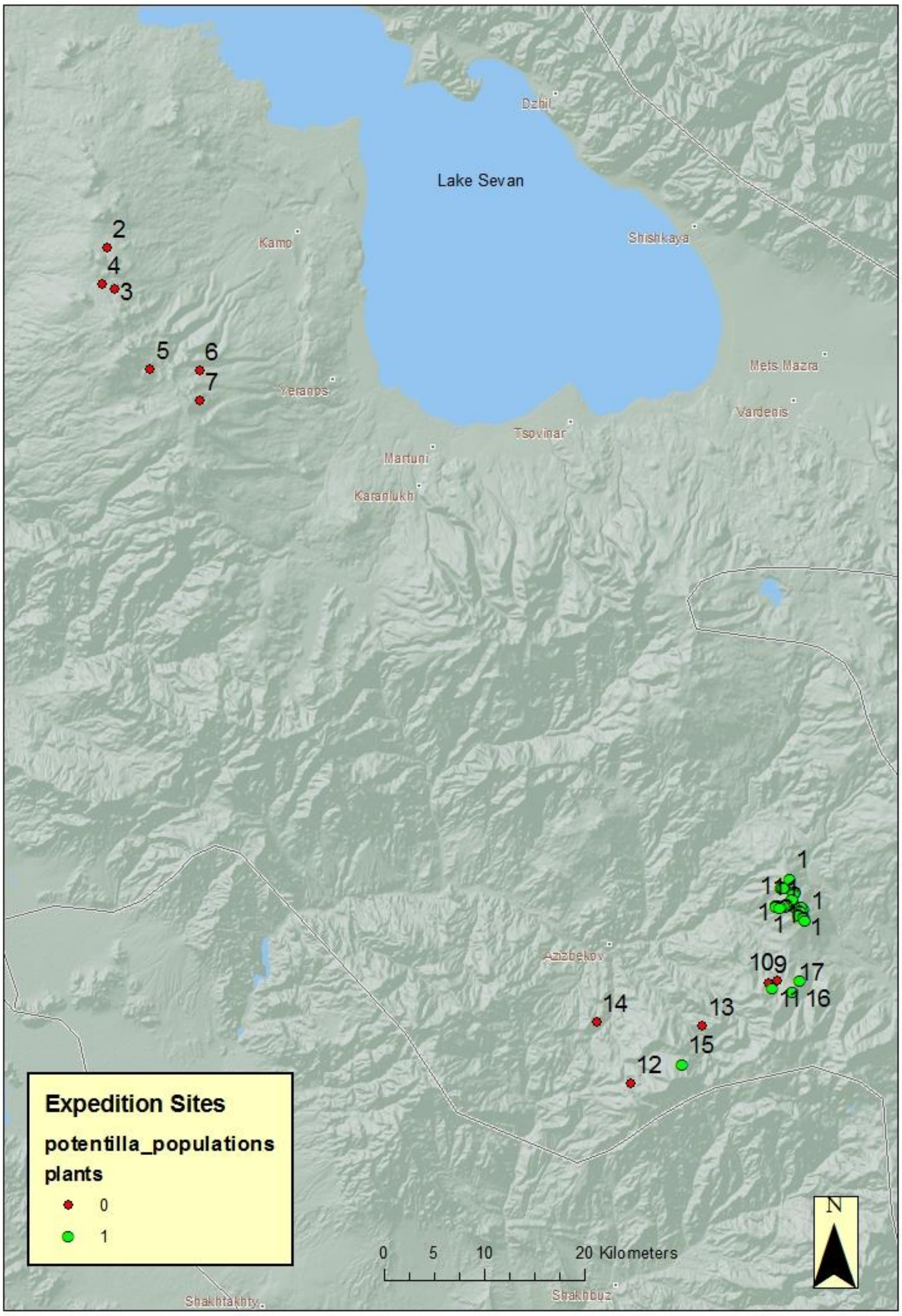

Figure 4. Position of expedition sites 2012-2015

Site No.	Date	Location name	East	North	Plants found (number)	Full search possible? (Yes/No)	Comment
1	2012-2015	Amulsar					
2	16.07.2015	area near Aknalich	493229	4462617	-	no	bad weather
3	20.07.2015	mountain Geghmavan	492715	4459004	0	yes	
4	20.07.2015	mountain Agudag	493969	4458609	0	yes	Need additional search on north slopes of mountain Agudag.
5	22.07.2015	mountain Grisar	497549	4450589	-	no	more slopes unreachable
6	24.07.2015	mountain Spitakasar	502525	4450481	0	yes	bad weather
7	26.07.2015	mountain Spitakasar	502521	4447506	0	yes	majority of slopes unreachable and the area is very big, west and south slopes to be checked
8	28.07.2015	mountain Archanoc	497080	4491590	-	no	
9	12.07.2015	mountain Gabur	560010	439715	0	yes	bad weather
10	14.07.2015	mountain Gabur	559099	4389538	0	yes	
11	16.07.2015	mountain Gabur	559508	4388946	81	yes	north slopes to be checked
12	9.08.2015	mountain near Martiros vil.	545370	4379538	-	no	
13	10.08.2015	mountain near Kapuit vil.	552498	4385255	-	no	
14	10.08.2015	mountain near Zaritap vil.	541994	4385619	-	no	
15	11.09.2015	mountain Gogi	550443	4381389	200	yes	eastern slopes, to be checked north slopes
16	2014	East of Gabur	562152	4389701	41	yes	
17	2014	East of Gabur	561494	4388628	24	yes	

Table 1. Sites searched for P. porphyrantha in Armenia

1.2.4 Habitat requirements

Although *P.porphyrantha* is widely cultivated in Russia, Europe and Northern America as an alpine mountain species, it is not always straightforward to propagate. Horticultural websites state that it survives well from seeds, though it grows very slowly. Armenia is listed as the provenance of these plants, but neither the Ministry of Nature Protection nor the Ministry of Agriculture of Armenia have given permissions for export of seed or planting stock of *P. porphyrantha* from Armenia. It is more likely that the plants grown in other countries are the progeny of a very few individuals taken from the wild. Garden plants currently being grown can therefore be expected to have relatively low genetic variation and cannot necessarily be considered representative.

Based on the results of studies carried out by the Project to date, *P. porphyrantha* can be considered to grow above 2450masl on large rock outcrops (Figure 5), relatively small boulders (Figure 6) and occasionally on scree (which incidentally is the listed habitat from Iran). It grows in small cracks and crevices and is often associated with the moss *Grimmia*. There is no obvious pattern in terms of the aspect that the plants face, but they are often found on the top of boulders or where they get a lot of sunlight. Cracks on the top of boulders and mosses will retain moisture which could be an important factor in supporting the plants of *P.porphyrantha*. The moss also provides a limited amount of humus which falls down into the cracks and provides a 'soil'.

P. porphyrantha is obviously a very stress-tolerant species and cannot tolerate competition from other species, growing almost completely apart from other vascular plants. The fact that it does not have dependence or associations with other plant species may simplify reintroduction. With some other species, such as members of the Orchidacae, much research and preparation is required to get the correct plant community structure and management in place before reintroduction is attempted. Although plant community structure can be discounted, there are many other edaphic factors (e.g. size of cracks in boulders and the presence/absence of moss or small amounts of soil) that require investigation *in situ* and *ex situ* before it will be possible to attempt reintroductions.

Figure 5 Examples of large rocky outcrops below Arshak where *P. porphyrantha* was found in 2012.

Figure 6 Small Boulder with 50 plants of *P.porphyrantha.*

1.3 Legislative, Regulatory and Policy Framework

1.3.1 Armenian Law

Legislation relating to *P. porphyrantha* in the Republic of Armenia is summarized below:

Laws and regulations relating to conservation of *P. Porphyrantha* in Armenia

- The Law of the RA "On flora", 1999
- The RA Mining Code enacted in 2012
- The RA Decree on Flora (781-N) issued in August 2014

Article 26 of the Armenian Mining Code prohibits excavation within any mining concession where there is a known occurrence of a species registered in the Armenian Red Book:

"Using of separate subsoil allotment shall be prohibited in the manner prescribed by the RA legislation, from the perspective of ensuring national security, protection of human lives and health, cultural values or nature and environment, where a land plot on the claimed subsoil allotment"…… "accommodates plants or animal settlements registered in the Red Book of the Republic of Armenia, or migration routes of animals."

This requirement applies regardless of the threat status of affected species and also appears to apply to any affected individual with no threshold concerning the proportion of a population affected. No advice is provided regarding situations where the remaining portion of an affected population may remain in a viable state despite the loss of some individuals, as predicted on Amulsar, or where it is normal for populations to fluctuate with naturally high mortality rates.

The new Decree on Flora (781-N) issued by the government of RA in August 2014, requires all proposed development projects on State Lands to undertake a baseline survey and to share any information on Red Data Book species with the Ministry of Nature Protection. A viable population should be preserved using a set-aside if necessary and, if translocation has to occur for the survival of a population, this must follow guidelines set out in the Decree. The proposed strategy must be discussed and agreed with the Ministry.

Lydian and Geoteam carried out baseline surveys that revealed the presence of *P. porphyrantha* on Amulsar and shared this information with the Ministry of Nature Protection.

The Project established a set-aside to preserve a viable population of the species on Amulsar Mountain in accordance with the requirements of the Decree. As outlined in this SAP, Lydian/Geoteam have translocated a proportion of the population of *P. porphyrantha* from Amulsar because they are located within the proposed mine pits and would otherwise be destroyed. These plants will be used to research the ecological requirements of the species as a basis for developing an effective restoration programme, as well as providing stocks to propagate plants for use in such a programme. A request for permission to translocate plants out of the proposed mine pits has been submitted to the RA Ministry of Nature Protection.

1.3.2 Lender Policies and Standards

Financial lenders to the Project have policies relating to environmental and social management, together with associated performance standards and requirements. IFC PS6 (IFC 2012) and EBRD PR6 both relate to Biodiversity Conservation and Sustainable Management of Living Natural Resources.

The implications of the Project under IFC PS6 and EBRD PR6 were assessed in a Natural and Critical Habitat Assessment (NCHA; see Appendix 4.10.3 of the Project ESIA). In line with the requirements of IFC PS6, species specialists were consulted during the NCHA process to review data on the status, distribution and potential population trends of *P. porphyrantha* with a view to determining whether Amulsar had critical habitat for it. These specialists included:

- Professor George Fayvush, Institute of Botany, NAS RA;
- Jalil Noroozi, Department of Conservation Biology, Vegetation and Landscape Ecology, University of Vienna;
- Dr. Peter Carey, University of Cambridge;
- Dr. George Schatz, Missouri Botanic Garden;
- Assistant Prof. Ketevan Batsatsashvili, Programme Officer Caucasus Plant Red List Authority; and
- Jamie Carr of the IUCN Red List team to discuss likely future climate change impacts.

The NCHA concluded that *P. porphyrantha* meets IFC PS6 Tier 1 criteria 1b and 1e and that Amulsar is critical habitat for the species according to EBRD PR6. The remainder of this document explains the rationale for the SAP presented in Section 3.

2 Actions towards Net Positive Impact

This section explains the rationale for actions that will be taken by the Project to achieve a net positive impact (NPI) on *P. porphyrantha*. The objectives and proposed timeframe for achieving this are defined in Section 2.1. The detailed forecast for NPI will be produced as the necessary results of research and monitoring become available.

A brief overview of the Project's impacts is provided in Section 2.2, and Section 2.3 describes the application of the mitigation hierarchy to avoid, minimize or reverse negative impacts (through restoration), followed by efforts to offset significant residual impacts and/or enhance habitat or populations so that population size and viability is increased. The SAP focuses on actions needed in addition to the measures included in the Project Biodiversity Management Plan (BMP), including research and further studies needed to demonstrate NPI with sufficient levels of assurance to satisfy the requirements of IFC PS6 and EBRD PR6 within a reasonable timeframe. This further work needed to underpin the SAP is described in Section 2.4.

To achieve NPI, a recovery programme has been designed in partnership with RA IOB NAS RA and the University of Cambridge Botanic Garden (UCBG) in the UK. This includes research on propagation techniques and population modelling as well as the establishment of facilities at botanic gardens so that research on Caucasian plants can be strengthened in future. The programme will be funded by Lydian/Geoteam for at least 4 years.

2.1 Objectives and Timeframe for Achieving NPI

2.1.1 Objectives

The objectives of the SAP are:

- To further understand the distribution and abundance of *P. porphyrantha* both globally and within Armenia to feed into both IUCN and national Red List programmes and update the status of the species as necessary;
- To design and implement an effective restoration programme resulting in suitable habitat for a viable and sustainable population on Amulsar Mountain in the long term, with increased numbers of *P. porphyrantha* post-mining; and
- To achieve an increase in the area of habitat protected for *P.porphyrantha* in Armenia.

2.1.2 Timeframe

Development of the open pits will be phased over several years, allowing time for research on the environmental requirements of the plant and on scope for translocation and propagation before significant loss of plants occurs.

An initial population model has been developed to provide precautionary estimates of likely recovery time for the population. This suggests that it should be possible to achieve a net gain within 20 years if suitable conditions can be created on the restored mine pits and if propagation techniques are successful.

2.2 Pre-mitigation impacts

A detailed review of impacts and proposed mitigation is provided in the Project ESIA (Wardell Armstrong, February 2016). There will be a physical footprint on Tier 1 critical habitat for *P. porphyrantha*, notably from the mine pits as these are located in the Sub-alpine Meadow with Alpine Elements and Sub-alpine Meadows habitats, within which *P. porphyrantha* occurs on suitable rock substrate. The physical footprint is approximately 150 ha, representing approximately 12.5% of the total area of critical habitat which is 1,200 ha (see **Figure 7**). The Project will remove the proportion of the population that is located within the mine pits, and further impacts may occur on remaining plants due to reduced habitat quality caused by fugitive dust and changes in microclimate around the rock outcrops supporting them. There were 1560 plants recorded in 2013 and 2014 within the area that will be destroyed by the mine pits. In 2015 a translocation took place from this area (see section 2.3.2). There are an additional 520 plants within the project disturbed area (a buffer around the physical footprint of the mine) and 1621 plants in the additional restricted area. Plants within the project disturbed area and additional restricted area are expected to be less vulnerable to effects of land use change than the Sub-alpine Meadow vegetation that they are associated with. Plants within the buffer and additional restricted areas are therefore not expected to die, but will be monitored closely.

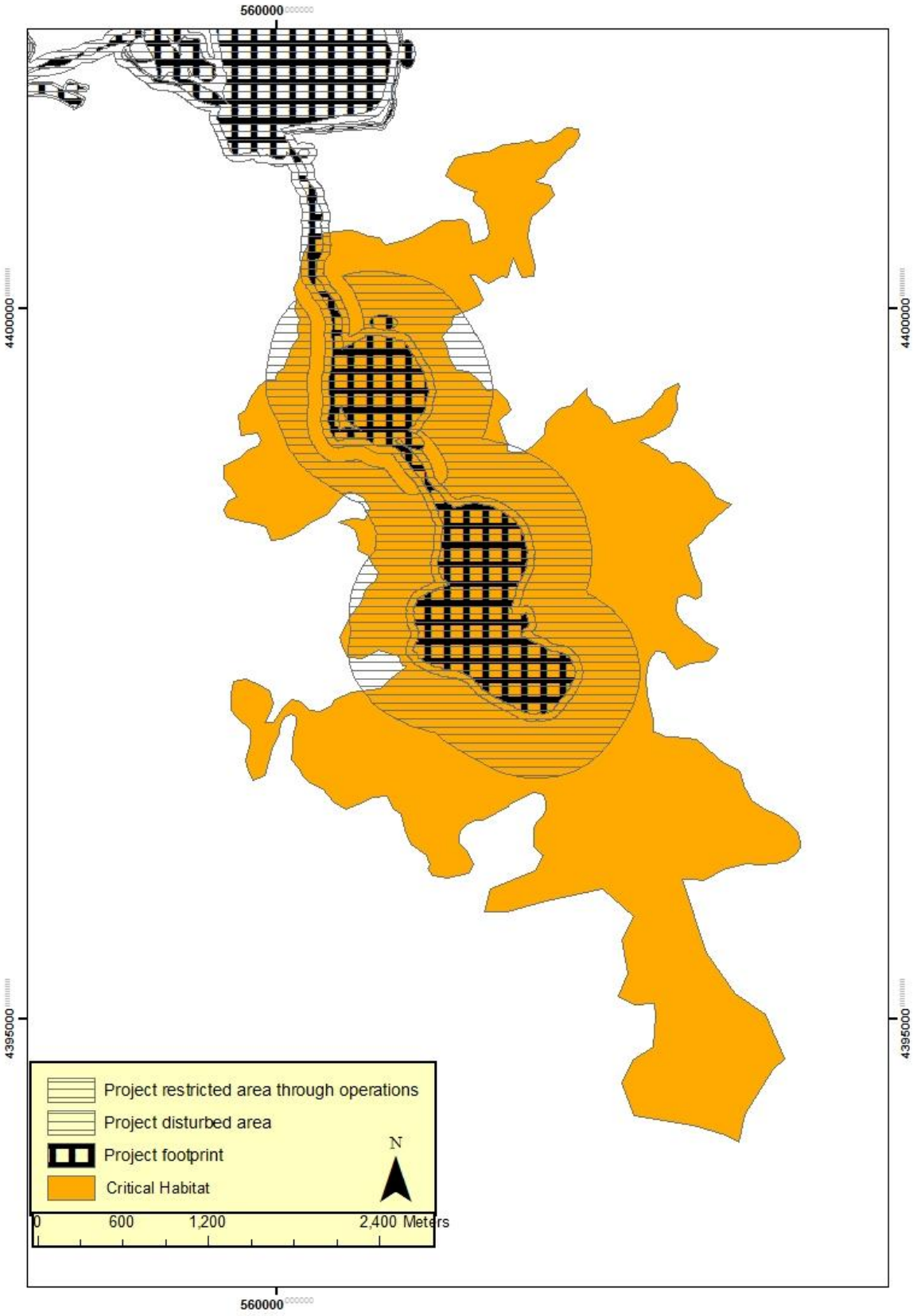

Figure 7 Footprint of the Project on critical habitat for *P. porphyrantha*

2.3 Mitigation Strategy

A summary of the Project's mitigation strategy is provided for reference, as it forms the framework for SAP actions towards NPI.

2.3.1 Mitigation Strategy: Avoidance

There are no viable alternatives to the location of the mine pits, but a large proportion of the sub-population of *P. porphyrantha* will be avoided as it is outside the infrastructure footprint.

Mine access roads and other infrastructure were designed to avoid concentrations of the plant: Figure 8 shows how the design for the pit on Erato and the roads leading into it was altered to minimise removal of rocks with *P. porphyrantha* growing on them. This approach to Project design will continue should any additional infrastructure (e.g. haul roads) be required as the Project progresses.

An area has been set aside in the southern part of the DMU to conserve at least 20% of the remaining *P. porphyrantha* population on Amulsar and its supporting Sub-alpine Meadow habitat, which will also safeguard other important biodiversity receptors such as *Ursos arctos* (Brown Bear) and an assemblage of alpine bird species (Figure 9). Lydian has agreed to avoid and protect this area and no mining-related activities will take place there. This also ensures that a source of *P. porphyrantha* seed will remain to play a part in allowing the plant to recolonise post mine-closure.

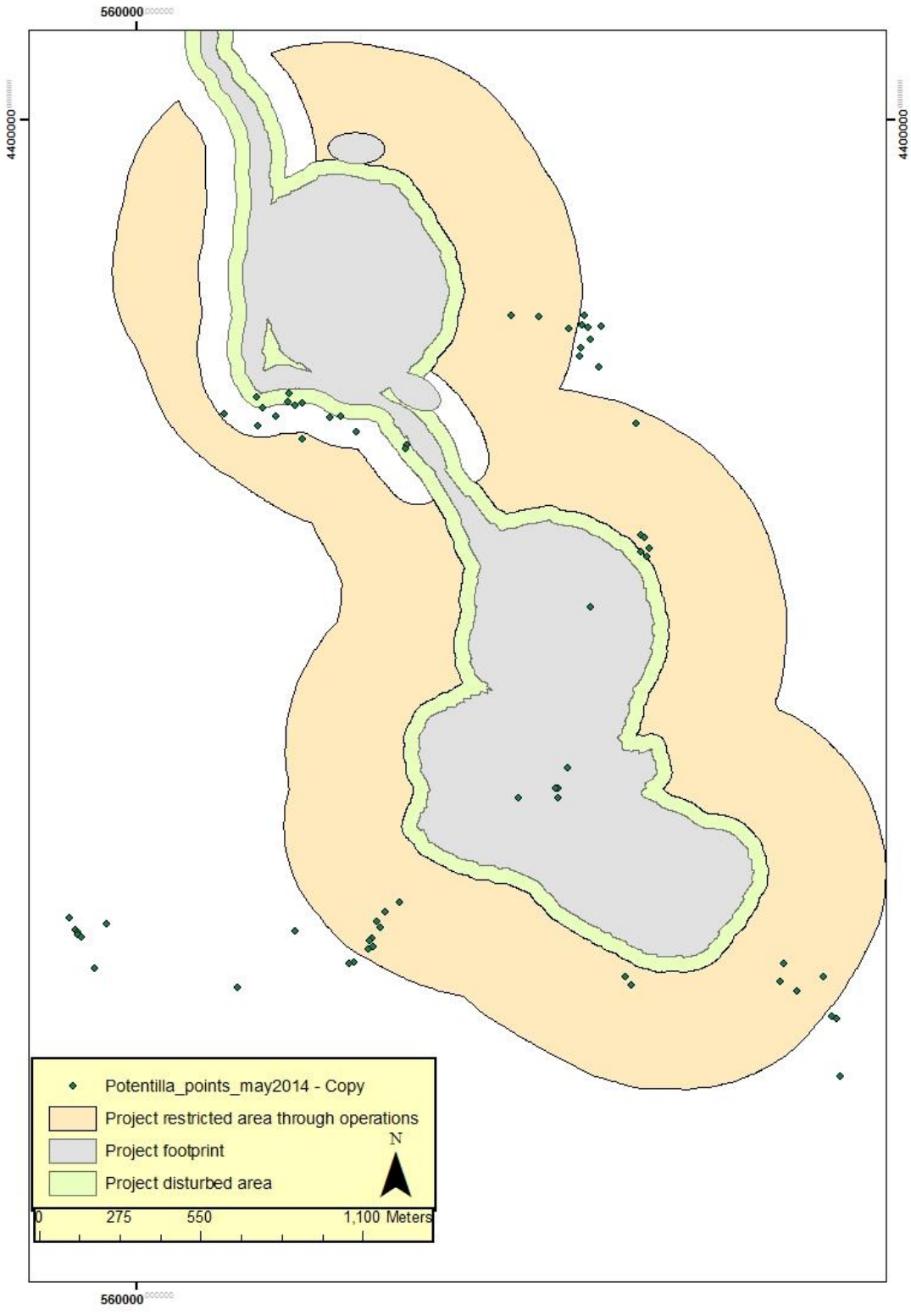

Figure 8: Design of mine pits to avoid *P. porphyrantha*

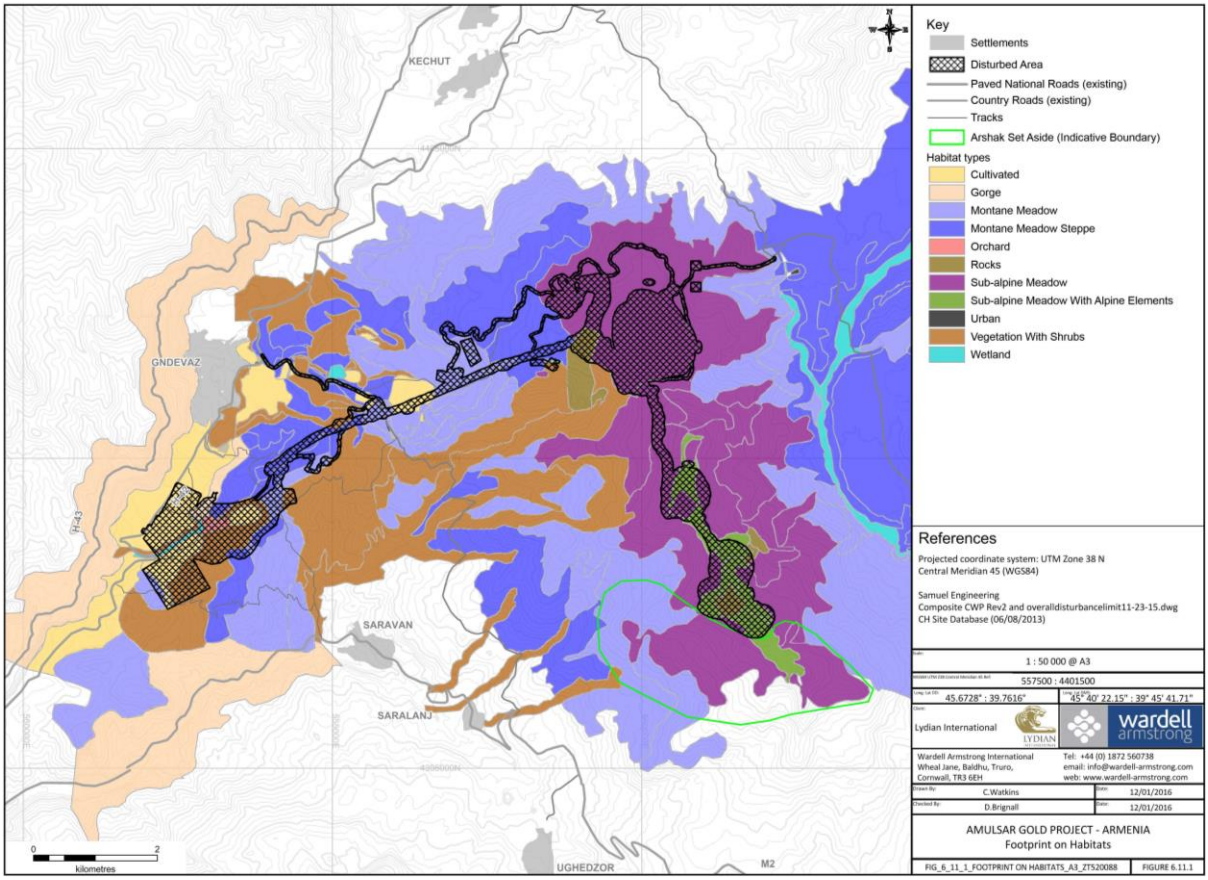

Figure 9 Set-aside (green outline) to protect a proportion of the *P. porphyrantha* population on Amulsar in situ (indicative boundary)

2.3.2 Mitigation Strategy: Translocation

The new Decree on Flora (781-N) issued by the government of RA in August 2014 requires all proposed development projects on State Lands to undertake a baseline survey and to share any information on Red Data Book species with the Ministry of Nature Protection. A viable population should be preserved using a set-aside if necessary and, if translocation has to occur to ensure the survival of a population, this must follow guidelines set out in the Decree. The proposed strategy must be discussed and agreed with the Ministry. Accordingly a request for permission to translocate plants out of the proposed mine pits was submitted to the RA Ministry of Nature Protection. The permit to translocate plants was granted in August 2015. The time taken to obtain the permit resulted in delay in translocation.

The Decree (781-N) states that plants moved from their original location should only be translocated to another area of the same habitat or to a recognised botanic garden. The Potentilla Project Team concluded that the only viable location for the translocation of *P.porphyrantha* was the Sevan Botanic Garden maintained by the IOB for the National Academy of Sciences of the RA.

A small number of plants were collected on June 10th 2015 from the tracks at the top of Artavadzes where the plant had begun to grow in 2014 and 2015. These plants were in imminent danger of being destroyed by vehicles. The plants were dug out of the track by carefully prising apart the rocks and excavating with a small fork. The plants were transferred to a tray filled with soil from the top of the mountain within seconds of being dug out. The plants were transferred to pots made of plastic, terracotta or handmade mixture of cement around a plastic mesh. Pots were filled with a mixture of gravel and a small amount of compost. A further 9 plants were collected on June 11th 2015 and potted in 8cm plastic pots. Four of the plants were planted in grit topped with a thin layer of soil. Pebbles were placed on the surface of the soil between it and the bottom of the plant to hold it away from the soil and prevent rotting. Five seedlings were planted in the same mixture but with a layer of grit on the surface to hold the plant away from the damp soil surface, again to help prevent rotting. The pots were transferred to Sevan Botanic Garden where they were kept in the shade until the glasshouse was ready to accept them.

Several plants were sown into soil in a tiny rockery at Sevan Botanic Garden in July 2015. These plants flowered and some set seed. Plants spread if they have space to do so in the growth medium. The root structure becomes very branched and spreading, and is very different to the tap root system found on plants growing in cracks in rocks on the mountain.

Management protocols required that a work programme and health and safety procedure were in place before the translocation of plants and movement of rocks could take place. On September 14th 2015 the collection of plants from Artavadzes and Tigranes began in earnest in difficult terrain (**Error! Reference source not found.Error! Reference source not found.**). The plants were individually checked for seeds. If seeds were present they were transferred to a packet. Each plant had its own packet so that genetic analysis could be carried out at a later date. The packets were labelled as either Tigranes or Artavadzes. Once seed had been collected rocks were broken apart using hammers and chisels. Soil around the plants was cleared away using 5mm wide laboratory spatulas, so that the roots could be better freed from the rock crevices (**Error! Reference source not found.Error! Reference source not found.**). Collection was completed on 23rd September 2015. Plants were often removed as a clump from the rock and were only separated on planting into pots at the Sevan Botanical Garden The total number of plants collected was therefore unknown until plants were potted up.

The total number of plants collected was 1685. On 31st October 2015 there were 845 plants in pots in the glasshouse, two of which had died by December 2015. 172 plants collected from Artavadzes are on one rockery and 191 plants collected from Tigranes are on the other

rockery at Sevan Botanical Garden (363 plants on rockeries in total). There are 477 plants being stored temporarily in boxes filled with soil and kept in the glasshouse for subsequent work on the North Erato rockeries in the spring of 2016 and as replacements for any plants that die in pots.

Surveys in 2013 and 2014 meant that the locations of most plants were known before collection started. However, to ensure no areas with *P.porphyrantha* were missed a search strategy was developed. The area at the top of Tigranes and Artavazdes was divided into sections on a map and each was searched systematically after collection had finished to count any plants that were either inaccessible or too difficult to remove from rocks. The smaller zones are where high concentrations of plants were known to exist whereas the larger areas are where it was almost certain no plants would be found.

The sweep of the area after the collection phase showed that 275 plants were not collected and 68% of these were from three zones. Georeferenced photos were taken of each zone. One rock in Zone 6 had 84 plants left on it representing 31% of all the remaining plants in the mine pit areas.

Figure 10 Collection from Tigranes Peak,

Figure 11 Excavated root system after

Amulsar	**removal of rock**

2.3.3 Mitigation Strategy: Minimisation Measures

Minimising incidental damage to plants remaining outside the direct mine footprint is an essential part of the Project mitigation strategy and measures have already been taken in the pre-development phase to protect plants through fencing and signs. A marking system is in place to identify rocks close to the proposed edges of pits where remaining plants might be at risk of collateral damage. In August 2013 different faces of rocks which were known to support plants of *P. porphyrantha* were sprayed with large green-painted dots visible from over 200m, to ensure that no engineers or workers accidentally damage the rocks (see Figure 12). The markings were revisited in July 2014 and October 2014 and all were still visible. The spots were repainted in 2015. The marks will continue to be monitored and re-painted as necessary as part of the Project BMP.

Figure 12 Rocks marked with green paint to indicate *P. porphyrantha* plants

In addition to the protection actions of the BMP, some plants will be identified for condition monitoring throughout Project construction and operation; this will include some plants on marked rocks. Monitoring activities will be described in detail in a Biodiversity Monitoring and Evaluation Programme (BMEP).

2.3.4 Restoration

Definition of suitable conditions for restoring populations requires improved knowledge of the ecological requirements of *P. porphyrantha* or the "niche" requirements of the species, to be gained through a series of research tasks, as well as the development of stocks of propagules (seeds or plants) to be reinstated in future.

Successful reintroduction of plants post-mining depends on the conditions that can be created in the back-filled mine pits. Ideally, rocky cliffs would be retained at the lip of the mine pits. It may be possible to leave boulders on the surface of the substrate filling the pits. Scope for creating the large boulders on which the plants grow will be assessed, together with the suitability of new micro-climatic conditions. This habitat design will be incorporated in a later version of the Mine Reclamation, Closure and Rehabilitation Plan.

Creation of the necessary habitat will commence after closure of the mine pits. Moss could be introduced to the new boulders and, once this has established, *P. porphyrantha* plants grown for the purpose and/or seeds may be planted in the moss to start the colonisation process. The exact approach will depend on the results of the research programme.

2.3.5 Offsets

The need for offsets is not yet clearly established. Specialists consider that it will be possible to maintain a viable population of the species on Amulsar Mountain throughout mining, albeit with reduced numbers in at least the short term. It is expected to be possible to achieve NPI through the actions identified in the SAP without the need for an offset. However, because restoration success is uncertain (it may not be possible to create suitable conditions post-mining to propagate sufficient plants or to establish them on newly restored habitat) a precautionary approach is being taken and the potential to avert risks to other Armenian populations through a conservation or protection mechanism will be explored while monitoring of the effectiveness of the SAP continues.

To support development of a Biodiversity Offset Management Plan (BOMP), should one be required, a series of expeditions will take place in 2015 to investigate the AOO of *P. porphyrantha* in RA. This work will aim to search for any new populations of the species and to review threats and pressures affecting existing populations. The results will be used to clarify the conservation status of the species in Armenia (and its designation in the RA Red Book) and thus define the context within which restoration efforts will be made.

2.3.6 Monitoring

Monitoring is needed to determine the effects of mine construction and operation on the plants remaining outside the mine pits and to assess the efficacy of mitigation measures and SAP actions. Production of a detailed BMEP is an important SAP task. Monitoring of the *P. porphyrantha* population at Amulsar has already been initiated (in 2013) and will continue throughout construction and operations. Effects of mine operations on the population will be monitored, e.g. by recording levels of dust or erosion taking place above rocks with plants on. A monitoring protocol has been developed and this is provided in Appendix B, together with a copy of the recording form that will be used. Success of re-introductions will also be monitored with links to an adaptive management plan. If survivorship from a cohort of introduced plants in any year is less than expected, more plants will be required for re-introduction the following year. Once a viable population is established a count of plants will be required every few years to prove a net gain of the population.

2.4 Research to underpin the SAP

2.4.1 Development of research facilities

In June 2015 the site for the glasshouse at the Botanic Garden at Sevan was confirmed by a meeting on site between staff of the IOB, GeoTeam, UCBG and TEC. The site (Figure 13) was derelict and required clearing. The old glasshouse was unrepairable.

Figure 13 Site of the glasshouse at Sevan Botanic Garden in June 2015

Work began to clear the site in late June. Design of the glasshouse was by S.Arevshatyan following his prototype at Gndevaz nursery and a visit to the Cambridge Botanic Garden. The design was approved by IOB, TEC and UCBG. The glasshouse (Figure 14) was completed on time to accept translocated plants in the Autumn of 2015. Benches were constructed to accept plants (Figure 15). The glasshouse has two main rooms with independent ventilation and heating, and a lobby that will have a desk and information boards.

Plants translocated from Amulsar were planted in pots and laid out in the two main rooms in October 2015 (Figure 15).

Figure 14 New glasshouse at Sevan Botanic Garden

Figure 15 Potted up plants of *P. porphyrantha* following translocation

Final services were completed before the onset of winter. The exception will be ventilation fans required to reduce temperatures in the summer that will be installed during spring 2016.

An area for two rockeries was cleared between the new glasshouse and the derelict old glasshouse. The rocks were collected and the area was laid out. The rockeries are formed of a rubble and soil bank and faced with stones collected from Tigranes on Amulsar (Figure 16). One rockery is planted with individuals from Tigranes and the other planted with individuals from Artavadzes.

Figure 16 Rockery at Sevan Botanic Garden with *Potentilla porphyrantha* plants already in place (October 2015)

Four small experimental rockeries have been constructed on the summit of North Erato at Amulsar (Figure 17 and Figure 18). These will provide an experimental area in which to try to introduce plants into an artificial habitat on the mountain. The rockeries evolved in design as they were built. The first rockery was built by banking stones up against an existing boulder in a half dome shape. Soil was then poured in between the rocks but this proved difficult. The second rockery was built in layers, banked up against an existing boulder, filling each layer with soil after it had been laid down and before the next layer was added. The third and fourth rockeries were built in the style of half a ziggurat; the centre of these rockeries was in-filled with rubble and soil, with larger flat rocks used to form the edges of the layers. The boulders for the first two rockeries face south, the third faces north and the forth faces north-east. Each rockery forms an arc around and against the boulder giving a wide range of aspects. These rockeries have been built with cracks of varying width to mimic the cliffs and rocks where the plant is found growing on Amulsar.

Figure 17 Rockery Number 2 on North Erato (rocks within a soil matrix)

Figure 18 Rockery no. 3 on North Erato (layers of rubble and soil faced with rock)

Once the experiments on *P. porphyrantha* are completed it is envisaged that the rockeries and glasshouses will be developed by the IoB within the Botanic Garden as the focus of a public display of Caucasian mountain plants, highlighting the important endemism of the

area. Currently there are three botanic gardens run by the National Academy of Sciences in Armenia (Yerevan, Sevan and Vanadzor).

2.4.2 Research questions

Research needed to achieve NPI on *P. porphyrantha* in Armenia addresses the following issues and questions:

1 Distribution and taxonomy of *P. porphyrantha* in Armenia:

a Are *P. porphyrantha* and *P. cryptophila* (another species listed in the RA Red Book but only known from historical records) the same species?

b What is the current distribution of *P. porphyrantha?*

c How connected are the separate populations/sub-populations of *P. porphyrantha*?

2 Pollination and dispersal mechanisms:

a How is *P. porphyrantha* pollinated and dispersed?

3 Niche and carrying capacity:

a What is the fundamental niche of *P. porphyrantha?*

b What is the realised niche of *P. porphyrantha?*

c What is the carrying capacity of boulders at a site?

4 Propagation techniques:

a) What are the best techniques for propagating *P. porphyrantha?*

b) What are the optimum growing conditions and therefore what conditions need to be created post-mining to support a viable population?

5 Population dynamics and modelling to estimate the time needed for the population to recover:

a What are the vital rates in a *P. porphyrantha* life-table?

b How long do *P. porphyrantha* plants live?

c What is the typical life time fecundity of a *P. porphyrantha* plant?

d What are the population dynamics of *P. porphyrantha?*

The following sections provide more detail about the need to address these issues and questions and the approach that will be taken.

2.4.3 Distribution and taxonomy of P. porphyrantha

Expeditions to localities listed in the Red Data Book of plants of the Republic of Armenia for both *P. porphyrantha* and *P. cryptophila* (Figure 3) took place in the summer of 2015 (Table 1) in accordance with the SAP agreed in 2105. Further expeditions are proposed for 2016. Material will be collected for morphological and karyological studies to be carried out at the Yerevan Botanic Garden. DNA analysis will be undertaken to determine the variation between and within populations. Further expeditions or searches of potentially suitable locations will also be carried out to obtain more comprehensive information on the species' range and distribution. If new populations are identified, information will be shared with the RA Ministry of Nature Protection for use in future revisions of the RA Red Book and to update the national and global AOO for the species.

2.4.4 Pollination and dispersal

If we can understand how plants are pollinated and dispersed we will have a much clearer idea of how quickly the Amulsar population could recolonize the area once mining has ceased. This may depend on how far pollinating insects will travel between individual plants, how far seeds are dispersed and by what means.

Spatial processes in pollination biology are generally poorly understood but results from relevant studies will be used to design a suitable study. This includes a study using *Delphinium nuttallianum*, in which emasculated plants were placed in pots at different distances (Schulke and Waser 2001). Pollinators were found to travel up to 400m within the population demonstrating that even relatively isolated plants can be pollinated. This study was carried out at 2700-3100masl in Colorado, USA and therefore the method should translate well to Amulsar. Plants will be placed in arrays of buried pots of flowering plants at set distances from known patches of *P. porphyrantha.* Observers will note the number of pollinating insects visiting the arrays per hour and also the number of pollinators that fly close by. It may be advisable to look at the fruits of plants at the end of the season to determine the success of pollination and number of seeds produced.

Seeds of the genus *Potentilla* are wind-dispersed, with longer distance dispersal by animals in fur or feathers (and in human clothing). A standard method for looking at short distance dispersal is to use sticky traps (Sutherland, 2006) set at set distances from a parent plant.

Although setting up the traps and collecting them again could be carried out by any trained staff, the study of the traps for seeds takes a long time. Long distance dispersal is best measured by looking at relatedness of plants within and between populations (although there are other methods as reviewed by Nathan 2006) and will be tied to the work described Section 2.4.3.

2.4.5 Determining the niche of P.porphyrantha

The environmental conditions within which a species can survive and reproduce are termed the fundamental niche. Hendry and Grime (1993) produced a manual that describes how to carry out tests to determine the life history traits of any plant species and this approach will be used. The work will require rockeries to be built and also glasshouses that are built to accommodate alpine plants (see Section 2.4.1).

The fundamental niche only describes the limits of where a plant could possibly grow. *P. porphyrantha* is an extreme tolerator of stresses which is why it can grow on rocks. However, as soon as there is any competition from other plants it may not survive, even if conditions are favourable. There are therefore large parts of the fundamental niche that the plant cannot occupy. The limits within the fundamental niche that a species actually occupies are known as the 'realised niche'. In the case of *P. porphyrantha* there may be an inimate relationship with a moss of the genus *Grimmia,* which could be key to our understanding of where the species can grow on rocks and boulders.

Effective translocation requires knowledge of the conditions needed to maintain plants in a good condition when they are taken from the mining area and transported to a new location. Because of the large number of plants involved, facilities may be needed in the vicinity of Amulsar to store them temporarily until they can be moved. Key to survival of most alpine plants is a stable climate which prevents moisture retention in the growing medium through the winter. Well-ventilated glasshouses will be used to protect plants from winter rainfall. If growing conditions are not tested prior to removal of the plants to a botanic garden there is a risk that they will die. A trial using a small number of plants would help to identify suitable techniques and conditions.

2.4.6 Propagation techniques

Preliminary experiments have been conducted using seeds of *P. porphyrantha* collected from Amulsar Mountain in September 2013. These were sown in a prepared section (outside) at Sevan Botanic Garden (200 seeds). Seeds will be planted in a specially prepared section outside at Yerevan Botanic Garden in late winter 2014/2015, based on the known requirements for growing alpine species of the semi-arid zone.

Eight hundred seeds were also taken to the IOB at Yerevan Botanic Garden for tests in controlled conditions. One hundred of these were set out in petri dishes on filter paper to test viability and germination rates. The germination rate for this small sample was over 80%, which is considered to be very high. Horticultural experience suggests the species can be germinated from seed barely covered by soil in spring or autumn, germination taking 1-3 months at 18 – 21 °C. Vernalisation does not appear to be necessary.

Twenty seeds were handed over to the specialist on microclonal propagation in the RA NAS IoB for an assessment of the potential of microclonal propagation of *P. porphyrantha*. The results of this initial test are not yet available.

Ten seeds were germinated for karyological analysis of this species. The number of chromosomes of *P. porphyrantha* will be identified at the botanic garden in Yerevan, and its karyotype (form and sizes of chromosomes, ploidy level, etc.) will be identified once the plants are large enough for samples to be taken.

Further studies on culture and propagation will be carried out in the new research facilities. A training programme is proposed for Armenian nursery workers or research technicians in partnership with the UCBG. Staff from UCBG will also visit Armenia to provide advice on cultivation and propagation techniques.

2.4.7 Population dynamics

It is important to consider whether a viable population *P. porphyrantha* can be expected in the longer term, given the impacts of mining and potential uncertainties about restoration success. A population model will be developed to estimate the time it will take for the population of *P. porphyrantha* to recover to at least its pre-mining size.

To support development of the model, the population dynamics of *P. porphyrantha* will be studied using monitoring data to be collected from permanent plots. The basic methodology to be used for monitoring is similar to that of Wells (1967) and is explained in Appendix B.

Key population parameters to be monitored include:

- Plant size; flowering; seed production and death; and
- Proportion of plants flowering and the average number of seed capsules produced per plant.

Natural factors such as weather will be recorded so they can be related to the plant population parameters.

The age distribution of plants in the population can be estimated using a method to count the rings of growth, somewhat akin to counting tree rings but requiring more expertise. A collaborator in Switzerland with expertise of alpine plants will be contacted to see if they are able to carry out this work and at what cost.

The model is based on the following basic equation in which N represents population size and t is time:

$N_{t+1} = N_t + (Births - Deaths) + (Immigrants – Emigrants)$

In most cases measuring immigration and emigration is virtually impossible and the value is set at equality so that the number of immigrants is assumed to equal the number of emigrants (it is intended to collect information on immigration and emigration, see Section 2.4.4).

If the number of births and deaths are measured over time the rate of population increase (λ) can be calculated so that:

$N_{t+1} = \lambda N_t$

To determine λ, life tables need to be constructed to follow plants through their life cycle. For perennial plants such as *P. porphyrantha* matrices are used so that the proportion of a cohort of plants surviving from one year to the next is recorded. Each cohort has its own life-table and these are then combined within an age structured population model. Typically survival is lowest in the early years (especially from seed to seedling), and once established a plant has a much higher probability of surviving from one year to the next.

For a species where we know that no plants live beyond five years of age the survivorship matrix for a single cohort could look like:

		Year t+1					
		1	2	3	4	5	6
Age at year t	0	0.1					

1	0.25				
2		0.5			
3			0.5		
4				0.5	
5					0

Seed production is likely to vary with age, so for example two-year-old plants could produce an average of 50 seeds, three- and four-year-old plants 100 seeds, and five-year-old plants 50 seeds.

The finite rate of population increase is related to the basic reproductive rate (R_0) of the plants in a population:

$$R_0 = \Sigma\, l_t\, m_t$$

Where l_t is the proportion of a cohort surviving to time t and m_t is the mean number of seeds produced by surviving plants between time t-1 and time t. This equation does not take into account the competition between individuals as density increases and a more realistic equation that includes density is:

$$N_{t+1} = N_t R / (1 + (aN_t)^b)$$

Information will need to be gathered for these very basic models, namely the proportion of individuals that survive from one year to the next, the age that individuals can reach and the number of seeds produced by individuals at each age. This information will be collected as part of the proposed monitoring programme which will generate results in time to develop reliable models well in advance of mine closure. Germination rate in natural conditions is likely to be far lower than that achieved in the laboratory and recruitment will therefore be measured in a separate experiment in the field.

Parameterising the equations above (or more complex ones not covered here) will allow us to predict how long the population will take to recover after the mine is closed. After the

habitat has been created, the required number of plants, grown *ex-situ,* will be planted into the new habitat. The mathematical model created will inform us how many plants will be required.

A very simple model without density dependence and for *P. porphyrantha* with a lifetime of five years, a lifetime production of 300 seeds, and with survival rates the same as the matrix above, suggests that if only 100 plants are introduced the population will recover to pre-mining levels in 16 years (Figure 19). With low-level density dependence in the model it would take 16 years. However, for the first few years the number of plants drops to levels where random effects could threaten the population.

When finalised, the mathematical model will inform us how many plants will be required to support a precautionary approach. A phenomenon known as the Allee effect tells us that small populations have a lower than expected rate of increase because they are more susceptible to random factors such as the weather. We propose to minimise these effects by introducing plants over a number of years. However, if 100 plants were planted in successive years, the population would be expected to recover to pre-mining levels in 15 years without density dependence and in 18 years if it is included (Figure 19). This last model is currently considered to be the most realistic and secure, although it may take longer for the population to recover in reality due to the various factors that might affect establishment and survival *in situ*.

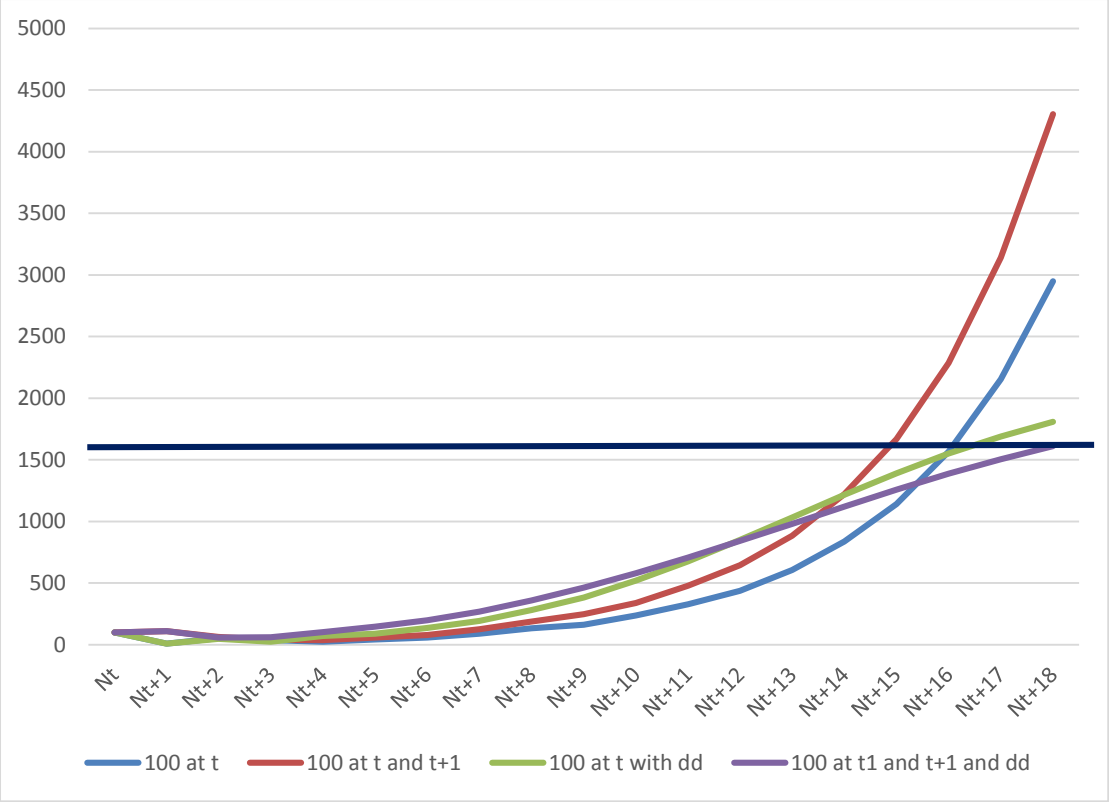

Figure 19 Proposed population model. **Pale blue line represents 100 plants introduced at time t, red line represents 100 plants introduced at time t and time t+1, green line represents 100 plants introduced at time t and including density dependence, purple line 100 plants introduced at time t and time t+1 with density dependence. Black horizontal line is target for no net loss of plants from pre-mining conditions**

3 SAP Updated December 2015

Task	Topic/ objective	Action required	Undertaken by:	Completion Indicator	Timeframe	Project control	Progress 2015
Objective: to enhance (in terms of numbers of plants, their survival over time as a viable population, and their area of occupancy at an appropriate scale) the population of *P. porphyrantha* at Amulsar			**Lydian & its contractors**	**Lydian**			
1	Protection of Arshak Peak set-aside and plants in other areas around mine pits.	All operations should avoid the set-aside. Areas of plants outside the set-aside will be marked and measures taken to avoid damage to them. Actions to be undertaken according to Project BMP.	Lydian & its contractors	Number of plants remains stable or increases	Through-out project	Lydian	Set-Aside in place. Plants outside set-aside remarked and gps located.
2	Develop an on-site monitoring plan to monitor numbers and condition of the plants in the set-aside and elsewhere during Project construction and operation, and to obtain ecological information for use in population modelling	• Specify monitoring locations and a programme of activities with timing, frequency and responsibilities for implementation. • Include protocols for monitoring,explaining which parameters will be monitored. • Identify requirements for training personnel to undertake monitoring surveys. • Explain how results will be used to support an adaptive management approach throughout Project operation. This may include indicators of condition or impact, to be developed after initial monitoring data have been interpreted, together with thresholds for corrective action or other management responses needed to ensure that NPI can be achieved as planned. • The plan forms part of the Project's BMEP.	Lydian/TEC	Library of completed monitoring forms and associated database	Through-out and after Project	Lydian	Monitoring of plots carried out in June 2015. Training of IOB staff not possible because there was no contract in place.
3	Establish growth facilities to enable experimental work on the ecology of the species in order to plan for effective site restoration.	It is envisaged that these facilities will become associated facilities of the Armenian Institute of Botany (IoB) and Yerevan Botanical Garden, allowing them to grow other Armenian plants of conservation importance, carry out research and display them to the public	Lydian/TEC/ IoB	Facilities transferred to management by IoB in 2020	2015	TEC	Glasshouse and rockeries built at Sevan Botanic Garden. Rockeries constructed on North Erato.

Task	Topic/ objective	Action required	Undertaken by:	Completion Indicator	Timeframe	Project control	Progress 2015
4	Translocation to preserve plants that would otherwise be destroyed by mining for purposes of rescue and research (see Task 6), and for inclusion in public displays to be developed in botanic gardens.	Translocated plants will be used for research as described in Task 6, to test survival rates in different conditions, and to enable propagation of plants to develop stocks needed for re-introduction. Translocation will be done under licence, in accordance with permit requirements and a Translocation Procedure to be developed and agreed with the Ministry of Nature Protection. Plants will be transferred to different facilities and locations as conditions in some locations may not be suitable for plants to survive. Due to the numbers of plants concerned, staging facilities will be needed to keep plants in good condition until they are transported to more distant locations in Yerevan or Sevan. Mature plants must be collected under licence by members of the IoB.	Lydian/TEC/ IoB	Plants collected, moved and grown in facilities	2015	TEC	Licence received from government RA in August 2015. Translocation plan conceived, written and carried out ahead of schedule in October 2015. Plants installed in glasshouse and rockeries at Sevan Botanic Garden
5	Develop propagule stocks to support research (see Task 6) and to facilitate restoration (Task 9).	Harvest seeds from Amulsar and develop a seed bank. Based on results of research, grow plants from seeds and monitor their survival. Based on results of research, grow plants from cuttings and monitor their survival. Testing the effectiveness of different propagation techniques forms part of the research programme outlined in Task 6.	TEC/IoB	Stocks of plants grown by 2025	2015-2025	TEC/IoB	Seeds collected from many hundreds of plants on Tigranes and Artavadzes before translocation in September 2015. Seeds transferred to IOB in Yerevan. Plants successfully grown in Yerevan and at Sevan, producing flowers and seeds.
6	Research to explore the ecological characteristics of the species in order to plan for effective site restoration.	Undertake a series of experimental activities in partnership with the IoB, Yerevan Botanical Garden and the UCBG. No attempt has been made before to reinstate this species to a post-mining landscape and there has not been any comprehensive study of its	TEC/IoB/ UCBG	Best conditions for growth of plants discovered	2015-2019	TEC/IoB	No progress as there is no contract between Lydian International and IOB and therefore no

Task	Topic/ objective	Action required	Undertaken by:	Completion Indicator	Timeframe	Project control	Progress 2015
		ecological requirements, population dynamics or genetics.					student.
7	NPI forecasting to demonstrate the Project's ability to achieve NPI.	Develop a detailed NPI forecast for the species based on the validated population model developed as part of Task 6. This will include estimates of likely recovery times for the Amulsar population under different scenarios.	TEC	NPI forecast accepted	2015-2020 iterative	TEC	Population data analysed from permanent plots. First three years of data not adequate for modelling, due to short timeseries.
8	Restoration plan to achieve NPI following mine closure.	Develop a detailed restoration plan to include: • Design or specification of habitat conditions needed for the plant to be reintroduced to the post-mining landscape after mine closure. • Specification for numbers and type of propagules (seeds, seedlings, mature plants) • Reintroduction programme, specifying timing of reintroduction and any follow-up management needed. • Protocol for follow-up including monitoring of success of re-establishment and any follow-up management requirements. • An adaptive management plan, for example, specifying circumstances under which further re-introductions might be needed.	TEC/IoB	Plan accepted	2020	TEC/IoB	NA
9	Habitat creation to achieve NPI following mine closure.	Create required habitat conditions on the back-filled mine pits, potentially by incorporating large boulders in the plan for the landscape at mine closure, if microclimatic conditions are suitable.	Lydian/TEC/ IoB/UCBG	Required Habitat created	Post mine closure	Lydian	NA
10	Research other populations in Armenia to identify suitable offset sites, should offset be necessary.	Undertake field surveys.	Lydian/TEC/ IoB	Report sent to IUCN RLA	2015-2016	TEC	Expeditions to sites carried out in 2015

Task	Topic/ objective	Action required	Undertaken by:	Completion Indicator	Timeframe	Project control	Progress 2015
11	Stakeholder engagement to increase capacity for research and raise awareness with regard to Caucasian plants.	Undertake stakeholder engagement and capacity building through collaboration with IoB and UCBG.	Lydian/TEC/ IoB		Through-out project	TEC	Meetings held between IOB and UCBG in February and June.

4 2016 Preliminary Project Plan

Task	Topic/ objective	Undertaken by:	Completion Indicator	Timeframe	Project control	2016 Plan
1	Protection of Arshak Peak set-aside and plants in other areas around mine pits.	Lydian & its contractors	Number of plants remains stable or increases	Through-out project	Lydian	Monitoring of plots on Erato and Arshak in July and September/October. Regular visits by environmental manager to ensure no collateral damage
2	Develop an on-site monitoring plan to monitor numbers and condition of the plants in the set-aside and elsewhere during Project construction and operation, and to obtain ecological information for use in population modelling	Lydian/TEC	Library of completed monitoring forms and associated database	Through-out and after Project	Lydian	Monitoring of plots twice in 2016. Student to be taught technique in July by P.Carey.
3	Establish growth facilities to enable experimental work on the ecology of the species in order to plan for effective site restoration.	Lydian/TEC/ IoB	Facilities transferred to management by IoB in 2020	2015	TEC	Glasshouse and Rockeries maintained under contract by IOB
4	Translocation to preserve plants that would otherwise be destroyed by mining for purposes of rescue and research (see Task 6), and for inclusion in public displays to be developed in botanic gardens.	Lydian/TEC/ IoB	Plants collected, moved and grown in facilities	2015	TEC	Already Completed

Task	Topic/ objective	Undertaken by:	Completion Indicator	Timeframe	Project control	2016 Plan
5	Develop propagule stocks to support research (see Task 6) and to facilitate restoration (Task 9).	TEC/IoB	Stocks of plants grown by 2025	2015-2025	TEC/IoB	Student to maintain and grow plants under contract to IOB. Further seed collection from Tigranes/Artavadzes September/October. Karyological studies carried out at Yerevan.
6	Research to explore the ecological characteristics of the species in order to plan for effective site restoration.	TEC/IoB/ UCBG	Best conditions for growth of plants discovered	2015-2019	TEC/IoB	IOB student trained in Cambridge. Student develops PhD programme with guidance from denior scientists at IOB, UCBG and Bodsey. Cambridge PhD student begins studies.
7	NPI forecasting to demonstrate the Project's ability to achieve NPI.	TEC	NPI forecast accepted	2015-2020 iterative	TEC	Further analysis of population data gathered in 2016
8	Restoration plan to achieve NPI following mine closure.	TEC/IoB	Plan accepted	2020	TEC/IoB	Discussion of requirements with landscape restoration team
9	Habitat creation to achieve NPI following mine closure.	Lydian/TEC/ IoB/UCBG	Required Habitat created	Post mine closure	Lydian	No Action
10	Research other populations in Armenia to identify suitable offset sites, should offset be necessary.	Lydian/TEC/ IoB	Report sent to IUCN RLA	2015-2016	TEC	Further expeditions to sites in Armenia in July-October. Plan expeditions for Cambridge PhD student to Iran. Cambridge PhD student begins study of genetic material.

Task	Topic/ objective	Undertaken by:	Completion Indicator	Timeframe	Project control	2016 Plan
11	Stakeholder engagement to increase capacity for research and raise awareness with regard to Caucasian plants.	Lydian/TEC/ IoB		Through-out project	TEC	Planning meetings to be held between IOB and UCBG in Spring (Cambridge) and Summer (Yerevan). Opening ceremony of Sevan glasshouse. Spring 2016.

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Appendix A - Proposed Global Assessment of *Potentilla porphyrantha* Juz.

This forms the basis of an IUCN Red List Assessment, based on information available as of November 2014.

A.1 Taxonomy

PLANTAE

TRACHEOPHYTA

MAGNOLIOPSIDA

ROSALES

ROSACEAE

Potentilla porphyrantha Juz.

A possible synonymous species has come to the attention of the assessors during the work for an ESIA. This species is *Potentilla cryptophila* Bomm.

A.2 Assessment Information

Red List Category and Criteria: EN A3c, B2a,bii&biii ver 3.1

Assessor: P Carey (with advice from K.Batsatsashvili, G.Fayvush,J.Noroozi, G.Schatz)

Justification: *Potentilla porphyrantha* Juz. has only been recorded from six sub-populations in the Caucasus (three in Armenia, two in Iran, one in Azerbaijan (Nakhichevan). The Azeri population is only known from an historic record. The area of occupancy is 48 km^2 based on occupied 2x2 km grid cells. It is found growing on moss cushions on rocky outcrops/boulders and sub-nival screes at altitudes above 2700 m. The main threat is climate change, and because this threat is universal across the extent of occurrence the population should be considered as a single entity for criterion B. A new sub-population was discovered in 2012 during the ESIA for a mining development and this accounts for 66% of the AOO. 50% of the global AOO of this species is now threatened by the mining development for which the ESIA was undertaken if there is no avoidance or mitigation strategy. In Armenia loss of habitat and plant collection could also be a threat. The species is grown as a garden plant, especially in

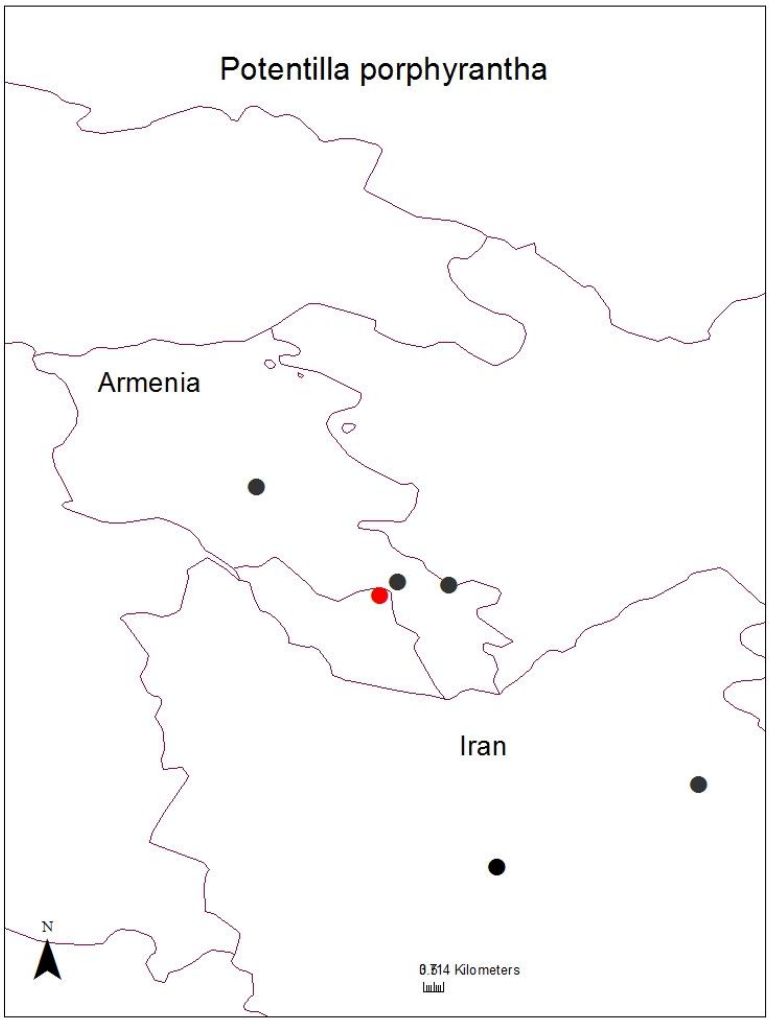
the USA. The provenance of the garden plants is unknown. This species was not evaluated for the Red List of the Endemic Plants of the Caucasus (Solomon *et al* 2013)

A.3 Geographic Range

Range description: The species was previously thought to have an Area of Occupancy of <10 km^2 (Armenia - Tamanyan *et al* 2010 and Iran - Noroozi *et al* 2011). Using the 2 x 2 km grid cell method the AOO would increase to 16km^2. Since the discovery of a new sub-population the AOO has increased to 48km^2 (Carey *personal observation* and publicly available EIA submitted to the government of the Republic of Armenia 17/10/14).

Countries: Armenia, Iran and Azerbaijan (Nakhichevan)

Range map:



Black dots represent extant populations, red dot is an historical record.

Site locations:

1) Recorded in 1988 at Sevsar and Agusarka in the Gegham Mountains, Armenia (40°14'04''E,44°56'23''N) (Tamanyan *et al* 2010).

2) Recorded in 1986 at Mets Ishkhanasar, Zangezur, Armenia (39°35'25''E, 46°12'31''N) (Tamanyan *et al* 2010).

3) Recorded at some time between 2003 and 2011, Sabalan, Iran (47°51'15.0''E, 38°16'24.6''N,)(Noroozi *et al* 2013)

4) Recorded at some time between 2003 and 2011, Sahand, Iran (46°31'08.6''E, 37°43'58.6''N, and 46°29'58.5''E, 37°43'56.0''N,)(Noroozi *et al* 2013)

5) The historic record (more than 60 years old) from Nakhichevan, Azerbaijan has an estimated location based on some village names.

6) Amulsar, Armenia (discovered in 2012, and recorded in 2013 and 2014) (45°43'02''E, 39°43'35''N).

There are further historic records from the Gegham mountain range in Armenia (close to the 1980s records – G.Fayvush *pers comm.* And including records for *P.cryptophila*) and one from Iran near the Caspian Sea although that population is thought to no longer exist (Noroozi pers comm.).

There are two further possible historic (recorded 1947 and held within the national herbarium of Armenia) Armenian sub-populations of *P.porphyrantha* (45°32'09''E,39°34'43''N and 46°09'53''E, 39°28'13''N) if *Potentilla cryptophila* Bomm. is confirmed as synonymous with *P.porphyrantha* (G.Fayvush *pers comm.*). However, as these are historic records the chances of finding the sites is small.

A.4 Population

Population: The species has five extant sub-populations, two of these (Armenia) occupy less than 8 km^2 between them. The two populations are 130km apart and considered in the Armenian Red Book as severely fragmented (Tamanyan *et al* 2010). The new population discovered in 2012 is in between the two populations listed in Tamanyan *et* al (2010). The new population numbers in the region of 7,500 plants whereas previously the total in Armenia was considered to be in the '00s. In Iran the species was found during a survey in three 10 x 10m plots , two of these were close together (Noroozi *et al* 2013). The species is

almost common in the two locations but is not expected to be found elsewhere in Iran (Jalil Noroozi pers comm.). The species should no longer considered severely fragmented.

Population trend: unknown

A.5 Habitat

Habitat: It is found on sub-nival screes in Iran above 4000m and has been assigned to the community *Potentilletum porphyranthae* ass. nov.hoc loco and is associated with Alopecurus *dasyanthus*,and *Potentilla argaea* (Noroozi *et al* 2013). In Armenia it was previously thought to be found in rocky slopes and screes at altitudes above 3300-3500m (Tamanyan *et al* 2010). The new population at Amulsar is found above altitudes of 2450m on boulders and a few plants are found on scree. Noroozi *et al et cit* (2013) summarise the geology of the Iranian sites thus: Sabalan is a Plio-Quaternary volcano, mainly composed of potassium-rich calc-alkaline andesitic rocks. Sahand volcano is a volcanic complex that has formed through two major episodes of volcanic activity: during Middle-Upper Miocene and Plio-Quaternary. The studied plots are localized over the Plio-Quaternary rocks mostly comprised of calc-alkaline dacitic and andesitic rocks. The soil of all these volcanic areas is constituted of lithosols (igneous rocks). This suggests *P*.porpyrantha is restricted to rocky areas high in mineral content and could be a metallophyte. The population discovered at Amulsar is also found in an area with the same geology. This might explain its restricted distribution.

At Amulsar the plants are strongly associated with cushions of a moss of the genus *Grimmia*. This is especially true of young plants that appear to germinate on the moss and gain water and nutrients from the moss. As the plants mature their woody root systems penetrate cracks in the rocks, which contain a certain amount of humus from decaying moss. *P.porphyrantha* plants are extreme stress tolerators and probably cannot compete with other species. *P.porphyrantha* has only once been seen growing intimately with any other higher plant species and on that occasion it looked as though the *Campanula* plant was overcrowding it.

Systems:Terrestrial

A.6 Threats

Major threats: Predicted climate change will remove the snow cover required for this species in the winter. Increased temperature through all seasons are likely to reduce all suitable habitat with little chance of migration to other sites (Noroozi *et al* 2011). In Armenia the main threat is indicated as global climate change and loss of habitats caused by “geological

factors" (Tamanyan *et al.* 2010). Geological factors could mean either seismic events or more likely erosion of the screes. The threat of temperature rise from global climate change applies to the whole of the population in the same way. Following the Guidelines for Using the IUCN Red List Catergories and Criteria (Version 11) section 12.1.2 the whole population should be assessed as a single enitity when assessing criterion B (Ketevan Batsatsashvili *pers comm.*).

Global climate change is a direct threat but may also be an indirect threat in that the amelioration in the climate may allow species that currnetly inhabit lower altitudes to survive in the areas currently inhabited by *P.porphyrantha* in the future. Being an extreme stress-tolerator *P.porphyrantha* will be outcompeted by most other species.

The population at Amulsar discovered in 2012 is directly threatened by mining activities in the next 5 years. Without any mitigation 50% of the global AOO will be destroyed. Although this is not enough to shift the categorisation from EN to CR it is a major threat.

Threats: Seed is collected from at least one sub-population for the horticultural trade although this is currently sustainable. The plant is grown as an alpine rockery plant (mainly in the USA and Canada).

A.7 Conservation Actions

Conservation Actions: The species is listed in the Armenian Red Data Book, Plants (Tamanyan *et al* 2010) but has no specific population recovery programmes within that country. The mining company has a written mitigation strategy but this assessment assumes there will not be one. In Iran there are no conservation measures in place.

A.8 IUCN Criteria

IUCN Criteria	Description	Measurement	Category
A	Population Size Declining		
1	Observed,estimated, inferred, suspected population decline over last 10 years or 3 generations where threat has ceased and decline can be reversed	there is no population trend information available	DD

	2	Observed,estimated, inferred, suspected population decline over last 10 years or 3 generations where threat has not ceased or is not understood or decline cannot be reversed	there is no population trend information available	DD
	3	A population size reduction of ≥50%, projected or suspected to be met within the next 10 years or three generations, whichever is the longer (up to a maximum of 100 years), based on (and specifying) any of (b) to (e) under A1.	50% of the global AOO could be destroyed in the next 5 years by mining activity	EN
	4	An observed, estimated, inferred, projected or suspected population size reduction of ≥ 80% over any 10 year or three generation period, whichever is longer (up to a maximum of 100 years in the future), where the time period must include both the past and the future, and where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible	there is no population trend information available	DD
B		Geographic range in the form of either B1 (extent of occurrence) OR B2 (area of occupancy) OR both		
	1	Extent of occurrence	24000 km^2	LC
	2	Area of occupancy	The population has an AOO of less than 500km^2 The threat of climate change applies to the whole population as a single location. The AOO is predicted to decline as is the quality of the habitat due to increasing temperature and lack of snow.	EN(B2a,bii&iii)
C		Population Size for Small Populations		
	1	Continuing decline in next generation	Population size is unknown but is assumed to be over 10,000 individuals.	LC
	2	Continuing decline in fragmented and/or fluctuating populations	Population size is unknown but believed to be in excess of 10,000 individuals and there is no evidence of current decline.	LC

D	Population Size - total size	Ultimately will be threatened by climate change	LC
E	Quantitative Analysis		NE

A.9 References

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Appendix B: Monitoring protocol

Plots are marked using permanent posts (wooden posts and possibly Fenomarkers in the longer term if monitoring continues for many years (http://www.berntsen.com/Go-Shopping/Surveying/Survey-Monuments/FENO-Survey-Monument)).

Plants are located by triangulation using tape measures attached to two measuring posts which can be metal rods painted a bright colour. Where posts are needed among rocks use metal rods 75cm to 100cm long.

Plants are revisited at intervals. Each plant has its own identification number and aspects of its life-history are recorded. Every time the rock is revisited the plants are re-measured and they retain their identification number from one visit to the next. A suitable rock for a permanent plot will have a large number of *Potentilla* plants, It should be easy to reach all the plants and be in a position that is not dangerous for workers to access.

The process is as follows:

1. Give the plot a unique number.
2. Take the GPS of the rock.
3. Take photos of the rock from a distance.
4. Position the marker post. The marker post should be numbered with the unique number from step 1 above.
5. Position the measuring posts (post A can be next to the marker post or otherwise use a hook on the marker post). The posts should be positioned so that tape measures can reach the plants without going around corners. There should be at least 2 measuring posts but there is no upper limit. If some plants will be difficult to reach from an existing post put in an extra one.
6. Measure accurately the distances between the measuring posts and make a sketch (Figure 20).
7. Measure and record distances; A to B, A to C, A to D, B to C, C to D. In this example distance B to D is not possible because the rock is in the way.
8. Take photos from each measuring post to the rock to help finding them in the future.

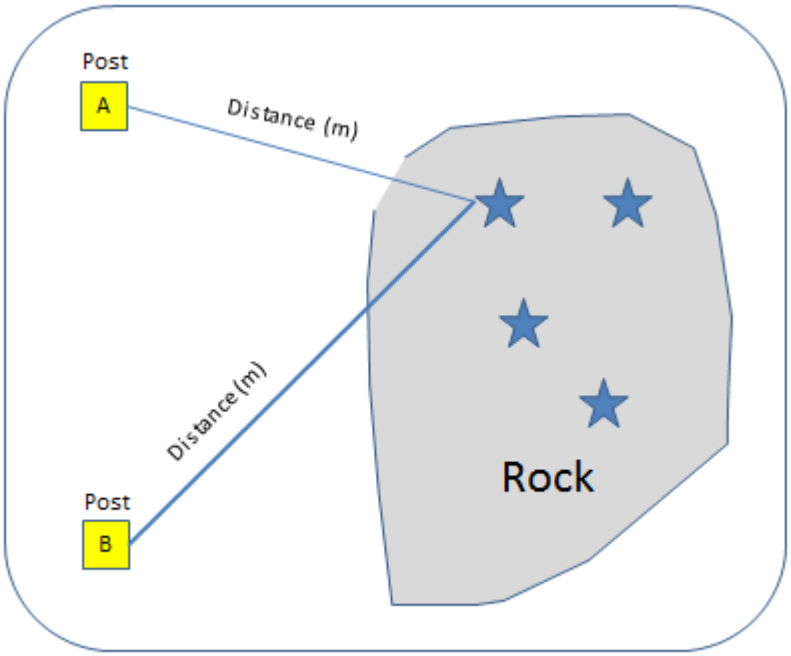

Figure 20 Diagram of plot method. Stars represent individual plants.

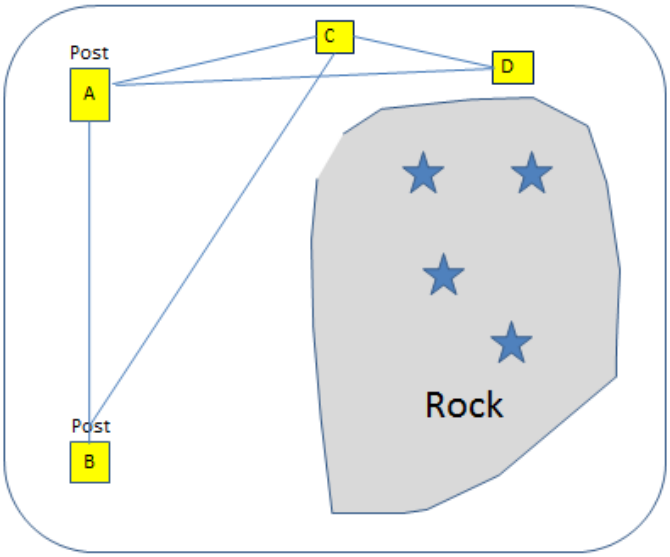

Figure 21 Measure between all posts accurately.

Equipment needed is as follows:

- Wooden marker posts.
- Metal measuring posts.
- A hammer will be needed to get the posts into the ground.
- Tape measures: The best tape measures to use are 25m or 30m and made of vinyl not metal (eg. made by Pitsco http://www.pitsco.com/store/). It is useful to have different coloured tapes to avoid confusion when measuring. The tapes are normally white but it is possible to get yellow or pink or orange.
- GPS: A GPS will always be needed to record the position of the rock/plot and then to find it again in the future.
- Clipboard: A clipboard is necessary to make writing on the recording forms easier. It is a good idea to have a clear plastic bag to keep the clipboard and recording forms in for when it is raining or windy. Alternatively buy Weatherwriter (http://www.wetwritesolutions.com/) or (http://www.weatherwriter.co.uk/).
- Copies of the Recording Form: At least one recording form for each rock/plot will be required. Start a new form for each rock. The recording form should include boxes at the top for general aspects of the plot and recording eg. Location and date. There should be columns for recording the position of the individual plants and the life-history parameters required. A sample form has been prepared (see below) and this will be modified by Geoteam (Sergey Arevshatyan) to include other variables of interest.

A recording form has been prepared, including boxes at the top for general aspects of the plot and recording eg. Location and date as well as columns for recording the position of the individual plants and the life-history parameters required. A sample form has been prepared (see below) and this can be modified as necessary.

Potentilla porphyrantha Recording Form												
Location			Rock Number				Date					
gps	East		North									
Surveyor names												
					2013				**2014**			
Plant id	**Post letter**	**Distance (m)**	**Post letter**	**Distance (m)**	**Size (cm) Summer**	**Size (cm) Autumn**	**Number of Flowers**	**Number of seed capsules**	**Size (cm) Summer**	**Size (cm) Autumn**	**Number of Flowers**	**Number of seed capsules**
1												
2												
3												
4												
5												
6												

7												
8												
9												
10												
11												
12												
13												

Appendix C: Indicative Costs (UK£) for *Potentilla porphyrantha* Research Programme

Research partnerships and finance

To ensure that research is carried out with the best knowledge and expertise available, research collaboration and partnership is proposed between the following organisations:

- RA's Institute of Botany (IoB) of the National Academy of Science;
- Lydian International Ltd with its fully owned subsidiary Geoteam CSJC;
- University of Cambridge Botanic Garden (UCBG); and
- Treweek Environmental Consultants (TEC) with Bodsey Ecology.

A formal agreement of Memorandum of Understanding has been established between Lydian, IoB, UCBG and TEC in which:

- Lydian establishes separate consultancy agreements with UCBG, IoB and TEC and supports the programme;
- TEC provides expertise and guidance and coordinates the programme with specialist input from Bodsey Ecology;
- UCBG provides advice on research, cultivation and propagation of *P. porphyrantha*. UCBG also provides training for Armenian nursery or research technicians; and
- IoB carries out research based in Yerevan and in Jermuk and manages translocation of plants if approved.

The Ministry of Nature Protection RA will also be involved in planning and will act to overview the project over the coming years.

Research budget

The proposed budget for the project during the next 4 years (mid-2014-early 2019) is around £407,000 i.e. roughly US$ 570,000 .

Table 2 Cost Schedule for research to underpin SAP

Cost By organisation							
	2014	2015		2016	2017	2018	Total
Cambridge	5950			34950	3700	3700	48300
CUTSmanagement fee	744	0		4369	463	463	6038
IOB/MNP	9008	25550		7445	7445	4296	53745
TEC/Bodsey	14950	29350		22100	19350	18250	104000
Armenian studentship		3000					3000
Cambridge Studentship (including travel)	0			37641	37141	37141	111923
Lydian capital costs	4960	27700		1500	2500	0	36660
Project totals plus CUTS	19796	110317		83005	70599	63849	363665
contingency@12%	2375	13238		9961	8472	7662	43640
Grand Total	**22171**	**123555**		**92965**	**79070**	**71511**	**407305**

Species Action Plan for Brown Bear *Ursos arctos* – Appendix 2 of the Biodiversity Action Plan for the Amulsar Gold Project

Prepared for:

Lydian International

By:

Treweek Environmental Consultants

CONTENTS

GLOSSARY OF ACRONYMS

BAP	Biodiversity Action Plan
BMP	Biodiversity Management Plan
BOMP	Biodiversity Offset Management Plan
BOS	Biodiversity Offset Strategy
EBRD	European Bank for Reconstruction and Development
ESIA	Environmental and Social Impact Assessment
ESMS	Environmental and Social Management System
Geoteam	Geoteam CJSC (an Armenian mineral exploration and development company)
IFC	International Finance Corporation
IUCN	International Union for the Conservation of Nature
Lydian	Lydian International Ltd
NCHA	Natural and Critical Habitat Assessment
NGT	Non-invasive Genetic Tagging
NPI	Net Positive Impact
NNL	No Net Loss (of biodiversity)
Project	Amulsar Open Pit Gold Mine Project
SAP	Species Action Plan
TEC	Treweek Environmental Consultants
WAI	Wardell Armstrong International
WWF	World Wide Fund for Nature - Armenia

1 INTRODUCTION

1.1 Purpose and contents of this document

Lydian International (Lydian) requested Treweek Environmental Consultants (TEC) to develop a Species Action Plan (SAP) for Brown Bear (*Ursos arctos),* which may be affected by its Amulsar Open Pit Gold Mine Project in Armenia.

The SAP forms part of the Amulsar Gold Project's Biodiversity Action Plan (BAP), which is an output of the Project Environmental and Social Impact Assessment (ESIA) and details all the actions needed to comply with Lydian's Biodiversity Policy, applicable laws and decrees and lender requirements relating to biodiversity and ecosystems.

This document summarises compliance requirements and provides a rationale for the actions included in the SAP for *Ursus arctos*. The SAP presents the actions that will be taken to achieve a net gain in population within a "reasonable timeframe". It includes some further survey work that is needed to confirm the best approach.

The remainder of Section 1 provides background information on the conservation status and distribution of *Ursus arctos* and a summary of surveys carried out so far (Section 1.2) and the legislative, regulatory and policy framework for the SAP (Section 1.3).

The rationale for actions to be taken to achieve a Net Positive Impact (NPI) on the species in Armenia is presented in Section 2.

The SAP is presented in Section 3.

1.2 *Ursus arctos:* background

1.2.1 Conservation Status

Ursus arctos is classified as Least Concern by IUCN and as Vulnerable in the RA Red Book. 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, while the Syrian subspecies is restricted to the south. The International Association for Bear Research and Management (IBA) and the Bear Specialist Group (BSG) of the IUCN Species Survival Commission (SSC) do not formally recognize these distinct sub-species, partly because of inadequate survey data in the region and the lack of genetic testing needed to confirm their existence. Nevertheless, the IUCN SSC does recognise differences between sub-populations

in terms of level of isolation and exposure to risk. There are 3 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 and Brown Bear 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), with an emphasis on re-establishing historical corridors and preventing further fragmentation of habitat[1].

A review of available scientific literature carried out for the ESIA (2013) provided limited specific information on bear populations in the region. Reports from the WWF Armenian Office were also reviewed along with the 2012 revised and amended Ecoregion Conservation Plan for the Caucasus[2]. Hardly any reliable surveys of bears have been carried out in Armenia and it is difficult to determine the abundance and trends of bears throughout the South Caucasus Region because of discrepancies in the data and the limited extent of surveys (Chestin *et al*. 1992). No adequate monitoring system for bear populations exists in the area, or monitoring is carried out with questionable methods that do not allow for accurate estimates of the true bear population trends in the region.

Bear distribution in the South Caucasus region has contracted significantly since historical times, due to increasing human activity and associated loss of forest cover. The species is also widely hunted. The present range is significantly smaller than the historical range (Lortkipanidze, 2010). Bear numbers have been low in the Lesser Caucasus mountains (including Armenia) since the middle of the 20th century (Vereshchagin 1958). They are considered to be likely to decline further due to ongoing intensification of farming and high levels of hunting, despite protection in law.

The population estimate in the 1970s was 292 bears (Vereshchagin, 1972) and Margarian (1987) estimated that there were only 150 bears left in the country. In the 1980s, data from governmental hunting districts suggested an increase in population to 600 (Kudaktin and Chestin, 1993, in Lortkipanidze, 2010), but according to the Wildlife Data Bank of the Caucasus

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

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

(NACRES, 2003), the current bear population in Armenia is unknown. Data needed to interpret the significance of the impacts of mining at Amulsar are therefore very limited.

1.2.2 Summary of surveys and results for Amulsar

Observations of bears were included in baseline surveys of Amulsar dating from 2008. In autumn 2011, more detailed observations were made 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. Presence of Brown Bear was noted in all these surveys, but the specialists reported that they were visiting the site, rather than being resident, and were present in very small numbers.

Further surveys were undertaken by the Armenian Institute of Zoology during 2013 and 2014 and observations were also made by ecological survey teams on Amulsar during ornithological surveys. In 2013 and 2014, numerous sightings and signs of Brown Bear were recorded. A number of dens were identified and numerous footprints could be seen all over the Amulsar mountain tops in spring and summer. Key areas appeared to be the southern side of the mountain, but many tracks and faeces were also found on the western slopes and further west up to Gndevaz village and the Arpa Gorge. In late May 2014, a female with two cubs was seen southeast of Gndevaz in areas where the mine Heap Leach Facility (HLF)) is proposed and specialists now consider there to be a confirmed breeding population using Amulsar.

Although bear tracks had been seen along the Vorotan Valley (east of Amulsar) in 2011, none were seen in 2013 or 2014, and in focus group surveys for ecosystem services review, herders reported that increasing levels of disturbance in the valley have caused bears to move. Further away from Amulsar Mountain, a male bear was observed east of Jermuk in late April 2013, and footprints were found on the muddy shores of Spandaryan reservoir. This reinforced anecdotal information suggesting that bears are also present in the wider landscape, though no systematic surveys had been done there before 2015.

1.3 Regulatory and policy framework

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 (Margarian, 1987).

The Project area is classified as critical habitat for Brown Bear in relation to EBRD's PR6, because the species is listed in Annex IV of the EU Habitats Directive. Although Armenia is not a member of the EU, EBRD expects clients to follow the spirit of EU Directives. In this case it means that the Project must ensure (i) that the ecological functionality of breeding sites and resting places for Brown Bear are not damaged or destroyed; and (ii) that the Project will not result in disturbances that affect the species' survival or breeding success, or reduce its area of occupancy. Mitigation measures employed will need to be sufficient to ensure a net gain for the species. Due to insufficient knowledge of the baseline situation with respect to Brown Bear, Project compliance with these conditions of PR6 / the EU Habitats Directive cannot be demonstrated and specific surveys on the local distribution of this species are required.

Brown Bear is also an apex predator and performs an important ecological role in maintaining animal populations associated with natural habitat. IFC PS6 therefore requires no net loss (NNL) of habitat to be demonstrated for the affected Brown Bear population.

2 Actions towards No Net Loss or Net Positive Impact

Ecological surveys carried out as part of the ESIA for Amulsar confirmed that a breeding population is present and identified potential loss of habitat, disturbance and barrier effects.

2.1 Baseline survey

A detailed baseline survey was carried out in 2015 to provide information on the size of the affected population, their movement patterns and their habitat requirements. The preliminary results indicate the importance of Amulsar for maintaining the affected population and help to confirm appropriate boundaries for a set-aside for Brown Bear. The results of the survey will feed into the Project Biodiversity Management Plan (BMP) and Biodiversity Offset Management Plan (BOMP), if appropriate. They will also be used to further develop the SAP.

2.1.1 Survey area

The survey focused on Amulsar within its wider context, as bears range over large areas. It also included areas that are proposed for the Project's natural habitat offset on Arshak Peak, as Brown Bear is a key feature of the natural habitat affected by the Project and an offset may be needed to ensure NNL/NPI as necessary.

Because of their intrinsic characteristics (huge territories, low densities), large mammals such as Brown Bear must be monitored over very large areas. They may wander over long distances in search of food, and their feeding range can shift seasonally. Therefore, and in order to sample a wider range of habitats, the survey area included not only Amulsar Mountain and the areas where presence of bears had already been indicated, but also surrounding areas with apparently suitable habitat and little disturbance.

The survey area is shown in Figure 1. In addition to Amulsar Mountain, the Arpa Gorge and around the Spandaryan reservoir, it included three other large areas that looked promising for Brown Bear based on preliminary field visits:

- The mountain range south of Spandaryan reservoir and south of the towns of Gorayk and Ughedzor;
- Herher state sanctuary, within the proposed Jermuk National Park, which offers a large expanse of wooded habitat; and
- Jermuk hydrological state sanctuary, another area within the proposed Jermuk National Park offering wooded valleys of the type affected by the mining project.

Note that the Vorotan Valley was not included in this proposal. No signs of presence of Brown Bear were found here, and the habitat does not appear particularly suitable: the valley is flat and open with little to no shelter, vegetation is very short, and there is important disturbance due to cow herding and frequent traffic. The survey area intersects 39 grid squares of 5x5 km. However, squares 35-37 were in a military conflict zone along the Armenian – Nakhchivan border and therefore had to be discarded for safety and security reasons. In addition, squares 7 and 29 were almost completely outside the proposed National Park area and were discarded. In practice, the survey was conducted in 34 grid squares.

2.1.2 Survey period

The survey started early in spring 2015, when the focus was on detecting den emergence and making observations on apparent age and gender of bears using hibernation/breeding dens on Amulsar Mountain and their movement patterns on emergence. This part of the survey was carried out from the end of February to the end of April. The amount of snow cover at this time of year is ideal for observing bear footprints and all of these were recorded with GPS.

An exploration of the wider area on foot was required to select the ideal sampling locations. This was done from mid April to mid May. The sampling sites were set up from mid May to mid June.

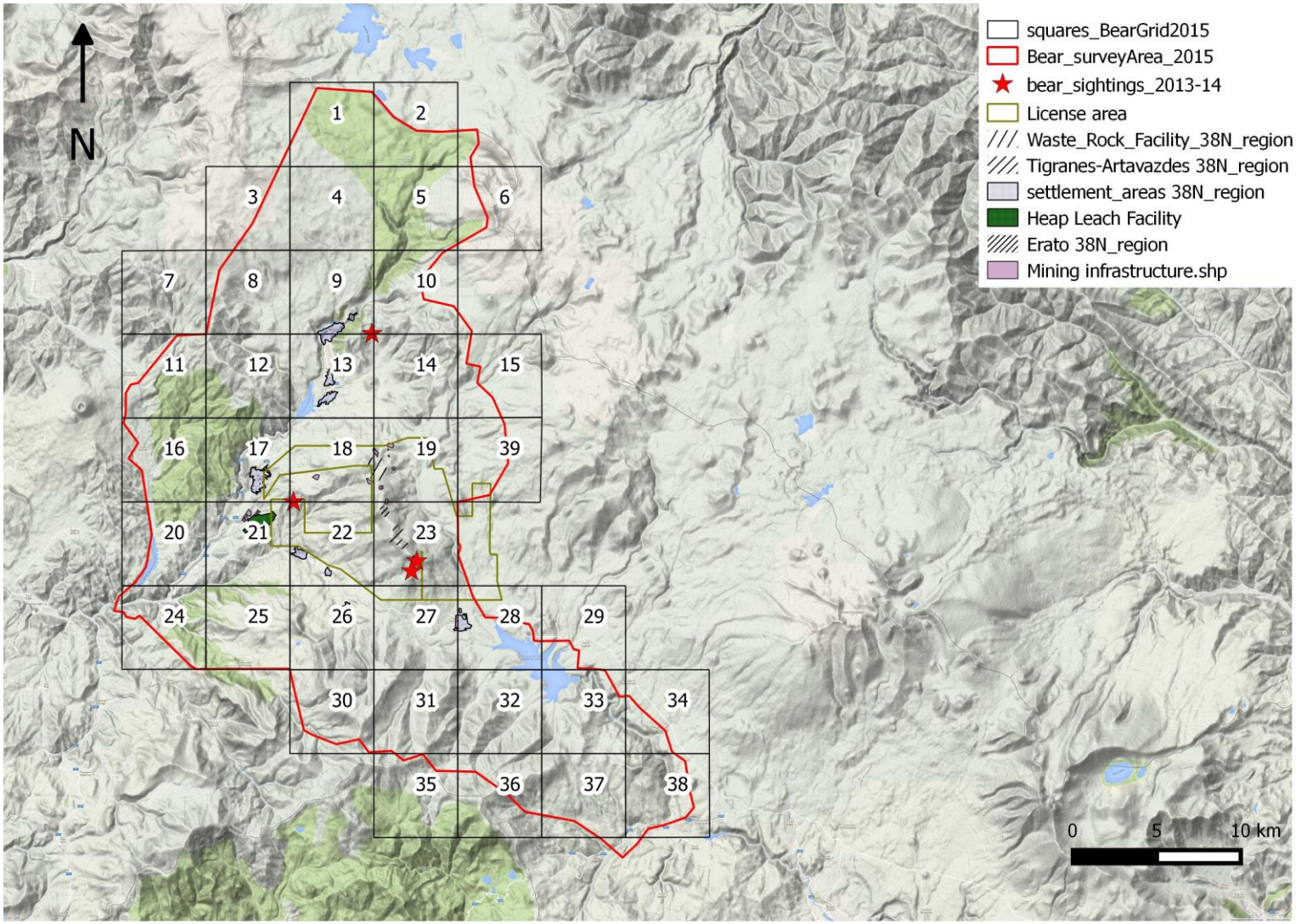

Figure 1. Outline (red) of survey area for Brown Bear, with location of observations of this species in 2013-14

2.1.3 Methods

Due to their shy, elusive nature Brown Bears are not easily surveyed, and specific techniques are required to get a realistic idea of the number of individuals in an area. It is challenging to obtain reliable information for sparsely distributed and elusive animals in such a large survey area.

2.1.3.1 Sampling techniques

Two principle non-invasive methods for ascertaining Brown Bear populations exist: non-invasive genetic tagging (NGT) and the systematic use of camera traps[3]. NGT (see De Barba *et al,* 2010 for method) is used to obtain trapped hair follicles to yield DNA samples, which can be amplified and identified to species by mitochondrial analysis. This technique has been used frequently in conservation planning in Canada (e.g. Alberta Grizzly Bear Recovery Plan 2008-2013) as it provides low-cost and high-yield data on species' occurrence and is idea as an initial step to establish the numbers of different bears in the study area and their genetic inter-relationships.

This technique can carry some error, however. Interpretation of false absences is a particular challenge. When a species is not detected at a site, one cannot be sure whether a species is truly absent, or present but simply undetected (MacKenzie *et al*., 2002; MacKenzie, 2005). This error can be corrected for by simultaneously using a second-survey method such as camera traps.

The use of automatic devices such as infra-red cameras has proved to be an effective method for assessing population numbers and density of Brown Bear (e.g. Nicolini *et al.,* 1997; Fisher *et al*., 2014). Combined with NGT sampling this method is extremely powerful at surveying carnivore populations (Nichols et al., 2007; Fisher & Bradbury, 2014).

A combination of these two techniques was used to assess Brown Bear density, movement and speciation. Use of the two techniques together aids interpretation of results, as it makes false negatives less likely.

[3] Telemetry collars are a third option using satellite collars that beam location data to the desktop, but these are the most expensive. GPS collars are cheaper but require recaptures or at least proximity to a receiver. Both of these options are not considered here given costs and the expertise and resource required.

Figure 2 shows how the two techniques can be combined to give more reliable results. Genetic analysis will be carried out only using those hairs from sites with bear photos.

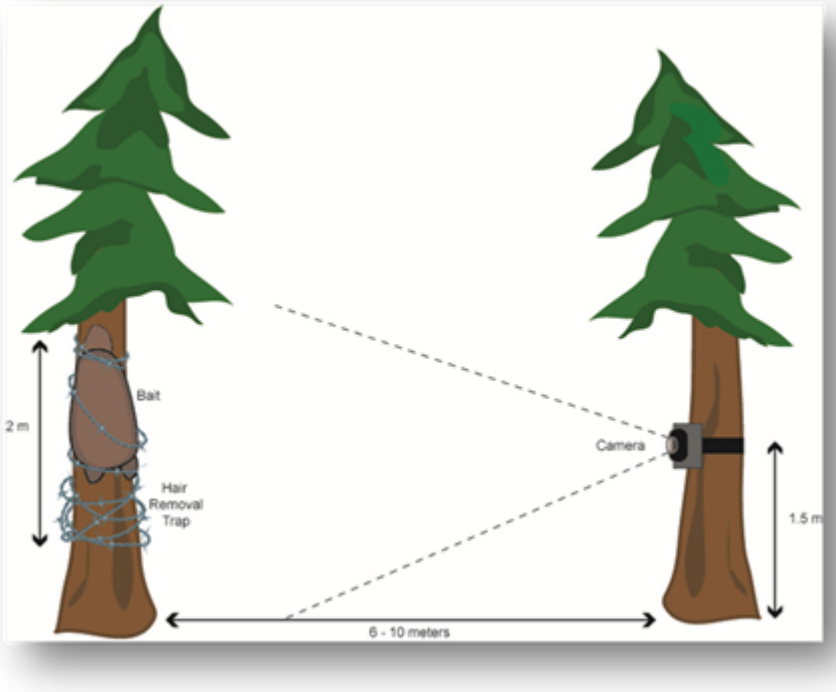

Figure 2. Relationship between non-invasive genetic tagging (left) and camera traps (right) as methods for surveying Brown Bear (Fisher and Bradbury 2014)

2.1.3.2 Sampling strategy and survey set up

To get a clear idea of the true density of bears in the area and to avoid reporting any false absences, sampling should occur at a relatively dense scale, e.g. with sampling sites located no more than 5 km from each other. Thus, one sampling site was selected in each 5x5 km grid square. The minimal distance between two sampling sites from neighbouring squares was 1.4 km, the maximum distance always less than 5 km except for site 1, which was at 6.1 km from the nearest one. The location of each sampling site is shown in Figure 3.

The survey started early in spring 2015, when the focus was on detecting den emergence and making observations on apparent age and gender of bears using hibernation/breeding dens on Amulsar Mountain and their movement patterns on emergence. This part of the survey was carried out from the end of February to the end of April. The amount of snow cover at this time of year is ideal for observing bear footprints and all of these were recorded with GPS.

An exploration of the wider area on foot was required to select the ideal sampling locations. This was done from mid April to mid May. The sampling sites were set up from mid May to mid June. The location of all 34 sites is shown in figure 3. Each sampling site consisted of a hair trap made by looping approximately 5 meters of barbed wire around a tree or boulder and one infrared, motion-triggered Ltl Acorn 6210 MC digital camera placed at a distance of 5-10 meters looking directly at the wire. A similar sampling design has been used many times before in North America (e.g. de Barba *et a*l., 2010, Fisher *et al.,* 2013) but only in a wooded environment using trees. We also used trees if they were available (see **Error! Reference source not found.**), but large parts of our survey area were entirely devoid of trees and in that case the barbed wire was anchored around big boulders. Each hair trap was baited with O'Gorman's LDC Extra scent lure (O'Gorman's Co., Montana, USA). Bears can smell the lure from a couple of hundred meters and will often come to investigate and rub against the baited barbed wire, thus leaving hair samples.

When all cameras and hair traps were in place, each trapping site was visited approximately twice a month to collect and replace memory cards, replace batteries, and collect hair samples using sterile methods. Hairs taken from each barb were put into separate coin envelopes and stored in a cool, dry place. Envelopes were labelled with date, number of square, number of loop (counting upwards), number of barb, and position/height in cm above the ground.

In squares 14 and 24 new locations for trapping sites had to be selected, as the cameras were stolen after having been operational for several months. In these two squares, data was therefore collected from two sites rather than one. This will be corrected for in the later statistical analysis. Camera 8 was stolen too, but much earlier in the season, when it had been operational for a few weeks only. In this square only the new location will be used in the analysis.

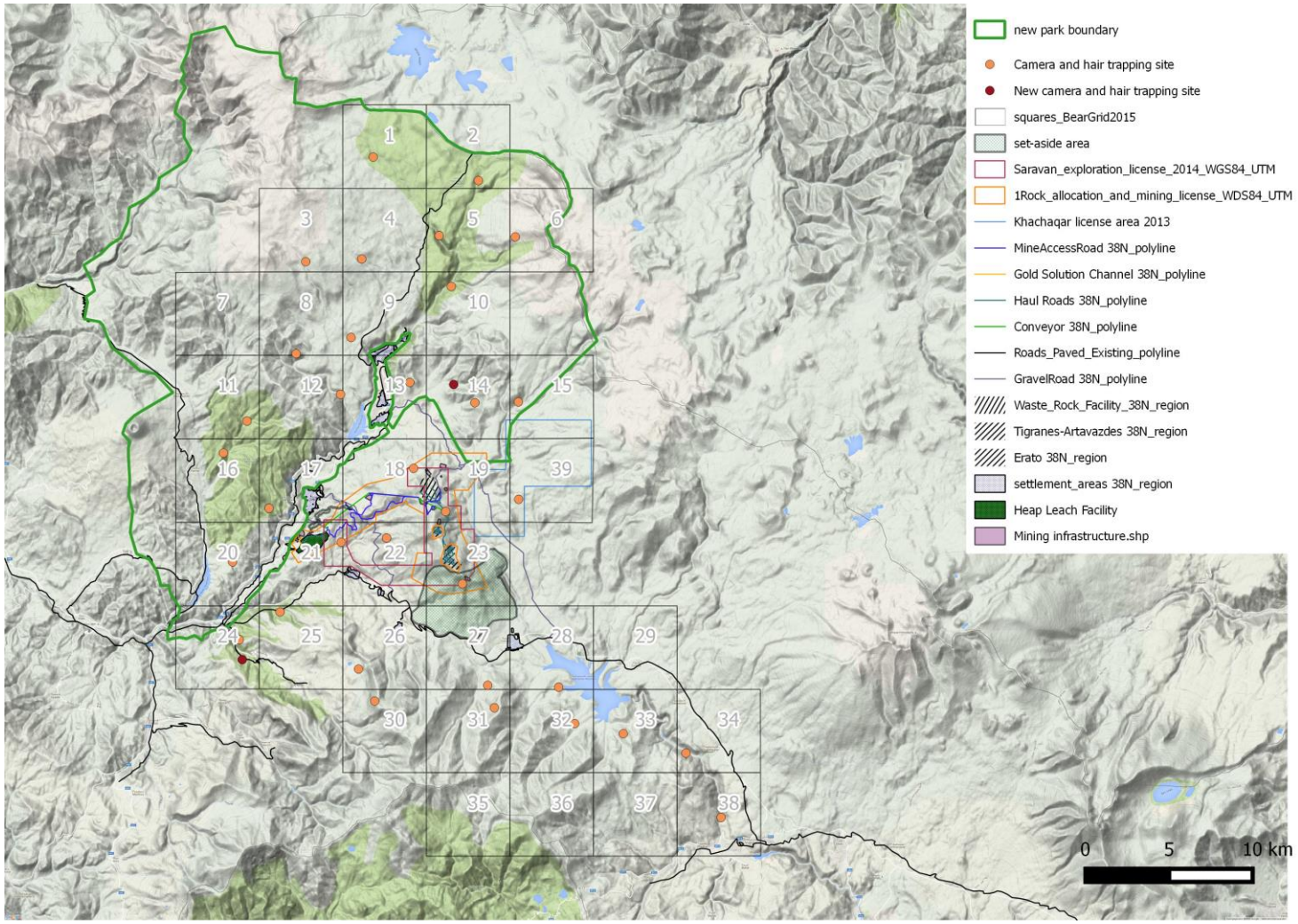

Figure 3. Location of trapping sites, with indication of set-aside area and proposed national park

2.1.3.3 Genetic testing

Hair samples were sent to Wildlife Genetics International (WGI; Nelson, British Columbia, Canada) to identify individuals and gender.

In April 2016, WGI provided results from 237 hair samples received in 2 batches on September 22 and October 27, 2015.

The 237 hair samples were classified as follows:

- 33 samples that lacked material suitable for analysis.
- 14 samples (6%): that gave failed or mixed species results.
- 19 samples (8%): identified by mtDNA as other-than-brown bear.
- 47 samples (20%): confirmed as hair from brown bear that failed microsatellite analysis, either during a pre-screening analysis (*n* = 38) or during multilocus genotyping (*n* = 9).
- 124 brown bear samples (52%): that were assigned individual identity.

The 124 good brown bear samples were assigned to 28 individuals, 7 male and 21 female.

There was lots of hair in these samples, with an average of 6.4 guard hair roots per extracted sample (treating 1 underfur as equivalent to 0.2 guard hairs). This was reflected in genotyping success, with 180 of 204 extracted samples (88%) producing a species identification, and 124 of 171 brown bear samples (73%) yielding complete genotypes for the 8 individual ID markers. Of the 133 samples that passed the prescreen, an outstanding 124 (93%) were genotyped successfully.

2.1.3.4 Interpreting results

Statistical occupancy models will be used to analyse these data (MacKenzie *et al*., 2003; MacKenzie *et al.,* 2006; Nichols *et al*., 2007; Fisher and Bradbury, 2014) and estimate population size, density and spatial distribution in the Study Area (Proctor *et al.* 2004, Solberg *et al.* 2006, Kendall *et al.* 2009). Data from camera traps can only be used to show presence of bears. Although cameras are invaluable for judging the extent of underestimation of bear occupancy as indicated by the hair sample data, they do not allow reliable identification to individual level. Unlike cats, which often have spotted or striped fur with unique pattern, all bears have more or less the same type of uniformly coloured fur and therefore look similar. In addition, many photos were taken at night, and even during the daytime the resolution of wildlife cameras is not high enough to reliably assess details of the fur. Bears can wander over

long distances, some covering more than 100 km in a month, so a single bear could theoretically visit many squares and be captured by several cameras, creating the false impression that several bears are present.

The results of this interim report should therefore be interpreted with care until the results of the final analysis are available. At this stage, they reflect presence/absence of bears in a particular square, and give some indication of which parts of the survey area are used by the species.

2.2 Baseline understanding of interactions between bears and people

The ability to develop an effective mitigation strategy for bears affected by the Project requires understanding of the true impact of bears on livelihoods and of the interactions currently taking place between bears and land users, including seasonal herding communities, villagers and hunters. Local communities often also have important information about the distribution and number of bears.

2.2.1 Interviews with land users

A programme of semi-structured interviews was therefore designed. Interviews were held with villagers, local livestock herders and other land users potentially in conflict with bears in July 2015. The resulting report is now available. Where communities are cohesive, “snowball sampling” was used to facilitate reaching the target respondents and to obtain information on:

- Perceived risk of conflict, tolerance towards conflict species and individual vulnerability to a conflict event were recorded via semi-structured household interviews to shed light on conflict resolution strategies that are likely to be the most effective and cost efficient.
- Attitude towards bears: behavioural intention and behavioural expression. Individuals’ behavioural expression or behavioural intention with regard to bears was recorded alongside their support or disagreement with potential management options. Behaviours of interest included intention to harm or exclude Brown Bear from an area and existing, proactive conflict reduction activities. Randomised Response Techniques were utilised for questions involving potentially sensitive or illegal behaviours to ensure data validity.

The results suggest a general awareness of the need to conserve brown bear and a willingness to accept enhanced conservation effort, but also a strong antipathy towards wolves.

2.2.2 Wider stakeholder consultation

Stakeholder consultation will be carried out with NGOs and other organisations active in bear conservation in the region in 2016, when baseline survey results are available. Organisations contacted will include the FPWC, an organisation already carrying out camera trapping in the Khosrov area. The FPWC is working to develop the Caucasus Wildlife Refuge - a 2000 ha territory which FPWC maintains as a privately managed conservation area, located in the south of the country in the Ararat region (Urtsadzor community, near Khosrov Forest State Reserve). (see http://www.sunchild.org/index.php?id=138&L=0&id=138 for further information).

Some engagement will also take place with the Yerevan zoo which cooperates with the Ministry of Territorial Administration and Emergency Situations to rescue trapped wild animals. FPWC is also involved with the conservation-related efforts of the zoo.

As part of the amendment to the Environmental and Social Impact Assessment (ESIA), additional disclosure and consultation will take place in early 2016 to raise bear awareness and explain the results of the current study.

2.3 Development of action and management plans

Based on the complete results of the baseline survey, any recommendations for further work will be made, including the need for further monitoring of bears to obtain more detailed understanding of their movement patterns and of the impacts of mining activity. The SAP will be maintained as a live document and used to inform management through the BMP. Recommendations will be made for conservation management actions as part of the Project's Biodiversity Offset Strategy (BOS). These will involve further discussion with stakeholders and land users in the proposed Jermuk National Park.

3 SAP

Preliminary SAP for Brown Bear

Task	Topic/ objective	Action required	Action to be undertaken by:	Completion Indicator	Timeframe	Project control	Status
	Establish a reliable baseline for Brown Bear to support detailed assessment of impacts and identification of suitable mitigation.	**Surveys of Amulsar Mountain and the wider landscape/ study area, to include specific actions identified below.**	**Lydian contractors: TEC/ASPB/ Alberta Innovates**	**Report presenting reliable baseline data spanning full season for Project-affected area and wider study area**	**Pre-construction, 2015**	**Lydian**	**Completed, but genetic testing remains to be done (April 2016)**
1	Effective and appropriately designed survey.	Produce survey plan.	TEC/ASPB/ Alberta Innovates	Detailed survey plan in place	End of January 2015	Lydian	completed
2	Identify hibernation/ breeding dens used on Amulsar Mountain and establish importance of different parts of the Mountain at den-emergence.	ASPB surveyors, surveying on foot, make observations of den-emergence, numbers and gender of bears, movement patterns immediately following emergence (sensitive period), preferred foraging areas.	ASPB	Observations reported	• Survey: March- April 2015 • Results: end of April 2015	Lydian	completed

Task	Topic/ objective	Action required	Action to be undertaken by:	Completion Indicator	Timeframe	Project control	Status
3	Obtain preliminary information on wider study area to inform detailed location of traps and potentially to enable individual bears to be identified.	1. Make observations of bears from elevated vantage points using spotting scopes in the wider study area. 2. Carry out local consultation to obtain supplementary information on areas used by bears.	TEC/ASPB including social specialists	Observations reported	Mid- April to mid May 2015	Lydian	completed
4	Robust survey design based on suitable recording locations that are accessible and potentially suitable for bears.	Reconnaissance survey: visit grid intersections and identify suitable sampling locations for camera and hair traps.	TEC/ASPB/ Alberta Innovates	Specialist approves proposed sampling points or locations	Mid April to mid May 2015	Lydian	completed
5	Survey equipment installed and fully operational.	Set up and test camera and hair traps at planned locations.	Lydian contractors (TEC/ASPB)	• Equipment procured and installed with camera and hair traps at 44 locations • Hair traps baited with lure • Test runs confirm equipment is appropriately installed and operational	From mid May to end of May 2015	Lydian	completed

Task	Topic/ objective	Action required	Action to be undertaken by:	Completion Indicator	Timeframe	Project control	Status
6	Data recording and processing.	• Visit camera traps, retrieve data, re-set traps; visit hair traps, retrieve samples. • Photo image analysis, data entry, data management.	Lydian contractors: TEC/ASPB/ Alberta Innovates	Data obtained for full survey period	Every two – three weeks per individual trap from May to October	Lydian	completed
7	Data analysis.	• Lab analysis of hair samples. • Occupancy analysis of camera and hair data. • Population estimation from genetics data.	• Lab analysis of hair samples by WGI • Occupancy analysis by TEC/Alberta Innovates	Results reported	• Genetic analysis: April 2016 • Occupancy analysis end of June 2016	TEC/ Lydian	• Genetic analysis of hair samples completed. • Occupancy analysis to be completed.

Task	Topic/ objective	Action required	Action to be undertaken by:	Completion Indicator	Timeframe	Project control	Status
8	Baseline reporting to provide a strong evidence base for application of the mitigation hierarchy, with data obtained and interpreted using robust techniques	Produce Baseline Report based on analysis of field data and specialist recommendations. Report should consider: • Value of current set-aside for Brown Bear and whether the boundary should be adjusted; • Any additional mitigation measures for Brown Bear to be added to the Project BMP; • Any specific monitoring measures to be added to the BMP.	TEC/Alberta Innovates	• Draft Baseline Report • Final Baseline Report	End November 2015	Lydian/ Geotea m	completed
9	Recommendations for further survey needed to support impact assessment and management planning towards maintenance of a viable population of Brown Bear, based on good understanding of bear numbers, movement patterns and habitat requirements.	Specialist to make recommendations including further monitoring to obtain necessary information.	Alberta Innovates	Recommendations submitted	July 2016	TEC/ Lydian	On completion of baseline survey and issue of report
10	**Stakeholder Consultation**						

Task	Topic/ objective	Action required	Action to be undertaken by:	Completion Indicator	Timeframe	Project control	Status
10a	Stakeholder engagement is effective and timely.	Incorporate bear-related plans for stakeholder engagement in the Project Stakeholder Engagement Plan, including specific aspects identified below.	TEC/Lydian	Stakeholder Engagement Plan includes plans for engagement on the topic of bear impacts and conservation	Early 2015	Lydian	completed
10b	Engagement with NGOs active in bear conservation in the Caucasus/Armenia to share experiences.	• Stakeholder mapping followed by identification of key stakeholders. • Meetings, discussions and shared field visits with NGOs involved in conservation of Brown Bear, including FPWC and WWF.	TEC/Lydian	Planned engagement included in Project Stakeholder Engagement Plan Meetings and discussions held with key organisations	2015	Lydian	ongoing
10c	Engagement with communities in proposed Jermuk National Park to seek their involvement in positive conservation actions for Brown Bear and to discuss implications of bear conservation for their livelihoods and wellbeing.	Carry out targeted meetings and surveys to obtain information on attitudes to bears, potential for bear/human conflict and likely attitude to conservation of bears or willingness to participate in conservation activities.	TEC/Lydian, including social specialists and community liaison officers	• Key Stakeholders identified. • Planned Engagement included in Project Stakeholder Engagement Plan. • Meetings and surveys held with communities and land users located in wider survey area.	Between May and October 2015	Lydian	completed

Task	Topic/ objective	Action required	Action to be undertaken by:	Completion Indicator	Timeframe	Project control	Status
10d	Engagement with Government to agree conservation actions and mechanisms.	Strategic meetings and ongoing discussion with representatives from Ministry of Nature Protection and Government advisors including Institute of Zoology.	TEC/Lydian	Planned engagement described in Stakeholder Engagement Plan	Ongoing	Lydian	Ongoing
11	**Impact Assessment and Mitigation Strategy**						
11a	Potential impacts can be predicted in terms of bear population, habitat availability and mobility in the landscape.	Detailed impact assessment to predict likely impacts of Project on population as identified through baseline survey.	Lydian and consultants	Detailed design reflects requirement for avoidance measures.	Pre-construction	Lydian	A preliminary impact assessment has been completed.
11b	A robust mitigation strategy is in place for the affected bear population on Amulsar.	Design of an appropriate mitigation strategy reflecting baseline and impacts and the mitigation hierarchy.	Lydian and consultants	Detailed design reflects requirement for avoidance measures.	Pre-construction	Lydian	A preliminary mitigation strategy has been completed. Detailed design of conveyor and crossings currently taking place.

Task	Topic/ objective	Action required	Action to be undertaken by:	Completion Indicator	Timeframe	Project control	Status
12	Conservation Actions towards NNL/ NPI : detailed Action Plan including offset proposals if needed.	Update SAP based on results of surveying.	TEC	• SAP is up to date • Project BOS and/or BOMP include provision for offsets for impacts on bear populations if needed	Final Baseline Survey Report July 2016, other documents updated accordingly during 2016.	Lydian	Preliminary conservation actions have been put forward; BMP has been updated with conservation actions. Further update on completion of baseline survey report .
13	**Monitoring and Evaluation**						

Task	Topic/ objective	Action required	Action to be undertaken by:	Completion Indicator	Timeframe	Project control	Status
13a	Bear monitoring to detect impacts of the Project.	Design and implementation of a detailed monitoring plan for Bear populations and their sensitivity to specific impacts.	TEC	• Bear monitoring requirements included in Project Biodiversity Monitoring and Evaluation Plan (BMEP) • Indicators identified with clear thresholds • Required monitoring frequency is established Responsibility for monitoring actions is clear	2016	Lydian	Planning phase
13b	Bear monitoring to review effectiveness of mitigation	Include in BMP any actions needed to monitor on-site mitigation measures and their effectiveness, e.g. use of crossings under the conveyor.	Lydian and contractors	BMP includes required monitoring measures	Ongoing	Lydian	completed

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Biodiversity Offset Strategy – Appendix 3 of the Biodiversity Action Plan for the Amulsar Gold Project

Prepared for:

Lydian International

By:

Treweek Environmental Consultants

CONTENTS

GLOSSARY OF ACRONYMS

Amulsar	Amulsar Open Pit Gold Mine Project
ARB	Armenian Red Book
ASPB	Armenian Society for the Protection of Birds
BAP	Biodiversity Action Plan
BBOP	Business and Biodiversity Offset Programme
BMP	Biodiversity Management Plan
BOMP	Biodiversity Offset Management Plan
EBRD	European Bank for Reconstruction and Development
ESIA	Environmental and Social Impact Assessment
ESMS	Environmental and Social Management System
IBA	Important Bird Area
IFC	International Finance Corporation
IUCN	International Union for the Conservation of Nature
Lydian	Lydian International Ltd
NCHA	Natural and Critical Habitat Assessment
NNL	No Net Loss (of biodiversity)
PA	Protected Area
PR	Performance Requirement (of EBRD)
PS	Performance Standard (of IFC)
RA	Republic of Armenia
SEP	Stakeholder Engagement Plan
TEC	Treweek Environmental Consultants
WAI	Wardell Armstrong International
WWF	World Wide Fund for Nature

1 Introduction

This document explains the approach taken by Lydian International (Lydian) to offset the impacts on biodiversity and ecosystems of its Amulsar Open Pit Gold Mine Project in Armenia.

The Biodiversity Offset Strategy (BOS) is part of the Biodiversity Action Plan (BAP) for the Amulsar Project, an output of the Environmental and Social Impact Assessment (ESIA). In line with good practice guidance, the Project's predicted impacts on biodiversity and ecosystems have been addressed in accordance with the mitigation hierarchy, and offsets are only proposed for residual impacts on certain priority biodiversity components which are expected to experience significant residual impacts despite planned avoidance and mitigation (for details of these refer to the Biodiversity Management Plan (BMP)).

The BOS will form the basis for a more detailed Biodiversity Offset Management Plan (BOMP) when the results of further studies are available, including a detailed loss/gain assessment.

1.1 Biodiversity Offset Requirements and Standards

A BOS has been developed to explain the Project's proposed approach to use of offsets to achieve required outcomes for biodiversity in line with the requirements of the International Finance Corporation (IFC) and the European Bank for Reconstruction and Development (EBRD), potential lenders to the Amulsar Project.

As well as general provisions to encourage the conservation and sustainable use of biodiversity, IFC's Performance Standard 6 (PS6) and EBRD's Performance Requirement 6 (PR6) require biodiversity offsets to be implemented as part of a Project's mitigation strategy if it is expected to have significant residual adverse effects on biodiversity which is "critical" according to certain criteria ("*in critical habitats, any significant residual impacts must be mitigated using biodiversity offsets*"). Implementing biodiversity offsets is also an "appropriate action" to achieve no net loss (NNL) of natural habitat (paragraph GN15 of PS6).

Lydian's own policy is to achieve NNL of biodiversity and to ensure that biodiversity and ecosystem functions are not systematically degraded or lost from the landscape as a result of the Amulsar Project. This means that species occurring in the Project's area of influence should have the same chances of long-term survival with the Project in place as without it and have access to similar amounts of suitable habitat as in the baseline situation. In line with this policy, Lydian has sought opportunities to undertake "additional conservation actions" as part of the BOS, so that NNL can also be achieved for biodiversity prioritized at national level, even if its habitat is not defined as "critical" according to PS6 or PR6.

The Republic of Armenia (RA) does not have laws or policies on biodiversity offsets. To demonstrate good international practice, the Amulsar Project's BOS has been designed to align with the principles and criteria set out in the Business and Biodiversity Offset Programme's (BBOP's) Standard on Biodiversity Offsets[1] to the extent possible, given that the process of designing offsets for the Project is not complete at this stage.

2 Residual Impacts of the Amulsar Project and the Need for Offsets

The Project ESIA's conclusions regarding the need for biodiversity offsets, based on its residual impacts and the current level of assurance about mitigation effectiveness and the ability to offset impacts, are summarised in the following sections.

2.1 Natural Habitat

Amulsar Mountain has extensive Sub-alpine Meadows, Sub-alpine Meadows with Alpine Elements, Montane Meadows and other vegetation types, which are considered to be natural according to the criteria in PS6/PR6. High mountain habitats such as Sub-alpine Meadows and Montane Meadows are identified as a Priority ecosystem in the Caucasus Ecoregion Conservation Plan (WWF, 2012) and Amulsar has good examples of them.

[1] Business and Biodiversity Offsets Programme (BBOP). 2012. Standard on Biodiversity Offsets. BBOP, Washington, D.C. Available from http://bbop.forest-trends.org/guidelines/Standard.pdf

The Project's impacts on natural habitat are described in Section 4.1.6 of the ESIA. They include:

a) The physical Project footprint within which vegetation will be either destroyed or fundamentally modified for the lifetime of the mine;

b) Areas of land surrounding the footprint, within which plant communities are predicted to become modified by dust deposition, deposition of pollutants or eutrophication; and

c) Additional restricted areas, within which land use may alter due to the Project's restricted access arrangements, with possible longer term effects on vegetation.

Based on the ESIA assumptions, the Project could affect 1805.2 ha of natural habitat, which represents 13.8% of the extent of natural habitat that has been mapped around the Project area.

Although all efforts will be made to avoid and minimise impacts during construction and operation (see BMP), and attempts will be made to restore vegetation in all disturbed areas post-mining, there will be residual losses within the physical footprint as well as modification in other zones. The Project has chosen to quantify its residual footprint on natural habitat using conservative or precautionary assumptions about levels of habitat loss and degradation within the Project-affected area and the likelihood of restoration success. On this basis the Project intends to implement a natural habitat offset in a nearby area, which forms part of a proposed new Jermuk National Park. The proposed approach to design and implementation of the offset is described in Section 3.

2.2 Critical Habitat for *Potentilla porphyrantha* Juz

Potentilla porphyrantha Juz is listed as Critically Endangered in the RA Red Book and assessment against IUCN criteria suggests it would be listed as Endangered. Amulsar supports one of only five known sub-populations globally and has critical habitat for this species based on the criteria included in PS6/ PR6. The proposed mine pits partially overlap this critical habitat and mining will cause at least a temporary reduction in numbers of plants, amounting to about 33 % of recorded plants and 21% of the estimated sub-population on Amulsar, as well as reducing the potential area of

occupancy. In terms of the global Area of Occupancy five of the 32 4km^2 grid cells are partly covered by the Project's physical footprint.

There is a high degree of confidence that a viable population will remain on Amulsar Mountain despite reduced numbers, but the ability to restore numbers of plants and increase them post-mining depends on techniques for translocation, propagation and reinstatement that have not been tested for this species before, as well as improved understanding of its habitat requirements. Hence the Project has chosen to develop a detailed Species Action Plan (SAP) as outlined in Section 3 of this BOS, to develop a robust, evidence-based approach. The significance of any residual impact on the Amulsar population of *Potentilla porphyrantha* in global, regional and national conservation terms might alter if further populations of the plant were discovered in Armenia. Searches in 2015 did not reveal additional populations, but further searches are planned, as indicated in the SAP. Confirmation of the need for an offset is contingent on:

a) monitoring results showing more extensive impacts than predicted, with decline in the condition and/or survival of plants in the residual population on Amulsar Mountain;

b) research through the BAP failing to improve understanding of the species' ecology and requirements;

c) failure to propagate or grow the species successfully *ex-situ* from seed;

d) lack of confidence that suitable conditions can be created post-mining; or

e) results of genetic studies suggesting the Amulsar population is genetically distinct or unique.

Given that the plant is a relatively slow-growing perennial there is considered to be ample time available to establish the need for an offset. This would be reinforced by failure to discover any further populations in Armenia, which would also strengthen the case for an offset based on formalised protection of the species, as it is currently vulnerable to several threats and pressures, as identified in the RA Red Book. This, together with climate change, make the species vulnerable to decline throughout its distribution in Armenia.

2.3 Critical Habitat for *Ursos arctos* (Brown Bear)

Ursus arctos is included in Appendix IV to the EU Habitats Directive and is listed in the RA Red Book as Vulnerable. It is also identified as a priority species[2] in the Caucasus Ecoregion Conservation Plan and is a key species associated with Amulsar Mountain's natural habitat, triggering critical habitat according PR6. Surveys of Amulsar and the surrounding area in 2015 confirmed regular presence of up to 10 different bears including cubs on Amulsar including Arshak and the western flank of the Mountain. The set-aside on Arshak Peak is intended to protect confirmed breeding habitat for one family unit (mother, cubs and visiting male). Ongoing use of this when construction starts will be monitored, but the likelihood of significant residual levels of disturbance has been identified, as well as barriers to movement and loss of feeding area for up to 10 bears. An offset is therefore considered necessary.

2.4 Other priority biodiversity features

Amulsar Mountain and its foothills provide high quality breeding habitat for 14 species of bird included in the RA Red Book. None of these species meet critical habitat criteria according to PS6/ PR6, but the Project has chosen to take a precautionary approach and include them in its BOS, with a view to achieving NNL and preferably a net gain in availability of suitable habitat and population size. The majority of these species are not expected to undergo significant population decline as a result of the Project but a small number may experience significant loss of habitat, notably White-throated Robin, Eastern Rock Nuthatch and Ruddy Shelduck. The majority of these species is expected to benefit from the Project's natural habitat offset, through "additional conservation actions". These would form part of the Project's adaptive management approach, with further specific offset interventions being identified and implemented for these species and for migratory raptor species of conservation importance, if monitoring showed decline in breeding or feeding activity due to unforeseen Project impacts. One such impact might be collision of raptors with powerlines, if the Project concludes it is not technically feasible to bury them, and diverters and insulation are not fitted. Other priority species are nationally protected reptiles, as well as Eurasian Lynx

[2] species identified by experts as in need of special attention in the Ecoregion Conservation Plan (WWf, 2012),

and Bezoar Goat (both of which were recorded on cameras using habitat in the Arshak Peak Set-aside in 2015).

3 Offset Strategy

To respond to the significant residual impacts identified through the Project's Natural and Critical Habitat Assessment (NCHA; Appendix 4.10.3 to the ESIA), the Project has developed this biodiversity offset strategy. The approach that will be taken to achieve NNL or a net gain, using offsets as appropriate, is summarised in the following sections for natural habitat, critical habitat and other priority biodiversity. In each section a summary table is provided. Further details can be found in the NCHA, the BAP and associated SAPs.

3.1 Natural Habitat

3.1.1 Overall strategy

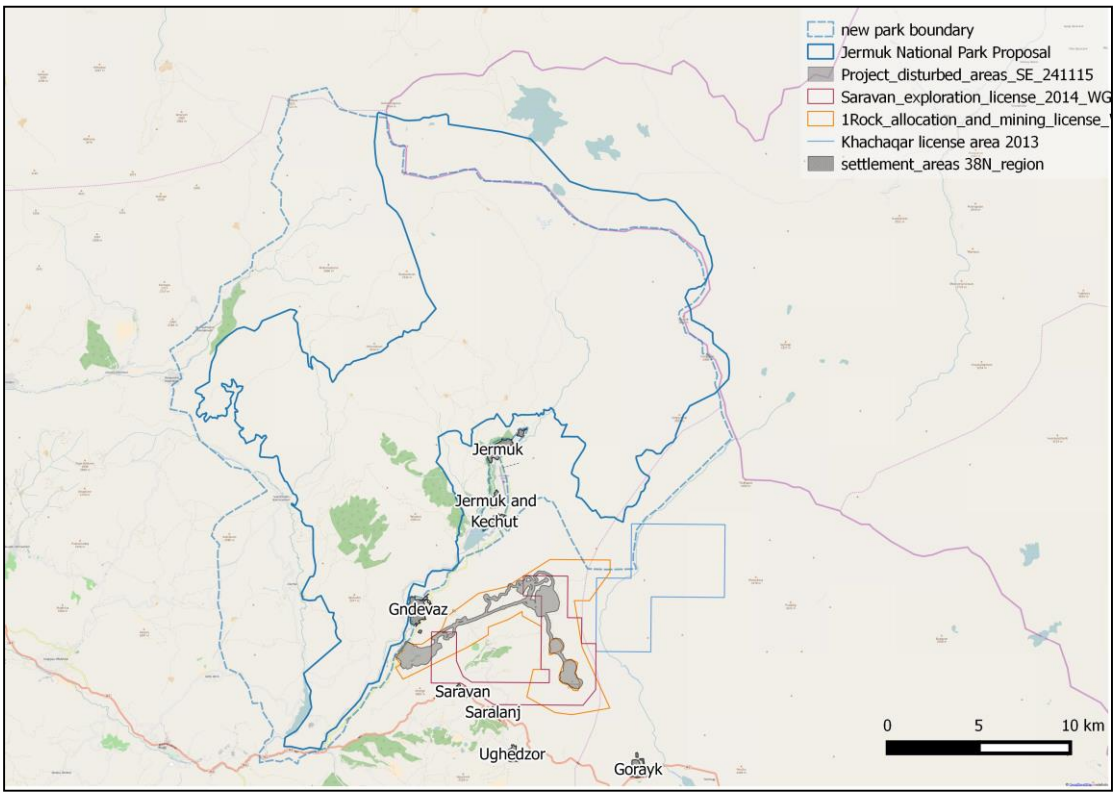
The Project is committing to the establishment of an offset to compensate for its impacts on natural habitat due to uncertainty about the ability to restore on site and the fact that the Project will introduce extensive changes in a natural context.

Lydian requires a natural habitat offset that also compensates for the residual impacts of its mining activities on some Armenian Red Book species associated with natural habitat.

Proposals to develop a new Jermuk National Park have been promoted by WWF Armenia and are part of Government plans, contingent on resources and funds. The Project proponent has conducted initial baseline biodiversity surveys to establish the suitability of the proposed National Park Area (Figure 1) for meeting its requirements for a natural habitat offset. Initial stakeholder mapping and engagement has also taken place to establish likely attitudes to a new National Park.

Based on the results of its ESIA and these initial baseline surveys, the Project has committed to invest in the establishment of Jermuk National Park. The creation of a sustainable National Park would provide a stable context for offset delivery, whilst also leaving a legacy for nature conservation in the Jermuk area.

Figure 1 Jermuk National Park proposal in relation to the Project area



After an initial establishment phase, it is envisaged that other organisations may wish to support or become involved in the development and subsequent management of the Park. After an initial establishment period of 5 years, day-to-day management and administration would become the responsibility of a National Park Board. The goal is to develop a self-financing and sustainable entity in the longer term.

Lydian's involvement in the establishment of the National Park would cease after 5 years. Lydian would continue to fund its offset interventions for an appropriate period, currently proposed as 25 years, in line with the planned duration of planned mining activity. The management required to deliver required outcomes will be integrated with the National Park Management Plan, but Lydian will retain responsibility for delivery of required outcomes, the monitoring of these outcomes and any adaptive management that is required during its commitment-period, in line with its biodiversity monitoring and evaluation plan.

Through this Biodiversity Offset Strategy, the Project is developing a detailed Jermuk National Park Project Implementation Plan to form the basis for necessary stakeholder engagement with communities, conservation NGOs and Government and provide a framework for the further biodiversity surveys that are needed to develop detailed management plans. The Project proponent commits to this plan and to full engagement with the stakeholder engagement process. The Project proponent also commits to providing substantial financial support for the National Park's establishment and ongoing management targeted on the Project's specific offset requirements for the lifetime of the Project.

Establishment of a National Park would confer protection on natural vegetation types, which have limited representation in Armenia's Protected Area System at present, in line with the Caucasus Ecoregion Conservation Plan (WWF, 2012). High mountain habitats are affected by overgrazing, which impacts on plant species diversity and reduces the food base of mountain ungulates. Poaching puts significant pressure on large mammals and endemic birds in high mountain regions. The proposed Jermuk National Park would provide opportunities to address both these types of pressure on vegetation and associated animal species, notably Brown Bear, other large carnivores such as Wolf and Eurasian Lynx and a number of reptile and bird species that are listed in the RA Red Book. Gains would be achieved by a) conferring protection from disturbance and hunting/poaching through establishment of the Protected Area and b) improving condition of degraded natural habitat.

Although the process of identifying specific offset interventions is not fully complete, the Project has: a) developed a metric to compare losses and gains of biodiversity; b) carried out initial baseline surveys to confirm that target vegetation types are represented in the proposed National Park; c) identified potential areas to implement management; and d) initiated stakeholder engagement. The following sections 3.1.2 to 3.1.5 provide more detail on how NNL would be demonstrated.

3.1.2 Demonstrating NNL

To demonstrate achievement of NNL it is necessary to show that gains achievable through offsets are commensurate with losses due to the Project. These gains may be achieved by enhancing biodiversity (for example by restoring areas of degraded habitat) or by conferring protection on biodiversity that would otherwise be lost to confirmed threats. An approach to the calculation of NNL has been developed, using a matrix combining biodiversity distinctiveness with habitat condition to derive scores (Table 1). Areas of land affected by the Project in hectares are multiplied by the appropriate score, reflecting the vegetation types they support and their condition. This gives an adjusted number of "impact units". The offset must result in an equal or raised number of units and this can be achieved by enhancing biodiversity on a fixed area of land, and/or by increasing the area of land under conservation protection or management[3].

PS6 requires that there should be NNL of natural habitat if feasible. Biodiversity offsets may be used as part of a suite of measures to achieve this. The Project developed a matrix which combines biodiversity distinctiveness with habitat condition to give a set of scores (see Table 1), in which possible scores of 0 to 24 have been normalised to a range of 0 to 1. Areas of land affected by the Project were multiplied by the appropriate score, (reflecting the vegetation types they support and their condition), to derive an adjusted number of "impact units". The offset must result in an equal or raised number of units and this can be achieved by enhancing biodiversity on a fixed area of land and/or increasing the area of land under conservation protection or management.

[3] the offset may be larger than the area impacted, but the ratio of impact:offset should never go below 1:1.

Table 1 Proposed Framework for Biodiversity Offset Metrics

		Biodiversity Distinctiveness			
		Very Low (0)	Low (2)	Medium (4)	High (6)
Condition	Optimum (4)	0	8 [0.33]	16 [0.67]	24 [1.00]
	Good (3)	0	6 [0.25]	12 [0.50]	18 [0.75]
	Moderate (2)	0	4 [0.17]	8 [0.33]	12 [0.50]
	Poor (1)	0	2 [0.08]	4 [0.17]	6 [0.25]

Each of the natural habitat types affected by the Project was assigned to one of the distinctiveness categories in the matrix, based on their intrinsic species richness/ conservation priority (Table 2).

Table 2 Distinctiveness of vegetation types affected by the Project

Distinctiveness Category	Vegetation or land use types
Very Low	Modified land, including arable fields
Low	Village grazing lands, gardens and orchards
Medium	• Montane Meadow • Montane Meadow Steppe • Wetlands • Vegetation with shrubs
High	• Rocks with *Potentilla porphyrantha* • Sub-alpine Meadow with Alpine Elements • Sub-alpine Meadow

The Project chose to take a conservative approach and assume that each vegetation type has the same condition throughout the Project-affected area and to use the category applicable to the majority of each type occurring in the Project-affected area. For example, the majority of Sub-alpine Meadow with Alpine Elements was in optimal

condition prior to the Project, whereas condition of Montane Meadows could generally be improved through modifications to management.

Habitat losses

The impacts of the Project on natural habitat are illustrated in Table 3, derived from the Natural and Critical Habitat Assessment undertaken by the Project. It was assumed that habitats in the Project's physical footprint will be lost, while those in the remaining part of the Project Disturbed Area, and those in the Ecologically Disturbed Area, restricted areas, and along the Kechut-Gorayk road, will persist, although probably in a degraded or modified condition, due to impacts such as dust contamination or altered grazing regimes. This approach makes it possible to distinguish between habitat loss and habitat degradation when estimating residual impact. For example the 254.2 ha. of Sub-alpine Meadow lost in the footprint is multiplied by 0.75, reflecting the fact that it has high distinctiveness and is in good condition, giving a sub-total of 190.7 units. The units are area (in ha) adjusted for their distinctiveness and condition, referred to as "habitat impact units" (HIU).

For the areas of Sub-alpine Meadow in the remaining part of the Project Disturbed Area (i.e. the buffer adjacent to the footprint) and in the Operational Restricted Zone, which total 403.3 ha, the difference between the current and future forecast state of that habitat post-Project must be determined. In this case it was assumed that the Sub-alpine Meadow would take on a vegetation composition more similar to Montane Meadow (medium distinctiveness) and be in poor condition, giving (403.3 x 0.75) less (403.3 x 0.17) = 233.9 HIUs. The third category of land affected by the Project included the Ecologically Disturbed Area, the Wildlife Restricted Area, the Restricted Area (by fencing) and the area next to the Kechut to Gorayk road. These areas will not be as affected as the previous category and were therefore assumed to drop by one condition category. The Sub-alpine Meadow will be poor instead of moderate condition and the calculation was therefore (242.3 x 0.75) less (242.3 x 0.33). Adding this to the result for the Project's physical footprint (190.7 HIUs) gave a combined impact on Sub-alpine Meadow of 424.6 HIUs. For each of the natural habitat types affected by the Project, a residual number of HIUs was determined as shown in Table 3 and this was used to establish the offset requirement.

Table 3 Calculation of residual impact on natural habitat

Natural Habitat Type	Baseline Distinctiveness	Baseline Condition	Score (from Table 4)	Area in Project footprint (ha.)	Forecast condition in footprint post project	Buffer zone adjacent to footprint and Operational Restricted Area (ha.)	Forecast habitat and condition in these zones post project	Score (from Table 4)	Wildlife and Fencing Restricted Areas, Ecological Disturbance Area and Area adjacent to Kechut Gorayk Road (ha.)	Forecast habitat and condition in these zones post project	Score (from Table 4)	Combined Impact (Habitat Impact Units)
Gorge	Medium	Optimum	0.67	6.985816	Lost	1.112049	poor	0.17	0	Moderate	0.33	5.236521
Montane Meadow	Medium	Moderate	0.33	38.72243	Lost	44.37338	medium	0.17	56.9865141	Poor	0.17	28.99598
Montane Meadow Stepp	Medium	Moderate	0.33	36.86121	Lost	54.16758	poor	0.17	324.780512	Poor	0.17	72.79589
Rocks	High	Optimum	1	24.52855	Lost	17.09099	poor	0.25	4.78417833	Moderate	0.5	39.73888
Sub-alpine Meadow	High	Good	0.75	254.2487	Lost	403.2993	poor	0.17	242.272231	Moderate	0.33	526.3544
Sub-alpine Meadow*	High	Moderate	0.5	0	n/a	0	poor	0.17	9.5	Poor	0.17	3.135
Sub-alpine Meadow Wit	High	Optimum	1	85.50257	Lost	42.4952	poor	0.17	2.09793668	Moderate	0.5	121.8226
Vegetation With Shrubs	Medium	Moderate	0.33	65.45379	Lost	38.73887	poor	0.17	45.5751248	Poor	0.17	35.08999
Wetland	Medium	Moderate	0.33	5.241163	Lost	1.187117	poor	0.17	8.77934988	Poor	0.17	3.324219
Total				517.5442		602.4645			685.275847			836.4934

3.1.3 Offset Delivery Options

The Project proposes to achieve NNL of natural habitat through the establishment of a new Jermuk National Park (to afford some protection to Caucasian Montane Steppe, Sub-alpine Meadows and other natural habitats which currently have little protection within the region) and the implementation of specific conservation management measures within the Park to enhance the condition of degraded natural habitat.

The extent of land potentially available in the proposed National Park is 38,867 hectares according to published data, which far exceeds the area that will be needed to achieve NNL. Surveys conducted by WWF Armenia of the proposed National Park and those conducted by Lydian/Geoteam in 2015 confirm that there are extensive areas of pasture that are currently in poor condition through overgrazing which could be included in a conservation management programme as well as areas of woodland and "shrubland" that is also degraded. However, based on the surveys of vegetation types and condition carried out in 2015 and the use of the metric described earlier, the potential offset gains were calculated, as described in the following section.

3.1.4 Calculation of offset gains

This section presents the proposed approach to calculation of gains required for the offset. Target vegetation types include Caucasian Montane and Sub-alpine Meadows that are afforded negligible protection in the region at present, as well as delivering benefits for other associated animal species of conservation concern that are affected by the Project. Firstly, an exchange rule is proposed whereby the offset provided will not be smaller than the area exposed to project impacts (in other words there will be a minimum ratio of impacted area to offset area of 1:1).

The Project's offset strategy is also based on an objective of "like for like" outcomes if possible, in which losses of one natural habitat type are substituted for by gains in the same different type. However, in certain circumstances "trading up" may be necessary, whereby losses in one type are offset through gains in a different habitat type of the same or higher levels of distinctiveness. Based on the vegetation surveys in 2015 (see report "Preliminary Baseline Surveys of the proposed Jermuk National Park") habitat

types identified in the proposed Park area were classified using the hierarchical BioHab system into sub-categories (Table 4; Figure 2).

Table 4. Sub-categories of habitats identified during survey of proposed National Park

Habitat	Number of sub-categories
Mountain Meadow (includes vegetation with shrubs)	13
Wetland	11
Sub-alpine Meadow	10
Mountain Meadow-Steppe	6
Sub-Alpine Meadow with Alpine Elements	2
Woodland	6
Rocks/Scree	1

Condition assessments were carried out on examples of the sub-categories, so that the baseline condition of each could be used to calculate the number of HIUs currently available in the surveyed area for use as an offset. For each “habitat”, calculating potential gain required four steps:

1. Scoring current distinctiveness and condition (Table 1);
2. Calculating number of current HIUs by multiplying the area by the score;
3. Calculating the number of HIUs achievable from gain in one “condition category”; and
4. Calculating the difference between steps 3 and 4 to give the potential gain in HIUs per habitat type.

The calculations show that 274 HIUs could potentially be gained from the surveyed area of 2086 ha. Most of the gain is predicted to come from improved management of Sub-alpine Meadow and Mountain Meadow habitats.

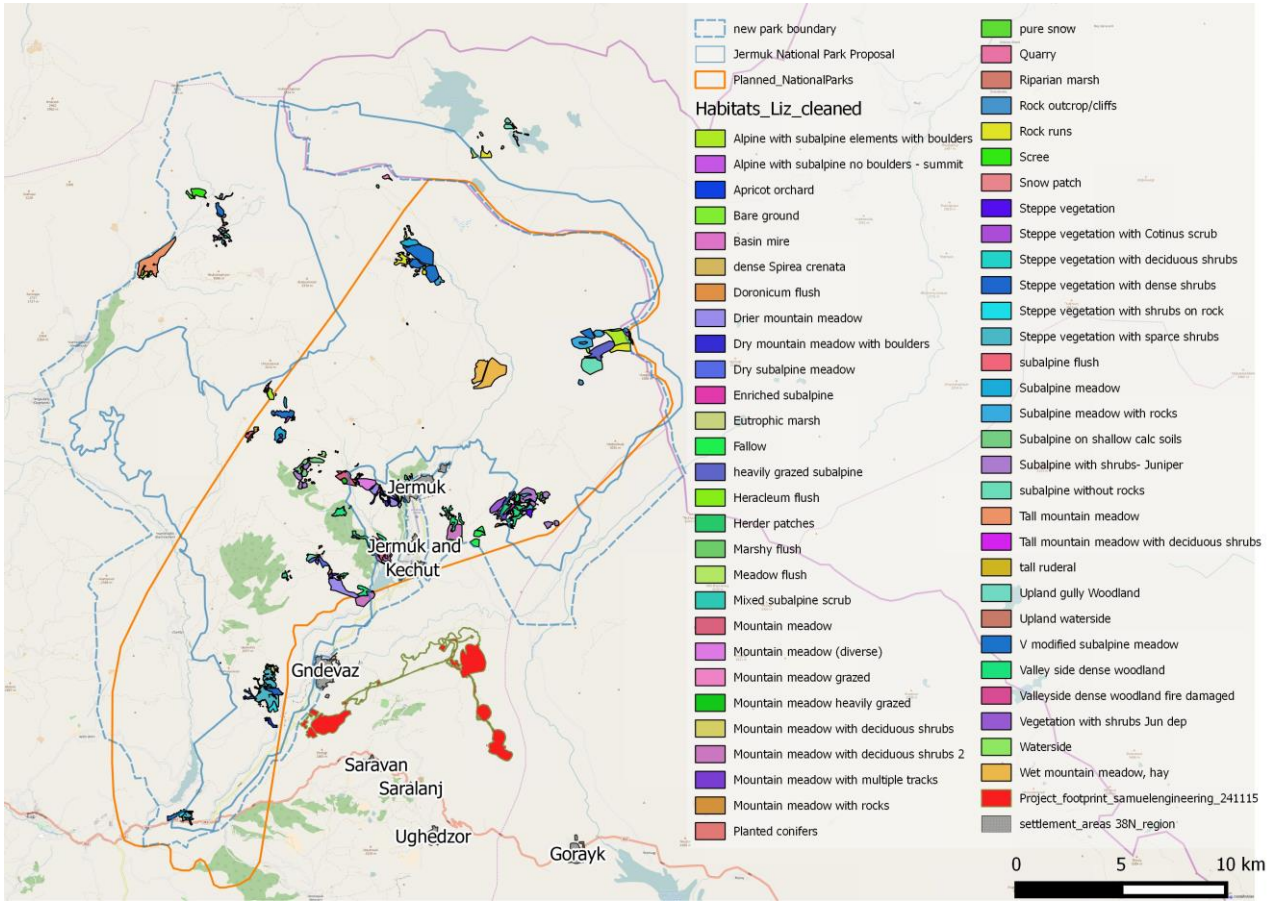


Figure 2 Habitats and sub-types surveyed in the proposed Jermuk National Park in 2015, with indication of three different planned or proposed boundaries for this park.

If it is assumed that the survey was broadly representative (believed to be the case), then the 274 HIU gain - even though it came from only approximately 5% of the new national park area - can be extrapolated to a potential gain of 5480 HIUs for the whole national park. This exceeds the 836.5 HIUs lost as a result of the Project. The exchange rule whereby the area offset should not be smaller than the area impacted will also be met as the area required to offset the 1805ha impacted by the Project will be exceeded even if only Sub-alpine Meadow and Mountain Meadow are targeted in the new national park. The area of these two habitats in the new national park is estimated at 25,800 ha.

Table 5. Calculated difference in HIU for habitats from the current state to an improved future state

Habitat	Area (ha.)	Current Score	Improved Score	Difference in HIU
Mountain Meadow-Steppe	189	188.7	189	0.26
Mountain Meadow	639	288.3	378.2	90
Sub-alpine Meadow	651	336.9	499.7	162.8
Sub-alpine Meadow With Alpine Elements	72.5	56.3	72.5	16.2
Wetland	33	14.3	19.3	5
Woodland	247	151.7	151.7	0
Total				274.3

Unfortunately, implementing targeted management of just Sub-alpine Meadow and Mountain Meadow does not fulfill the requirement of the second principle of like-for-like outcomes. There is a loss of 121.8 HIU of Sub-alpine Meadow With Alpine Elements due to the Project and the surveyed area could produce only 16.2 HIU. However, extrapolating from these sampled data to estimate likely availability of different vegetation types in the wider proposed National Park area it is likely that 324 HIU will be available.

An indicative outline for the proposed offset is as follows:

- 162.4 ha of Sub-alpine Meadow With Alpine Elements (121.8/0.75);
- 72.8 ha of good condition Mountain Meadow-Steppe protected (see Table 5);
- 40 ha. of rocky habitat protected (see Table 5);
- 19.8 ha. of Wetland under better management (33 x 3/5 see Table 5);
- 205.2 ha. of Mountain Meadow under better management (639 x 28.9/90 see Tables 3 and 5); and

- 2,243 ha. of Sub-alpine Meadow under better management (651 x 561/162.8; see Tables 3 and 5) (n.b. includes Vegetation with Shrubs from Table 3).

The total land requirement to offset the 1805 ha of the Project impact area would therefore be 2743.2 ha in the new National Park.

3.1.5 Provisional costs

Preliminary discussions were held with relevant stakeholders to discuss possible roles, responsibilities and costs associated with establishment of a new National Park in Armenia. These have been used to derive a provisional cost for establishment and initial management of the Park. Costs remain provisional at this stage, due to uncertainty regarding ongoing management costs. Offsets should last "in perpetuity" or at least for the period during which impacts are expected to occur. This means that contributions to management may need to be supported for at least 20 years if not longer.

Conservation Costs vary widely (Balmforth *et al*., 2003), from less than \$0.1 per km^2 per year to over \$1,000,000 per km^2 per year for programmes in which restoration is needed to recover conservation value. Costs tend to be lower in wilderness areas where there are fewer anthropogenic threats and pressures to manage. In the developed world, costs differ widely, but include figures of \$5,000 to >\$40,000 per km^2 per year for sampled U.S. nature reserves, and \$15–50,000 per km^2 per year for U.K. reserves and agri-environment programmes.

Rather than attempting to "value" biodiversity lost and gained in monetary terms, the costs of achieving long-term equivalence have been estimated in terms of the likely costs of the management needed to achieve required biodiversity outcomes. There is considerable uncertainty about these costs at this stage, pending further survey of proposed offset locations and engagement with stakeholders about required management and associated costs. Taking a mid-range estimate of conservation costs per year for UK reserves and assuming that conservation gains are needed over an area of 2000 ha, a provisional cost of \$600,000 per year is estimated.

Table 6 Proposed approach to NNL/Net Gain for impacts on Natural Habitat

	Summary of approach:
Goal	Natural habitat offset to achieve NNL in the extent, distinctiveness and condition of natural vegetation types affected by the Project as well as NNL/Net Gain of suitable habitat for associated species, notably Brown Bear, Eurasian Lynx, Bezoar Goat, Red Book bird species and endemic reptile species.
Proposed offset	The Project has committed to invest in the establishment of a new National Park at Jermuk. Extensive areas of degraded natural habitat, considered to be of suitable types to offset the Project's impacts, are available in the proposed National Park. Surveys in 2015 established the likely suitability of the proposed park area in terms of vegetation type and opportunity for enhancement. These surveys also confirmed the presence of suitable habitat for the majority of priority species affected by the Project and for Brown Bear with critical habitat affected by the Project. Gains will be achieved by a) protecting habitats and species from disturbance, future land use change and poaching and b) enhancing quality of over-grazed vegetation. Initial surveys suggest that the biodiversity offset for the projected loss of natural habitat could be delivered through the implementation of conservation management actions needed to restore good quality natural habitat and that there are extensive areas of suitable habitat available.
Aligning with conservation priorities at a national, regional and global scale	Establishment of a new Jermuk National Park has been included in national conservation plans for many years. The State Strategy on Developing Specially Protected Nature Areas and National Action Plan for Armenia (2003-2010) envisaged establishment of 11 new SPNAs, including Jermuk National Park, but its implementation has been constrained by lack of funding. High mountain habitats including Sub-alpine Meadows and Meadow Steppes are identified as a Priority ecosystem in the Caucasus Ecoregion Conservation Plan (WWF, 2012). Establishment of a National Park would confer protection on natural vegetation types, which have limited representation in Armenia's Protected Area System at present. The proposed National Park would provide opportunities to address overgrazing (which impacts on plant species diversity and reduces the food base of mountain ungulates such as Bezoar Goat) and reduce levels of poaching (which puts

	Summary of approach:
	significant pressure on large mammals and endemic birds in high mountain regions). This is also in line with the Caucasus Ecoregion Conservation Plan (WWF, 2012), which identifies Brown Bear and Bezoar Goat as priority species. These would both benefit from formalised protection and community-based efforts to reduce poaching, as would several bird species.
Loss/Gain calculations	Loss/gain calculations have been done, based on condition assessments for habitat types and sub-types within the proposed Park area.
Stakeholder Engagement	Realising the required gains will require engagement with seasonal and local herders, to ensure that changes in pasture management can be implemented without adverse effects on their livelihoods. Further work is needed to develop an effective Stakeholder Engagement Plan. Initial engagement has taken place to identify key stakeholders and establish their level of interest in a potential National Park. However further, more intensive engagement is needed to: a) secure government approval at national and local levels; b) secure local "buy-in" with current land users and identify potential roles in management to achieve habitat enhancements, as well as need to engage on the topic of poaching; and c) explore scope for development of alternative livelihood activities including nature-based tourism.

3.2 *Potentilla porphyrantha*

A series of actions are being taken to ensure a Net Gain for *Potentilla porphyrantha* and are detailed in a Species Action Plan (SAP). They include:

a) Avoidance of as many plants as possible.
b) Set-aside to ensure a viable proportion of the sub-population remains *in situ*.
c) Translocation or rescue of plants within the mine footprint that would otherwise be destroyed, for use in scientific study and research on ecological requirements and propagation methods (now complete).
d) Experimental *ex-situ* trials of plant growth and propagation to support a programme of introduction onto the landscape post mine closure, as well as production of plants and propagules in sufficient quantities when needed.
e) Development of a population model to estimate the numbers of plants that should be reinstated and the time needed to restore pre-mining numbers, if possible (see below).
f) Monitoring the effects of mining operations to detect any impacts in areas retaining plants in the vicinity of the mine footprint and to identify any unforeseen additional losses of plants.
g) Habitat creation on the back-filled mine pits for restoration of population post mine-closure. The likely success of this is uncertain.
h) Monitoring of success of re-introductions with links to an adaptive management plan.
i) Offsets if needed, based on the outcome of preceeding measures.

Key to this strategy is the development of a population model which will be used to estimate the time it will take for the population of *Potentilla porphyrantha* to recover to at least its pre-mining size. This model requires validation using monitoring data to be collected in the next three years. It will be used to establish how many plants need to be re-established on Amulsar post-mining, or protected through an offset, to support a precautionary approach and demonstrate a net gain. It will draw on a science research programme for *P. porphyrantha* which involves collaboration between in-country teams, external experts and academic institutions including the RA NAS Institute of Botany and the University of Cambridge Botanic Garden (UCBG) in the UK.

3.2.1 Provisional Costs

A budget (of around US$ 680,000 to 2018) has been developed with the agreement of the partners and has been allocated by Lydian International to support a research programme which is now underway. Additional budget would be needed to support establishment of an offset if needed, expected to take the form of protection for a population of *Potentilla*

porphyrantha, possibly as part of a new protected landscape. This would require commitment to management costs for at least the duration of the mine.

Table 7 Proposed approach to NNL/Net Gain for impacts on *Potentilla porphyrantha*

	Summary of approach:
Goal	The objectives of the SAP are: • To design and implement an effective restoration programme resulting in suitable habitat for a viable and sustainable population on Amulsar Mountain in the long term, with increased numbers of *Potentilla porphyrantha* post mining; and • To achieve an increase in the area of habitat protected for *Potentilla porphyrantha* in Armenia. The goal is to achieve a net gain in numbers of plants within a reasonable timeframe, currently estimated at 20 years.
Proposed actions	Proposed actions are set out in detail in the SAP for *Potentilla porphyrantha.* Specialists consider that a viable population will remain, including plants within the set-aside. Nevertheless, a precautionary approach is being taken as restoration has not been attempted for this species before. A major programme of research has been initiated to determine the species' niche characteristics and requirements, and to inform planning of the restoration programme (see the SAP for details). Targeted searches in 2015 did not reveal any additional populations in Armenia. If no further populations are found and if research through the SAP suggests that a net gain in numbers cannot be assured with strong evidence, scope to achieve net gain by conferring formal protection on another Armenian population will be explored together with the IoB and the Ministry of Nature Protection, as the species has no formal protection in Armenia at present and is threatened by habitat loss and collection as well as climate change.
Aligning with conservation priorities at a national, regional and global scale	The Armenian Red Data Book for Plants identifies threats to the conservation of the species from plant collection as well as habitat loss. There is no formal recovery programme in place at national level. The Project's SAP should enhance levels of understanding of the biology of the species and its habitat requirements considerably and includes capacity building and other actions to raise public awareness of the importance of Caucasian plants and to display them in botanic gardens. New, specially prepared facilities have been developed to support the proposed research, including

	Summary of approach:
	rock gardens suitable for alpine species and a new glasshouse in Sevan. Growth trials and further studies of propagation are proposed to take place here. Collaboration with the NAS Institute of Botany means that the Projects's actions will comply with national research and conservation priorities. If the need for an offset is confirmed, formal protection of the plant in at least one location would improve its conservation prospects in the country in the longer term.
Loss/gain calculations	A preliminary model has been developed to show how population size can be expected to grow over time, given different levels of reintroduction of plants and based on various assumptions about their survival and subsequent spread. This model will be further developed based on data obtained through the SAP. The preliminary model suggests that it should be possible to achieve an increased population size within 20 years.
Stakeholder Engagement	Active engagement with the Ministry of Nature Protection, the NAS Institute of Botany and the Armenian Botanic Garden will be maintained throughout the Project. The Project will also seek to engage with national and international NGOs and with the IUCN to ensure that the plant is formally assessed for red listing purposes.

3.3 Ursus arctos

A series of actions are being taken to ensure a Net Gain for *Ursus arctos* and are detailed in a Species Action Plan (SAP). They include:

a) Final analysis of 2015 survey data (see Table 8) to establish numbers, gender and movement patterns of Brown Bears currently using Amulsar Mountain.
b) Ongoing monitoring on Amulsar Mountain (Arshak Set-aside) and in the proposed Jermuk National Park so that a net gain outcome can be demonstrated.
c) Development of a conservation management plan to enhance habitat for Brown Bear in the National Park, likely to target hunting and impacts of unplanned infrastructure such as roads.
d) Further stakeholder engagement to ensure effective conservation using a participatory approach.

Table 8 Proposed approach to NNL/Net Gain for impacts on Ursus arctos

	Summary of approach:
Goal	• NNL of suitable habitat to maintain a viable population of *Ursus arctos* despite the presence of the Project. • Improved connectivity of the landscape for *Ursus arctos* in the region. • A net gain in population over time through protection and efforts to reduce disturbance and poaching.
Proposed actions	Actions that will be taken to ensure NNL of suitable habitat for *Ursus arctos* are described in detail in the SAP for *Ursus arctos.* The establishment of a new National Park at Jermuk would confer some protection on the species and could provide opportunities to manage levels of disturbance, hunting and poaching.
Aligning with conservation priorities at a national, regional and global scale	*Ursus arctos* is a priority species in the Caucasus Ecoregion Conservation Plan and is listed as Vulnerable in the RA Red Book. *Ursus arctos* is also included in Appendix IV to the EU Habitats Directive. It is identified as a priority species[4] in the Caucasus Ecoregion Conservation Plan and is a key species associated with Amulsar Mountain's natural habitat, triggering critical habitat according PR6. There is considered to be an urgent need for action to improve connectivity of habitat for isolated sub-populations in the region and to reduce levels of poaching. Some conservation initiatives are underway in Khosrov in Armenia and conservation action in the Jermuk area would strengthen chances of success in terms of landscape connectivity.
Loss/gain calculations	When residual impacts are confirmed (this requires final analysis of 2015 survey data), these will be expressed in terms of loss of habitat area and suitability for the affected population. The likely contribution of the proposed natural habitat offset will be determined in terms of gains in habitat units. A minimum viable habitat area will be identified and an assessment will then be carried out to establish whether any other pressures are acting on population that could be managed or reversed, such as poaching, for example. If any particular requirements of the species will not be met by the natural habitat offset and if significant residual impacts are confirmed following further survey, additional species offset

[4] species identified by experts as in need of special attention in the Ecoregion Conservation Plan (WWf, 2012),

	Summary of approach:
	options will be explored to meet the NNL/ Net Gain requirements. These additional measures may be in separate locations, be expressed through habitat creation or restoration measures or other mechanisms aimed directly at supporting existing or new populations.

3.4 Other Priority Species

Several other priority species were identified in the ESIA that could be exposed to impacts or which occur in the wider area. These do not meet PS6/PR6 critical habitat thresholds, but are nevertheless of conservation importance in Armenia, regionally or in some cases globally. They include, for example:

- Egyptian Vulture
- Lesser Kestrel
- Lammergeier
- Caspian Snowcock
- Corncrake
- Eagle Owl
- White-throated Robin
- Ruddy Shelduck
- Pallid Harrier (on migration)
- Great Snipe (on migration)
- Eurasian Lynx
- Bezoar Goat
- Endemic reptile species

In line with its policy, the Project has chosen to identify additional conservation actions that can be taken to benefit as many of these species as possible. This may be through measures such as:

- Providing additional nesting habitat;
- Supporting the Armenian Society for the Protection of Birds in its ongoing research on Lesser Kestrel;
- Reducing grazing pressure and disturbance in parts of the proposed Jermuk National Park;
- Managing hunting pressure.

Scope to integrate additional conservation actions into the Project's natural habitat offset will be reviewed following ecological surveys of the Jermuk National Park area in 2015. Interventions to improve breeding bird habitat would be covered under annual

conservation costs associated with the natural habitat offset. A number of these species will be included in the Project's monitoring programme so that any unforeseen impacts can be detected and the need for further action identified as part of the Project's adaptive management approach. This applies in particular to Egyptian Vulture, Lesser Kestrel, White-throated Robin, Eastern Rock Nuthatch, Ruddy Shelduck, reptiles, Eurasian Lynx and Bezoar Goat.

Table 9 Priority Species

	Summary of Approach:
Goal	NNL of suitable habitat and the maintenance of viable populations of Priority species through additional conservation actions.
Proposed actions	Surveys in 2015 confirmed species occurring in the proposed National Park and identified potential conservation actions. This might be through provision of nest sites, for example or by reducing levels of poaching.
Aligning with conservation priorities at a national, regional and global scale	The Project has sought to benefit other Priority species in line with conservation plans for the country and region. Priority species in the Caucasus Ecoregion Conservation Plan include Bezoar Goat, which has an established population in the Arpa Gorge and in the area proposed for the Project's natural habitat offset and also Eurasian Lynx. The Bezoar Goat will not be affected directly, but remaining populations are isolated and are threatened by poaching as well as genetic isolation. The species has been driven to extinction in many parts of its former range, is listed in the IUCN Red List as Vulnerable and is included in the national red list of Armenia. It occurs in areas adjacent to the Project-affected area and may have occurred within it in the past. It will benefit from establishment of the Jermuk National Park, particularly if effective measures to control hunting can be identified. Reduced grazing levels would also benefit it. As indicated in the Caucasus Ecoregion Conservation Plan: "local people need to be included in conservation activities, since poaching is the major threat to the animal". Engagement with communities in the proposed National Park is therefore planned, to commence in 2015.
Loss/Gain calculations	The potential gains to be achieved through protection and enhancement of natural habitat will be considered for each priority species. Based on the surveys in 2015, specific additional requirements for each species will be reviewed and potential management actions identified that might either improve suitability of habitat or enhance population size or viability.
Stakeholder Engagement	It will be important to maintain communication with NGOs active in the country to address concerns about the conservation of priority species and to make people aware of the actions being taken by the Project to safeguard their populations.

4 Conclusions

The ESIA for the proposed Amulsar Project and the NHCA carried out to comply with the requirements of IFC PS6 and EBRD PR6 have concluded that a biodiversity offset is needed to compensate for potential significant residual adverse effects on natural habitat and impacts on Brown Bear. Offsets may also be needed to achieve a net gain of critical habitat for *Potentilla porphyrantha*.

There is a high degree of confidence that offset requirements can be met for natural habitat and Brown Bear within the area proposed for establishment of a new Jermuk National Park. A Biodiversity Offset Management Plan (BOMP) will confirm the locations of proposed offsets, the specific management actions to be taken and the resources that will be required to ensure that these actions continue for an adequate period. The BOMP will also identify stakeholders and involved parties and set out a process for engagement and participation that meets the requirements of the BBOP Standard in accordance with Principle 6.

Lydian has carried out initial consultations with relevant stakeholders to develop initial estimates of costs and these are being finalised, together with a Project Implementation Plan (PIP) for Lydian's inputs to establishment of the National Park and its ongoing management. Lydian's proposed budget for support is set out in Table 10. Further detail can be found in the PIP.

Table 10 Proposed Budget for Lydian's inputs to Jermuk National Park establishment and management

Project Activities	Year					Total	Observation / Comment
	2016	2017	2018	2019	2020		
Objective 1. Jermuk National Park has all necessary planning documents for its development in place (Planning Investments)							
Result 1.1. Management, investment and business plans are elaborated in a participatory way according to international standards and practices							
Activity.1.1.1 Baseline Studies	50,000	50,000				100,000	
Activity 1.1.2. Strategies for MP programs	10,000	10,000				20,000	
Activity 1.1.3. PA Management Planning	60,000	60,000	30,000			150,000	
Activity.1.1.4. Other required plans		10,000	10,000	5,000	5,000	30,000	
Sub-total: R1.1.	**120,000**	**130,000**	**40,000**	**5,000**	**5,000**	**300,000**	
Sub-Total: O1	**120,000**	**130,000**	**40,000**	**5,000**	**5,000**	**300,000**	
Objective 2. Jermuk NP is recognized, becomes operational and has functioning protected area management in place (PA investments)							
Result 2.1. The legal and social recognition of the Jermuk NP is supported. Conflict Management is operating successfully							
Activity.2.1.1. Legal Recognition: Support demarcation, zoning and legal recognition	30,000	50,000	20,000			100,000	
Activity.2.1.2. Social Recognition: Implementation of public consultation and conflict management mechanisms		5,000	5,000	5,000	5,000	20,000	
Sub-total: R2.1.	**30,000**	**55,000**	**25,000**	**5,000**	**5,000**	**120,000**	
Result 2.2. Investments in PA infrastructure and equipment are made according to requirements							
Activity .2.2.1. Prioritization of planned investments	10,000					10,000	
Activity.2.2.2. Procurement of PA infrastructure	50,000	350,000	500,000	400,000	300,000	1,600,000	based on MP
Activity.2.2.3. procurement of PA Equipment	50,000	50,000	50,000	50,000	50,000	250,000	based on MP
Sub-total: R2.2.	**100,000**	**400,000**	**550,000**	**450,000**	**350,000**	**1,850,000**	
Result 2.3. Measures for public awareness and education are implemented							
Activity.2.3.1 Organization of public awareness campaigns on local and national level	5,000	5,000	5,000	5,000	5,000	25,000	
Activity.2.3.2. Production and distribution of information material	5,000	5,000	5,000	5,000	5,000	25,000	
Activity.2.3.3. Establishment and regular update of PA website	5,000	2,000	1,000	1,000	1,000	10,000	
Activity.2.3.4. Organization of promotional events to increase publicity and visibility	5,000	5,000	5,000	5,000	5,000	25,000	

Activity.2.3.5. Environmental Education programme	15,000	10,000	10,000	10,000	10,000	55,000	
Sub-total: R2.3.	**35,000**	**27,000**	**26,000**	**26,000**	**26,000**	**140,000**	
Result 2.4. The staff of PA administrations receives basic and advanced trainings in accordance with the requirements of a modern PA management							
Activity .2.4.1. Implementation of training plans	10,000	15,000	15,000	15,000	15,000	70,000	
Activity .2.4.2. Organization of exchange workshop between staff of other selected PAs		5,000	5,000	5,000	5,000	20,000	
Sub-total: R2.4.	**10,000**	**20,000**	**20,000**	**20,000**	**20,000**	**90,000**	
Result 2.5. Measures for biodiversity conservation and monitoring are supported							
Activity .2.5.1. Conservation measures for selected priority species are implemented			50,000	50,000	50,000	150,000	
Activity 2.5.2. Biodiversity monitoring program implementation is initiated			50,000	50,000	50,000	150,000	
Sub-total: R2.5.			100,000	100,000	100,000	300,000	
Sub-Total: O2	**175,000**	**502,000**	**721,000**	**601,000**	**501,000**	**2,500,000**	
Objective 3. Adjacent communities of Jermuk NP benefit from investment in socio-economic development of the support zone (Investment in support zone)							
Result 3.1. Tools, strategies and plans to promote socio economic development of adjacent communities are coordinated with all relevant stakeholders							
Activity 3.1.1. Socio-economic Baseline Studies	10,000	20,000				30,000	
Activity 3.1.2. Elaboration of the Socio-economic development of Strategies	5,000	5,000				10,000	
Activity 3.1.3. Preparation of a Support Zone plan for Jermuk NP		10,000				10,000	
Sub-total: R3.1.	**15,000**	**35,000**				**50,000**	
Result 3.1. Investments in socioeconomic development of the adjacent communities are executed							
Activity .3.2.1. Implementation of Quick Start Measures (QSM)	20,000	30,000				50,000	
Activity .3.2.2. Financial Participatory Approach (FPA)		100,000	150,000	150,000	100,000	500,000	
Activity.3.2.3. Socio-economic long-term measures (LTM)		100,000	100,000	100,000	100,000	400,000	
Sub-total: R3.1.	**20,000**	**230,000**	**250,000**	**250,000**	**200,000**	**950,000**	
Sub-Total: O3	**35,000**	**265,000**	**250,000**	**250,000**	**200,000**	**1,000,000**	
Objective 4. PA Governance structure is established and becomes functional							
R4.1. Investments in institutional capacities and sustainability are executed							
Activity .4.1.1. Establishment and Strengthening of the Regional	25,000	25,000	25,000	25,000	25,000	125,000	

Advisory Board							
Activity .4.1.2.. Establishment and strengthening of PA Friends Association	25,000	25,000	25,000	25,000	25,000	125,000	
Sub-total: R4.1	**50,000**	**50,000**	**50,000**	**50,000**	**50,000**	**250,000**	
Sub-Total: O4	**50,000**	**50,000**	**50,000**	**50,000**	**50,000**	**250,000**	
Objective 5. Sustainable financing of Jermuk NP is ensured							
Result 5.1. Funds to cover Jermuk NP annual operation costs are available long-term							
Activity .5.1.1. Agreement with the government on the scheme to support PA operation costs (e.g through CNF, or other mechanisms)							To be covered through consultant's budget
Activity.5.1.2. Provision of operational support based on agreed terms and duration				150,000	150,000	300,000	
Sub-total: R4.1	**0**	**0**	**0**	**150,000**	**150,000**	**300,000**	
Sub-Total: O4	**0**	**0**	**0**	**150,000**	**150,000**	**300,000**	
Contingencies:	**20,000**	**20,000**	**20,000**	**20,000**	**20,000**	**100,000**	
TOTAL: DISPOSITION FUND	**400,000**	**967,000**	**1,081,000**	**1,076,000**	**926,000**	**4,450,000**	
Consultant's Budget (Project Implementation and inputs to survey, monitoring and management planning, as well as integration of BOMP with Park Management Planning process).	**300,000**	**250,000**	**250,000**	**250,000**	**250,000**	**1,300,000**	
GRAND TOTAL	**700,000**	**1,217,000**	**1,331,000**	**1,326,000**	**1,176,000**	**5,750,000**	

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