



REPORT

WASTE DUMP FACILITY SITE ALTERNATIVES ANALYSIS

Amulsar Gold Project, Central Armenia

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15 May 2013

113-81597SS

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EXECUTIVE SUMMARY

This revised Site Alternatives Analysis (SAA) report summarizes the evaluation process conducted for the sites identified as potentially viable for development of a mine waste dump facility (WDF) for the Amulsar gold project in central Armenia. The SAA was a multi-disciplinary process led by Golder Associates Inc. (Golder). This final report has been completed by Golder for Lydian International Ltd. (Lydian). Technical specialists in the fields of geotechnical engineering (Golder), biodiversity (Tweek Environmental Consultants), cultural heritage (ERM), visual impacts (LUC), social (Lydian in-house), water resources (Golder) and experienced environmental and social development consultants (Gone Native and Shared Resources) were integrally involved in the creation and population of the decision matrices used in the SAA.

The SAA process was completed to ensure that the site selected for the WDF is the optimal site for a range of multidisciplinary considerations, consistent with the International Finance Corporation (IFC) requirements and in consideration of the views and specific regulatory requirements of the Government of Armenia. This revised WDF SAA addresses the requirements of the IFC Performance Standards (PS), in particular PS1 on Assessment and Management of Environmental and Social Risks and Impacts and PS6 on Biodiversity Conservation and Sustainable Management of Living Natural Resources.

In IFC PS1, emphasis is focused on the assessment and management of environmental and social risks in particular with respect to greenfield development as discussed in Guidance Note (GN) 25:

- For greenfield developments, the ESIA includes an examination of technically and financially feasible alternatives to the source of such impacts, and documentation of the rationale for selecting the particular course of action proposed. The purpose of the alternatives analysis is to improve decisions on project design, construction, and operation based on feasible alternatives to the proposed project. This analysis may facilitate the consideration of environmental and social criteria at the early stages of development and decision-making based on the differences between real choices. The alternatives analysis should be conducted as early as possible in the process and examine feasible alternatives; alternative project locations, designs, or operational processes; or alternative ways of dealing with environmental and social impacts.
- IFC PS 6 emphasizes the need to avoid impacts on biodiversity and ecosystem services. No project activities should be carried out in critical habitat unless it can be demonstrated that there are no other viable alternatives within the region for development of the project on areas of habitat that are not critical. Project activities within certain internationally recognized areas for biodiversity conservation should also be avoided with a similar requirement to demonstrate that there are no viable alternatives. This includes “key biodiversity areas” such as “Important Bird Areas (or IBAs).” Careful consideration of alternatives is important to demonstrate that appropriate efforts have been made to avoid impacts on natural and critical habitat and on key biodiversity areas.

An initial WDF SAA report was completed by Wardell Armstrong International (WAI, 2012a), with technical support provided by Golder, KD Engineering, and International Mining Consultants. This initial



WDF SAA evaluation considered six potentially viable sites; all located in close proximity to the planned mine. Of these six potentially viable WDF sites, two of the sites were also considered as potentially viable heap leach facility (HLF) sites in the initial HLF SAA for potential HLF development (Golder, 2012a). The original WDF SAA evaluation (WAI, 2012a) selected Site 5 as the preferred site for WDF development from among the sites considered. Note that Site 5 from WAI (2012a) was subsequently changed to Site 13 for the original HLF SAA (Golder, 2012a) and will be referred to as Site 13 hereafter.

The original WDF SAA (WAI, 2012a) and HLF SAA (Golder, 2012a) evaluations were completed prior to completion of the archaeology and biodiversity baseline studies. In addition, subsequent to the completion of the original SAA reports, it has been determined that all the potentially viable WDF and HLF development sites within the Vorotan Valley are within the designated “non-immediate impact zone” of the Lake Sevan Catchment. Lake Sevan has an ecosystem of considerable importance to the Republic of Armenia and is legally protected. Therefore, Lydian has determined that potential ecosystem and biodiversity impacts to the Lake Sevan “non-immediate impact zone” from HLF and WDF development are to be considered in this revised SAA. As a result, both original HLF and WDF SAA evaluations have been revised to consider the additional baseline studies and potential impacts to the Lake Sevan non-immediate impact zone.

This report provides the revised WDF SAA process, which involved a four-step assessment:

1. The first step consisted of an initial high-level, desktop-based screening assessment to identify all potentially viable WDF sites with apparent suitable topography for development of a WDF within 20-25km from the Amulsar deposit. This was followed by a site visit that selected 27 potential sites for further analysis based on a visual scoping assessment.
2. The Initial Screening Assessment was completed to analyze the potentially viable sites for WDF development. This was a multidisciplinary process that included the expertise of a panel of subject-area experts based on five screening categories, namely: (i) Biodiversity-Environmental; (ii) General Location; (iii) Infrastructure; (iv) Social/Cultural; and, (v) Technical. A matrix based on 28 key criteria covering these categories was used to compare alternatives. Specialists identified potential “fatal flaws” for each category. Any alternative site that had a fatal flaw or for which development might result in significant adverse impacts across any of these 28 criteria was eliminated. Twelve (12) of the identified sites were eliminated due to fatal flaws, with eleven (11) sites eliminated due to significant adverse impacts. Four sites advanced to the next phase of assessment.
3. A Semi-quantitative Rating Assessment of the four (4) short-listed sites was then completed. The four (4) short-listed sites were subject to a detailed assessment to rank each indicator (across the five screening categories) and a weighting factor was applied for each site against this indicator. The team agreed to a list of 27 indicators capturing the main issues for the decision-making process to select a suitable site. The ranking system agreed upon included both a binary and specific ranking depending on the indicator as decided by the specialists. The binary ranking provided for a -3 rating for highly unfavorable conditions and a 0 rating for neutral conditions. The more specific ranking provided for a -3, -2, -1, and 0 rating based on specific criteria developed and



- agreed upon by the specialists. The unidirectional -3 to 0 scale captures the idea that potential impacts in all areas considered in the matrix are negative with regards to social and environmental receptors. Weighting factors were then developed on a 1 to 5 scale with a 5 carrying the most weight and 1 carrying the least. The selection of the weighting factor for each indicator was decided through a participative process involving all specialists that considered the relative significance of each primary indicator. Similarly, the rankings applied to each site for each indicator were identified firstly through specialist input, and then through participatory review with the group to reach consensus. The results were tabulated for these four sites and the scores assessed.
4. The last step was the preparation of conceptual layouts for each shortlisted site as a basis for preliminary review by the specialists to agree on which sites would be viable from a technical and financial perspective

The results of this revised WDF SAA carried out for the Amulsar project resulted in the selection of Sites 13 and 27 as the preferred sites for WDF development. Sites 11 and 19 were ranked third and fourth respectively, and would be considered as alternate WDF sites if development of the WDF at Sites 13 and 27 proved technically unfeasible.

The most favorable WDF sites, Sites 13 and 27 are now undergoing further engineering evaluation using additional information from technical studies, field characterizations, and site-specific engineering evaluations. The results of the additional WDF site evaluations will be included in the revised Feasibility Study (FS) for the Amulsar project. The WDF feasibility-level design will incorporate design considerations to mitigate potential adverse environmental, biodiversity, cultural heritage and social considerations identified during the SAA evaluations.

The SAA has objectively quantified and qualified the various options to arrive at the best option from technical, environmental, biodiversity, cultural heritage, and public safety and community/social points of view.



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1.0 INTRODUCTION AND BACKGROUND

This revised Waste Dump Facility (WDF) Site Alternatives Analysis (SAA) has been prepared by Golder Associates Inc. (Golder) for Lydian International Ltd. (Lydian) to summarize the evaluation process conducted for the potentially viable sites for the location of a WDF for the Amulsar gold project in central Armenia. This revised WDF SAA was performed by Golder with collaboration from various discipline specialists from Golder (e.g., geotechnical, geology, environmental, water) and external experts for biodiversity (Jo Treweek, Treweek Environmental Consultants), cultural heritage (Emlen Myers, ERM), visual impacts (Sam Oxley, LUC), social and environmental consultants (Judy Kreps, Gone Native; and Liz Wall, Shared Resources), and Lydian in-house specialists, and is intended to comply with international best practice with regards to assessment of alternative locations for major Project infrastructure components.

An initial WDF SAA report was prepared by Wardell Armstrong International (WAI 2012a), with support from Golder, Lydian, KD Engineering, and Independent Mining Consultants, that evaluated six potential sites for WDF development. Potential sites on the north and western sides of Amulsar Mountain in Vayots Dzor Marz (province) were excluded from the initial WDF SAA due to the perception of local concerns and objections to the development of a WDF with close or widespread visual impacts on key areas of the town of Jermuk. Sites beyond the immediate vicinity of the mine pits, e.g., beyond approximately 5 km, were also excluded from the initial WDF SAA due to economic limitations and environmental impacts of hauling large volumes of mine waste material over long distances (WAI, 2012a). Of the six sites considered in the initial WDF SAA, Site 5 was selected for consideration and advancement by Lydian for the Amulsar Feasibility Study. It should be noted that Site 5 from the initial WDF SAA report (WAI 2012a) was previously designated as Site 13 in the HLF SAA (Golder, 2012a) and will be referred to as Site 13 hereafter in this revised WDF SAA. It should also be noted that the site designated as Site 6 in the initial WDF SAA (WAI 2012a) was previously referred to by Golder as Site 11 in the HLF SAA and for consistency, will be referred to as Site 11 herein.

Site 13 is located approximately 4 km north of the planned open mine pit and 800 m west of the Vorotan River valley. The Site 13 WDF design was advanced to complete additional engineering evaluation and design for the Amulsar Feasibility Study (KDE 2012). The Feasibility Study WDF was designed to accommodate up to 158 million tonnes (Mt) with potential for expansion.

To ensure appropriate consideration of alternatives for siting of the mine waste facilities, Lydian initiated a review of the SAA process (in September 2012) and requested consideration of additional sites, including sites located on the western side of Amulsar Mountain in Vayots Dzor Marz and sites located outside of the boundaries of the Lake Sevan non-immediate impact zone and the Gorayk IBA. In support of advancing the Amulsar SAA process, Golder has coordinated this revised WDF SAA to consider additional potential WDF sites and alternatives beyond the 5 km radius limit and to consider the most



recent Amulsar baseline assessments. Additional baseline studies completed since the WAI (2012a) WDF SAA was completed include archaeology, biodiversity, and social considerations in support of the impact assessment presented in the ESIA draft report (WAI, September 2012). The results of these recent studies and regulatory consultations that have occurred since the initial WDF SAA was completed warrant consideration of additional WDF alternatives.

This revised WDF SAA was expanded to include the 26 sites considered for the revised HLF SAA (Golder, 2013), plus the inclusion of one additional potentially viable site located near the current exploration camp. The locations of these potentially viable sites are shown on Figure 1. The additional potentially viable WDF site is referred to as Site 27 and was previously characterized with a geotechnical site investigation. Site 27 is considered to have merit as a potential small WDF that could be developed to provide suitable surface area upon which mine infrastructure facilities (e.g., maintenance shops, offices, process support facilities, etc.) could be constructed. The evaluation of Site 27 therefore utilized the existing geotechnical and site characterization information.

As shown on Figure 1, several of the potentially viable sites (Sites 3, 4, 5, 6 and 8) are located partly or completely within the Gorayk IBA, which was designated (amongst other features) because it supports two breeding pairs of Egyptian vulture (*Neophron percnopterus*), a species listed as Endangered by the International Union for Conservation of Nature (IUCN) and the national Red Book of Armenia. International Finance Corporation's (IFC) Performance Standard (PS) 6 (IFC 2012a) permit development within certain internationally recognized areas only if there is no other technical and economically viable alternative in areas which are not "critical or natural" (paragraphs 13-19). This includes "key biodiversity areas" such as an IBA.

The potential for a hydrological connection to Lake Sevan through the Spandaryan-Kechut (currently non-operational) and Kechut-Sevan tunnels was one concern due to the value placed on Lake Sevan within the country. A total of twelve of the potentially viable WDF sites that were evaluated are located entirely or partially within the non-immediate impact zone of the Lake Sevan catchment, as illustrated on Figure 2. Under the Lake Sevan Law, Lake Sevan is categorized as an ecosystem of strategic importance and has a specific law that governs its protection. The catchment basin of Lake Sevan as defined by the Sevan Law, includes the Kechut and Spandaryan reservoirs, and the basins of the Vorotan River to Spandaryan reservoir and the Arpa River to Kechut reservoir. Article 10, Part 1 of the Law on Lake Sevan states that, "any type of activity detrimental to the Lake Sevan ecosystem is prohibited in the central, immediate impact, and non-immediate impact zones." Article 9.2 states that commercial activity in the non-immediate impact zone is to be carried out in accordance with the maximum permissible discharge standards (i.e., Maximum Allowable Concentrations or MACs) and the requirements set forth by the legislation of the Republic of Armenia.



Since involvement of stakeholders is essential to the success of the project, this revised WDF SAA report presents an overview of IFC requirements and of Lydian's efforts regarding stakeholder engagement in Sections 2.0 and 3.0, respectively. The WDF selection process was advanced by undertaking an initial high level, desktop-based screening assessment that included field reconnaissance and a fatal flaw analysis that identified 27 potentially viable sites. The desktop study is discussed in Section 4.0 and the screening assessment in Section 5.0. A fatal flaw analysis was established such that the following criteria resulted in a site being excluded from further consideration:

- Sites located further than a 6 km radial distance from the open pit
- Significant visibility from Jermuk (due to its significance as a tourist destination)
- Sites with insufficient topography and space to collect and manage acid rock drainage (ARD) and for the wastewater treatment plant (WWTP)
- The presence of significant geotechnical flaws (e.g., poor foundations conditions, adverse site gradient, and/or avalanche zones)
- No suitable haul road route and/or too far for economically viable truck haulage

The screening assessment included a review of adverse impacts and consideration of the cumulative impact of each of the 28 key screening criteria for each site, such that a site with numerous adverse impacts also resulted in its elimination from further consideration. The result of this assessment and the fatal flaw analysis resulted in the elimination of 23 sites.

The screening assessment phase was followed by a semi-quantitative site ranking evaluation of the four remaining sites. A detailed discussion of the semi-quantitative process is presented in Section 5.0. This process included an evaluation and ranking using a numeric scoring system that included a weighting evaluation based on relative importance for a variety of sub-categories. Of the remaining four sites, Sites 13, 27, 11, and 19 were identified in order of preference as the four most viable sites. Of these four sites, Sites 13 and 27 were identified in order of preference as the two most preferred WDF sites for consideration by Lydian and the various stakeholders for the Amulsar project. The SAA process is shown in general terms with respect to site assessment and selection in the Table 1.

Table 1 WDF SAA General Process

Step 1 – Desktop Study and Site Reconnaissance	27 Sites Selected
Step 2 – Initial Screening Review	Fatal Flaw Analysis and Review of Significant Adverse Conditions: 23 Sites Eliminated
Step 3 – Semi-Quantitative Ranking	Review of Remaining 4 Sites: 11, 13, 19, and 27
Step 4 – Site Selection	Sites 13 and 27 selected as the WDF preferred sites recommended for advancement with Sites 11 and 19 as alternative sites



A discussion of the IFC Requirements is presented in the next section followed by a detailed discussion of the site reconnaissance and subsequent screening and semi-quantitative assessments conducted by Golder and the discipline specialists.



2.0 INTERNATIONAL FINANCE CORPORATION REQUIREMENTS

The SAA has been revised to include the requirements of IFC Performance Standards, in particular PS1 on Assessment and Management of Environmental and Social Risks and Impacts and PS6 on Biodiversity Conservation and Sustainable Management of Living Natural Resources.

PS1 established the need to conduct an alternative assessment as part of the ESIA. In accordance with best practice, alternatives assessed typically cover siting of major infrastructure components. PS1 states in the footnote to paragraph 7 that “The client [*i.e., Lydian*] will conduct... an examination of alternatives”:

“The client will establish and maintain a process for identifying the environmental and social risks and impacts of the project (see paragraph 18 for competency requirements). The type, scale, and location of the project guide the scope and level of effort devoted to the risks and impacts identification process. The scope of the risks and impacts identification process will be consistent with good international industry practice,¹⁰ and will determine the appropriate and relevant methods and assessment tools. The process may comprise a full-scale environmental and social impact assessment, a limited or focused environmental and social assessment, or straightforward application of environmental siting, pollution standards, design criteria, or construction standards.¹¹ ... The risks and impacts identification process will be based on recent environmental and social baseline data at an appropriate level of detail. The process will consider all relevant environmental and social risks and impacts of the project, including the issues identified in Performance Standards 2 through 8, and those who are likely to be affected by such risks and impacts...

“11 For greenfield developments or large expansions with specifically identified physical elements, aspects, and facilities that are likely to generate potential significant environmental or social impacts, the client will conduct a comprehensive Environmental and Social Impact Assessment, including an examination of alternatives, where appropriate.”

With respect to greenfield development, PS1 provides specific guidance within Guidance Note (GN) 25:

GN25. “For greenfield developments, the ESIA includes an examination of technically and financially feasible alternatives to the source of such impacts, and documentation of the rationale for selecting the particular course of action proposed. The purpose of the alternatives analysis is to improve decisions on project design, construction, and operation based on feasible alternatives to the proposed project. This analysis may facilitate the consideration of environmental and social criteria at the early stages of development and decision-making based on the differences between real choices. The alternatives analysis should be conducted as early as possible in the process and examine feasible alternatives; alternative project locations, designs, or operational processes; or alternative ways of dealing with environmental and social impacts.”

PS1 in paragraph 13 and 14 states that the client will establish management programs:

“These programs, in sum, will describe mitigation and performance improvement measures and actions that address the identified environmental and social risks and impacts of the project... The programs may apply broadly across the client’s organization, including contractors and primary suppliers over which the organization has control or influence, or to specific sites, facilities, or activities. The mitigation hierarchy to address identified risks and impacts will favor the avoidance of impacts



over minimization, and, where residual impacts remain, compensation/offset, wherever technically²⁰ and financially feasible²¹.”

Detailed definitions are provided in footnotes 20 and 21:

20 “Technical feasibility is based on whether the proposed measures and actions can be implemented with commercially available skills, equipment, and materials, taking into consideration prevailing local factors such as climate, geography, demography, infrastructure, security, governance, capacity, and operational reliability.

21 “Financial feasibility is based on commercial considerations, including relative magnitude of the incremental cost of adopting such measures and actions compared to the project’s investment, operating, and maintenance costs, and on whether this incremental cost could make the project nonviable to the client.”

PS6 specifically addresses the need to avoid impacts on biodiversity and ecosystem services when selecting locations to develop projects. Clients should not “significantly convert or degrade natural habitats” unless, *inter alia*, “no other viable alternatives within the region exist for development of the project on modified habitats. Furthermore, project activities must not be undertaken in critical habitat unless it can be shown that all the following conditions can be met (IFC PS6 paragraph 17):

- **“No other viable alternatives within the region exist for development of the project on modified or natural habitats that are not critical”**

PS6 Guidance Notes further emphasize the need to consider project development options, which would avoid impacts on natural or critical habitat. Compliance with the requirements of IFC PS6 in this regard was therefore a major driver behind review of viable alternatives.

In addition, PS6 Guidance Note states the following in paragraph 44 and 45 as noted below:

GN44. “Significant conversion or degradation of natural habitat will not take place unless the client is able to demonstrate that all three requirements in paragraph 14 have been undertaken and the company has demonstrated that its proposed activities comply with land-use and licensing regulations. The first bullet point is that no viable alternatives exist for that project on modified habitat (within the region). This is especially relevant to agribusiness projects where it might be feasible in some cases to site the project on heavily modified and degraded lands rather than in areas that have recently been deforested or on other forms of natural habitat (e.g., tropical savannah). In these cases, a well-developed locations alternative analysis should be conducted to explore potential viable options for development on modified habitat. The term “viable” includes, but is not limited to, technically and financially feasible alternatives. This analysis will in most cases be in addition to the alternative analysis included as part of the risks and impacts identification process. It should be a considerably more in-depth analysis than what is typically included in an ESIA, and should provide specifics on alternatives in the landscape for developing the project as well as the breakdown of cost increases for developing modified versus natural habitat.”



GN45. *“The second bullet point in paragraph 14 is with respect to stakeholder engagement and consultation. If a project has the potential to result in significant conversion or degradation of natural habitats, relevant stakeholder groups must be engaged as part of a rigorous, fair and balanced multi-stakeholder dialogue. Client requirements for stakeholder engagement are described in Performance Standard 1 and related guidance can be found in Guidance Note 1. Stakeholders should specifically be engaged with respect to (i) the extent of conversion and degradation; (ii) the alternatives analyses; (iii) biodiversity and ecosystem services values associated with the natural habitat; (iv) options for mitigation, including set-asides and biodiversity offsets; and (v) identification of additional opportunities for biodiversity conservation (see paragraph GN34). Clients must keep a record of such stakeholder engagement and consultation activities and demonstrate how viewpoints have been reviewed and integrated into the project design. Stakeholders should include a diverse set of opinions, including scientific and technical experts, relevant authorities/agencies responsible for biodiversity conservation or the regulation/management of ecosystem services, and members of the national and international conservation NGO community, in addition to Affected Communities.”*



3.0 STAKEHOLDER ENGAGEMENT

Lydian discovered the Amulsar deposit in 2006, with stakeholder engagement activities commencing as soon as geological investigations began on the mountain. The engagement process has become more formalized over the intervening years, with the creation of Community Liaison Committees (CLC) in the three initially affected villages (Saravan, Goryak, and Gndevéz) in 2010 and one more CLC created in 2011 for Jermuk. A Community Liaison Officer meets monthly with the CLCs in the four communities for updates & feedback. Lydian also consults with local communities through local program assistants.

Lydian has built a 5-year record of accomplishment of community engagement with local villagers (CLC, grievance boxes, monthly newsletters), fully compliant with International Best Practice regarding Stakeholder Engagement (World Bank Group, Equator Principles).

More than 50 public consultation, disclosure events & informal meetings have taken place since 2007 in the locally affected communities, and a formal Stakeholder Engagement Plan (SEP), prepared and implemented in line with IFC PS requirements, was adopted in early 2011, guiding how to consult, inform and work with local villagers. The SEP was updated in April 2013 to reflect the current project.

The results of this SAA will be shared with affected communities and Project stakeholders (including relevant regulatory authorities) via Lydian's existing stakeholder relations program.

Public meetings and consultations with stakeholders will take place in the coming months to present and discuss the outcomes of the WDF SAA.



4.0 INITIAL DESK STUDY AND SITE RECONNAISSANCE

The revised SAA began with a desk study and site evaluation conducted using available information to review potentially viable HLF (Golder, 2013) and WDF sites in Vayots Dzor Marz and in an expanded area in Syunik Marz. This desk study included site characterization information gained from the recent site reconnaissance performed on Sites 1 through 27, by Golder's senior technical specialists from Denver, Colorado (Brent Bronson and Rick Kiel) and Nottingham, England (Gareth Digges La Touche), supported by Lydian's mine Environmental Manager (Carl Nicholas). The site reconnaissance was conducted over a four-day period from 1 to 4 November 2012. The site reconnaissance took the opportunity to assess additional sites for the WDF, as the site requirements for both facilities share several similar properties.

This phase of work comprised two distinct steps:

- The desk study identified potentially viable sites from satellite imagery combined with a digital elevation model of the area, available 1:100,000 topographic maps and existing knowledge of the area on the part of the Golder and Lydian teams.
- A review of the Field Reconnaissance Reports completed for the HLF SAA (Golder, 2013) for Sites 1 through 26 as identified on Figure 1. The field reconnaissance reports document observations and notes regarding biodiversity, environmental, infrastructure, social, cultural, and technical issues, together with photographs at each site. A Field Reconnaissance Report was also prepared for Site 27 based on site-specific information gathered during the geotechnical investigation conducted during the fall of 2011 in this area and from field observations during the November 2012 field reconnaissance.

The location of the sites considered during the *screening assessment* are shown on Figure 1 along with many of the key environmental, biodiversity, social, and infrastructure characteristics in the study area.

The Site 27 Field Reconnaissance Report is included in Appendix A. The reports for Sites 1 through 26 are included in Appendix A of the HLF SAA report (Golder, 2013).



5.0 SCREENING ASSESSMENT

The twenty-seven sites identified on Figure 1 were evaluated as potentially viable locations for a WDF first in a *screening assessment*. The sites are situated within the Arpa, Darb, and Vorotan River Catchment areas. As previously noted, twelve of the sites are located within the Lake Sevan non-immediate impact zone as depicted on Figure 2.

Based on the expert and specialist consultations and information gained from the field reconnaissance and input from the discipline specialists, the key project biodiversity, physical environmental, social, technical viability, and economic viability subcategory considerations were established and used to develop the screening criteria as shown on Tables 2a through 2e. The subcategory considerations are presented as headers in Tables 2a through 2e and are posed as questions such that a positive response means the constraint is favorable to the selection of the site. This was initially undertaken in a phased manner with discipline specialists populating the tables independently. The tables were then updated by Golder based on initial feedback received during a conference call on 28 November 2012, and subsequently finalized during a follow-up conference call on 6 December 2012.

A discussion of the applicable buffer zones, exclusion areas, site constraints, ranking criteria and fatal flaw decision-analysis is provided in the following sections.

5.1 Buffer Zones and Exclusion Areas

Application of the *screening assessment* criteria shown on Tables 2a through 2e included definition and inclusion of buffer zones and exclusion areas around sensitive environmental features, communities, and service infrastructure. A buffer zone was generally considered a specifically delimited area within which WDF development was considered to be an adverse condition and was to be avoided in the planning stage. As such, siting for the initial 27 sites avoided these areas. Exclusion areas were typically areas where WDF development would create a significant adverse condition to the environment or local community. These exclusion areas were therefore avoided to the extent practical and given special consideration in the screening assessment and semi-quantitative ranking process.

5.1.1 Buffer Zones

The buffer zones were defined in accordance with Armenian regulatory guidance, under direction from Lydian for the gas pipeline and Vorotan-to-Arpa tunnel, on information provided by Geoteam CJSC and information from the ESIA prepared by WAI. They were identified as follows:

- Major Rivers (Vorotan, Arpa and Darb) and their significant, permanent tributaries – 200m from each bank, which exceeds the setback distance required by Armenian Decree N64 of 150 m
- Iran-Armenia Gas pipeline – 200m buffer on either side based on information provided by the pipeline owner, ArmRus Gazprom



- Spandaryan-Kechut Tunnel (currently not in operation) linking the Vorotan river to the Arpa river – 50m buffer on either side based on recent communications with Geoteam and similar regulatory requirements elsewhere in the European Union

5.1.2 Exclusion Area Considerations

Exclusion areas were identified to comply with Government of Armenia laws and international policies and standards. They were also identified to avoid impacts on key environmental and biodiversity receptors identified through baseline studies and impact assessments. The presence of a site within or near an exclusion area was considered as adverse within the initial screening assessment. Such sites were given more significance and generally ranked more negatively in the semi-quantitative ranking assessment. The following exclusion areas were identified:

- Settlements: 1km boundary around settlements to any periphery of the key mine infrastructure specific to gold metallurgical processing facilities based on the Armenian regulations for sanitation protective zones (SanPin 2.2.1/2.1.1.1200-03, 4.1.23). The presence of a sanitation protection zone was not considered to represent a fatal flow at the screening assessment stage as potential mitigation including physical relocation and economic compensation measures could be considered for some of the villages depending on site-specific conditions, social impacts, and after thorough local community input and involvement. Any site that advanced in the screening assessment that was located within an exclusion zone was heavily negatively weighted in the semi-quantitative ranking assessment. In addition, sites between 1 and 2 km around settlements were also considered as potentially adverse conditions.
- Gorayk and Jermuk Important Bird Areas (IBA).
- Biodiversity – Potential Critical Habitat: Some parts of the search area may constitute critical habitat according to the definition in PS6, due (amongst other factors) to the presence of species that are listed as Endangered on the IUCN Red List and/or in the national Red Book. Egyptian vultures (Endangered) breed in the vicinity and populations pass through and feed during the spring and autumn migrations. There is also a population of an alpine plant, *Potentilla porphyrantha* (Critically Endangered in the Armenian Red Book) on Amulsar Mountain. Alternatives that would avoid impacts on potential critical habitat were sought.
- Archaeology: It was considered preferable to avoid known cultural heritage sites identified as having medium to high importance. Sites of unique importance for cultural heritage (i.e., no go zone) have been already identified and mapped by ERM.
- Lake Sevan Law: The catchment basin of Lake Sevan as defined by Sevan Law covers Kechut and Spandaryan reservoirs, which includes the basins of Arpa and Vorotan rivers up to Kechut reservoir. The Lake Sevan catchment basin is divided into three zones: the central zone, an immediate impact zone, and a non-immediate impact zone. The purpose of identifying the non-immediate impact zone is to prevent the potential for negative impacts on Lake Sevan.

5.2 Site Constraints

The presence of villages and other limiting infrastructure, such as road crossings and existing government facilities that may create site constraints was identified and considered during the screening process.



The identification of potentially viable WDF sites at the initial *screening assessment* level was based on criteria shown on Tables 2a through 2e. The key initial screening criteria considered (in no particular order of significance) are discussed briefly in each of the following sub-sections.

5.2.1 Suitable Topography

The presence of steep slopes and the presence of landslide deposits or poor ground conditions were considered generally as being geotechnically unfavorable to the location of the WDF unless the geometry permitted construction of a suitable toe buttress or other constraint to provide adequate WDF stability. Steep slopes were also considered a constraint if it affects access requirements for truck haulage. Topographic constraints also consider the availability of suitable topography to collect and manage any acid rock drainage (ARD), including a suitable location for a treatment plan and associated infrastructure (e.g., ponds). Topographic screening constraints are primarily included on Table 2e.

5.2.2 Geology and Hydrogeology

Each site was assessed based on the geologic and hydrogeologic conditions relative to the suitability of the site and foundation conditions for development of a WDF. Based on surveys undertaken by Lydian, previous characterization studies completed by Golder personnel at select sites, and observations from all the sites during the November 2012 site reconnaissance, each site was evaluated for the presence of unfavorable geology that could impact the viability of developing a WDF (for example extensive recent surficial lava flows, hummocky topography indicative of unstable foundation conditions, landslides, numerous springs, snow avalanche chutes, etc.). Geologic screening constraints are primarily included on Table 2e.

5.2.3 Capacity (Surface Area)

Each site was assessed based on surface area as to the likelihood of it having the sufficient capacity to meet the project waste rock storage requirements (i.e., 180-Mt site with the capacity to be expanded to 240 Mt, for a single WDF scenario; or, alternatively, provide for a minimum of a 100-Mt WDF assuming a multiple site development scenario). Capacity screening constraints are primarily included on Table 2e.

5.2.4 Environmental Factors

The primary environmental constraints were those identified as requiring buffer zones or consideration of an exclusion area including the proximity to settlements, the IBAs, the Lake Sevan non-immediate impact zone, and other concerns related to general biodiversity of the sites. Other environmental factors considered were the presence of river crossings (with the aim to minimize haul road crossings of major watercourses) and avoidance of impacts to perennial streams.



5.2.5 Social Factors

Each site was evaluated with regard to its proximity to local communities and settlements, whether the construction of the WDF would require physical displacement of any inhabitants or would result in economic displacement. The specific type of economic displacement anticipated was considered and is predominantly associated with the loss of communal grazing lands by local and seasonal herders and relocation of community water supply infrastructure. Also considered was the WDF visual impact potential from settlements and major highways. Impacts to community water supplies including both agricultural and potable water use were considered. Although considered in the SAA, some economic displacement will be difficult to avoid due to the high levels of land-use by herders (both residential and seasonal) across the area; however, the degree of economic displacement does vary from one site to another.

5.2.6 Infrastructure

The presence of any significant infrastructure was documented based on available mapping and site observations. Such infrastructure included roads, power transmission lines, a fiber optic line, irrigation and water supply channels, tunnels, a military observation station, a meteorological station, and a high-pressure trans-national gas pipe line. Such infrastructure is considered to pose constraints and/or mitigation requirements.

Radial distance from the open pits is considered a key environmental and economic screening constraint for a WDF, due to the logistical requirement of developing mine truck haulage roads from the pits to the waste rock disposal site. From an environmental perspective, long haulage routes result in greater disturbance, visual, and dust/carbon emission impacts. Long mine haulage also can have a significant impact on the economic viability of the WDF location. Based on these considerations, sites greater than 6 km were deemed a fatal flaw, while sites from 3 to 6 km where the haul road would require one or more main road or river crossings were noted as being potentially adverse on this basis.

5.2.7 Biological Diversity

Efforts were made to identify locations for the WDF that would (a) avoid significant adverse impacts on critical habitat and (b) avoid significant conversion or degradation of natural habitat. Most of the study area is used to some extent for agriculture, including communal grazing, hay harvesting and in some cases cultivation for crops. Intensity of use varies and a large proportion of potential sites are considered “natural habitat” according to the definition in PS6 because they retain “viable assemblages of plant species of largely native origin.” Others are more intensively used and modified due to farming and include a higher proportion of artificially introduced species. Options outside the two IBAs in the area were identified. Based on the results of baseline ecological surveys and consultation with conservation



organizations that are active in the area, alternatives that would avoid impacts on potential critical habitat were also sought.

5.2.8 Archaeology

The archaeological and cultural heritage potential of each site was assessed by ERM from the results of three field inspections in 2011 and 2012, the results of field surveys commissioned by Geoteam with local archaeologists and the examination of satellite imagery. Sites were designated as either being of *low potential* (for example no resources identified, but close to a site where resources have been identified), *high potential* (for example close to a site where resources have been identified and the site has not been surveyed to confirm absence), or *within* (for example where the site has confirmed archaeological resources within it). Some sites were not designated as there was insufficient data to undertake an assessment. These sites were not rated, as archaeological consultants had not visited the sites as yet.

5.3 Ranking Criteria and Fatal Flaws

Following compilation of the screening criteria table the presence of adverse conditions, including fatal flaws, at each site was identified. Where adverse conditions were identified, they are highlighted on Tables 2a through 2e through shading. Adverse criteria are shaded orange, whereas conditions considered to represent fatal flaws are shaded red. The following criteria were established as indicative of a fatal flaw that resulted in the site being excluded from further consideration:

- The presence of unsuitable geotechnical conditions, (e.g., extensive ancestral landslides, poor foundations conditions due to clay and multiple springs, recent extensive lava flows, etc.) that cannot be buttressed or otherwise remediated to provide a stable WDF
- Suitable space for collection and management of ARD, including necessary water treatment facilities (e.g., plant, ponds, office, etc.)
- Located beyond 6 km from the open pit where the haul route would result in an increase in a variety of impacts to the environment, increased risk to health and safety of workers, and result in an economically unviable impact to the project due to increased truck haulage costs
- Significant visibility from Jermuk (due to its significance as a tourist designation)

If the site in question scored a fatal flaw (i.e., red) or had significant adverse conditions (i.e., orange) as determined and agreed to by the specialists team, then it was considered that the site did not warrant further assessment. Twelve sites (Sites 1, 2, 8, 15-18, 20-23, and 25) were discounted from further assessment based on one or more fatal flaws.

Ten additional sites (Sites 3-7, 9-10, 12, 14, 24 and 26) were discounted for various reasons due to significant adverse conditions. Site 14 was discounted due to its selection as the preferred HLF site. Sites 3, 4, 5 and 6 were discounted due to their presence within the Gorayk IBA. Site 7 was discounted due to a combination of its distance from the open pit, difficult constructability and challenging foundation



conditions, and the presence of at least one river crossing. Sites 9, 10, 12 and 24 were discounted due to a combination of challenging and difficult site constraints requiring multiple locations for ARD management facilities, and river and road crossings. Site 26 was discounted based on a combination of significant adverse conditions including difficult construction conditions, access for heavy equipment, difficult closure conditions and limited visibility (i.e., not widespread across the town or affecting key areas) at a distance of over 5km from Jermuk.

Sites 11, 13, 19, and 27 were advanced for additional evaluation in the *semi-quantitative* site ranking.



Table 2a Initial Screening Criteria – Biodiversity/Environmental

WDF Site	Outside Lake Sevan Non-Immediate Impact Zone?	Beyond 50 m of the Spandaryan Kechut Tunnel? [Note 5]	Beyond 1km sanitary protection zone for Communities?	Outside IBA Area boundary?	Outside area of supporting habitat for IBA? [Note 1]	Outside Natural Habitat? [Note 2]	Outside potential critical habitat? [Note 3]
1	YES	YES	NO (0.7km South of Saravan)	YES	YES	YES	YES
2	YES	YES	YES (1.1km E/NE of Ughedzor)	YES	YES	YES	YES
3	NO	YES	YES (Ughedzor – 2km E/NE)	Partially	NO	YES	YES
4	NO	YES	YES (2.3 km W/NW of Gorayk)	NO	NO	YES	NO
5	NO	YES	YES (1.1km N of Gorayk)	NO	NO	NO	NO
6	NO – Vorotan	YES	YES (2km N of Gorayk)	Partially	NO	NO	NO
7	NO – Vorotan	YES	YES (6km N/NE of Gorayk)	YES	NO	NO	NO
8	NO – Vorotan	YES	YES (1.3km N/NE of Gorayk)	NO	NO	NO	NO
9	NO – Vorotan	YES	YES (4km N/NE of Gorayk)	YES	NO	NO	NO
10	NO – Vorotan	YES	YES (3km N/NE of Gorayk)	YES	NO	NO	NO
11	NO – Vorotan	YES	YES (4km S/SE of Kechut)	YES	NO	NO	NO
12	NO – Vorotan	YES	YES (6km N of Gorayk)	YES	NO	NO	NO
13	NO – Vorotan	YES	YES (4km S/SE of Kechut)	YES	NO	NO	NO
14	YES	YES	YES (2km E of Gndevaz)	YES	YES	NO	NO
15	YES	YES	YES (4km E of Gndevaz)	YES	YES	NO	NO
16	YES	YES	YES (3km NE of Saravan)	YES	YES	NO	NO
17	YES	YES	YES (1.8km NE of Saralanj)	YES	YES	NO	NO
18	YES	YES	YES (2km NE of Saralanj)	YES	YES	NO	NO
19	YES	YES	YES (1.6km E of Saralanj)	YES	YES	YES	YES
20	YES	YES	NO (0.6km N of Saralanj)	YES	YES	YES	YES
21	NO – Vorotan	YES	YES (4km NE of Gorayk)	YES	NO	NO	NO
22	NO – Vorotan	YES	YES (1km N of Tsghuk)	YES	NO	NO	NO
23	YES	YES	NO (0.5km E of Sarnakunk)	YES	NO	NO	NO
24	YES	YES	NO (Immediately West of Ughedzor and 1km to West End of Site 24)	YES	YES	YES	YES
25	YES	YES	YES (1.5km S/SE of Ughedzor)	YES	YES	YES	YES
26	NO – Kechut	YES	YES (1.5km SE of Kechut)	YES	YES	NO	NO
27	NO	YES	YES (3km SE of Kechut)	YES	NO	NO	NO

General Note to Tables 2a through 2e: Red shading indicates a fatal flaw while orange shading indicates a potential significant adverse condition. Bold fonts indicate the site was selected for advancement to the semi-quantitative assessment phase.

Note 1: Supporting habitat for the IBA. Goryk IBA was designated based on certain criteria, notably Egyptian Vulture (EV) and lesser kestrel, but it was entirely designed as a buffer round the lesser kestrel breeding colony and doesn't reflect area important for EV and other species (see below). All species use Vorotan Valley but surveys not carried out for western side of the Concession Area. EV, Golden Eagle and Long-legged buzzard relatively adaptable in terms of feeding if area around nest site is not disturbed. Nest sites not confirmed.

Species	Season	Population Estimate	IBA Criteria	IUCN Status	Note
Lesser Kestrel <i>Falco naumanni</i>	breeding	10-20 breeding pairs	A1, B2	Least Concern	Hunts actively at Site 6, entire hunting area not established
Egyptian Vulture <i>Neophron percnopterus</i>	breeding	1-2 breeding pairs	A1	Endangered	Breeding sites within or near IBA not known. Feeds widely but concentrations of feeding activity around Sites 6 and Site 13
Long-legged Buzzard <i>Buteo rufinus</i>	breeding	5-6 breeding pairs	B2	Least Concern	Breeding sites previously on Amulsar. Relatively adaptable, feeds widely
Golden Eagle <i>Aquila chrysaetos</i>	breeding	2-3 breeding pairs	B2	Least Concern	Breeding sites not confirmed. Shortage of suitable sites likely may be possible to create artificially.

Sites 4 and 5 inside IBA, but existing information suggests not used much by designated species; Site 6 and Site 13 have concentrations of feeding activity. Sites 7,9,10 and 21, 22, 23 may all be used by Gorayk EV, but use of these areas not known at present. EV likely to be able to adapt provided no major disturbance around nesting locations (Not known). Site 14: closer to Jermuk IBA. Little known about populations associated with Jermuk and their ranges.

- Note 2:** Need to show there were no alternatives on habitat that is not natural (this exercise) and achieve>NNL of natural habitat if possible. Map needed of natural/modified habitat. Criteria for screening out “modified”: cultivated land, intensively grazed areas (including round large herder camps) roads, tracks, paths, buildings. All other land likely to be “natural.” Criteria for “natural”: retaining high proportion of species that would be expected to occur in a relatively undisturbed or un-managed example of the vegetation type (e.g., steppe grassland).
- Note 3: Critical Habitat** – The entire area of search is within the migration corridor for raptors including Egyptian Vulture. It is not possible to confirm whether trigger densities of population for Critical Habitat will be met until proposed spring survey carried out. Until that point, the entire concession has to be considered potential CH for migratory raptors/EV at this stage. “NO” is indicated where existing information suggests suitability for feeding/settling likely to be lower due to land use, disturbance etc. (not definitive). NB critical habitat areas differ for different species. CH for Potentilla is not directly affected by any of the alternatives but NB location of haulage from mine pit to 15, 16, 17, 18 could cross populations?
- Note 4: Ecosystem Services** – Vorotan Valley provides important services, as do rivers, grasslands, and forests around villages. Levels of dependence are not established. Input needed to determine whether there are any services that would be difficult to substitute for existing users who have limited alternatives and depend on these services a lot.
- Note 5: Spandaryan – Kechut Tunnel:** A 50 m buffer was maintained on either site of the tunnel alignment as a site selection criteria so all sites are at least 50 m from the mapped tunnel alignment.



**Table 2b Initial Screening Criteria – General Location**

WDF Site	4. Within rock allocation area (RAA)?	16. Within exploration license area?
1	NO	YES
2	NO	YES
3	NO	YES
4	YES	YES
5	YES	YES
6	YES	YES
7	NO	YES
8	YES	YES
9	NO	YES
10	NO	YES
11	Partially	YES
12	YES	YES
13	YES	YES
14	NO	NO
15	NO	NO
16	NO	NO
17	Partially	Partially
18	Partially	Partially
19	YES	YES
20	NO	YES
21	NO	Partially
22	NO	NO
23	NO	NO
24	NO	Partially
25	NO	YES
26	NO	Partially
27	Partially	Partially

Note 1: The Rock Allocation Area is shown on Figure 1 and consists of the area where mining and mineral processing activities are permitted. It was granted for the open pit, waste rock dumps & crushing and is valid until 2034.

Note 2: The exploration license covers a slightly broader area where exploration activity has been permitted as shown on Figure 1.



Table 2c Initial Screening Criteria – Infrastructure

WDF Site	Radial distance from the Open Pit	Haul Route Avoids River crossing?	Haul Route Avoids Impacts Near or Crossing a Paved Road?	Avoids gas pipeline crossing or impact?	Avoids Spandaryan-Kechut Tunnel crossing by haul road?	Heavy equipment access?
1	>3 km	NO	NO	YES	NO	MODERATE
2	>3 km	YES	YES	YES	NO	FAVORABLE
3	>3 km	YES	NO	YES	NO	FAVORABLE
4	>3 km	YES	YES	YES	YES	FAVORABLE
5	>3 km	YES	YES	YES	YES	FAVORABLE
6	>3 km	NO	YES	YES	YES	FAVORABLE
7	>3 km	NO	YES	NO	YES	MODERATE
8	>6 km	NO	YES	YES	YES	FAVORABLE
9	>3 km	NO	YES	NO	YES	FAVORABLE
10	>3 km	NO	YES	NO	YES	MODERATE
11	>3 km	YES	YES	NO	YES	FAVORABLE
12	<3 km	NO	YES	YES	YES	FAVORABLE
13	<3 km	YES	YES	YES	YES	MODERATE
14	>3 km	YES	YES	YES	NO	FAVORABLE
15	<3 km	YES	YES	YES	YES	DIFFICULT
16	<3 km	YES	YES	YES	YES	DIFFICULT
17	<3 km	YES	YES	YES	YES	DIFFICULT
18	<3 km	YES	YES	YES	YES	DIFFICULT
19	<3 km	YES	YES	YES	YES	DIFFICULT
20	>3 km	YES	YES	YES	NO	DIFFICULT
21	>6 km	NO	YES	NO	YES	FAVORABLE
22	>6 km	NO	NO	NO	YES	FAVORABLE
23	>6 km	NO	NO	NO	YES	FAVORABLE
24	>3 km	NO	NO	YES	NO	MODERATE
25	>3 km	NO	NO	YES	NO	FAVORABLE
26	>3 km	YES	YES	YES	YES	DIFFICULT
27	<3 km	YES	YES	YES	YES	FAVORABLE

Note 1: Significant adverse conditions (orange shading) were considered where a paved road or river crossing was required by the haul road or and where the terrain would make access to heavy equipment very difficult or where the site was greater than 3 km from the open pit.

Note 2: A fatal flaw (red shading) was considered on an economic basis for haul distances greater than 6 km where either a river or road crossing were required.



Table 2d Initial Screening Criteria – Social/Cultural

WDF Site	Site is not highly or widely visible from key areas of settlements (by day, and nighttime lighting)?	Presence of community water supply point/source	Outside of area with known immovable cultural/archaeological sites (i.e., is the Site free of archaeological resources?) ("-" means not yet subject to archaeological survey or consideration, status unknown.)	Avoids Physical resettlement of local human inhabitants	Avoids economic displacement?
1	NO – Saravan and Saralanj	None identified	(“-” means not yet subject to archaeological survey or consideration, status unknown.)	NO	NO – agricultural land
2	NO – Saralanj and Ughedzor	None identified	-	YES	NO – agricultural land and Ughedzor
3	NO – Saralanj and Ughedzor	None identified	-	YES	NO – agricultural land
4	NO – Saralanj and Ughedzor	None identified	-	YES	NO – agricultural land
5	NO – Gorayk	None identified	High Potential – Site 5 has neither been visited nor assessed via remote sensing, but it lies in close proximity to Site 6, which has a high number of known archaeological resources. <i>Accordingly, it is believed that Site 5 has high potential to not be free of archaeological resources.</i>	No	NO
6	NO	Gorayk source adjacent	Within – Site 6 is known to contain archaeological sites. <i>Accordingly, Site 6 is not free of archaeological resources.</i>	YES	NO
7	NO	None identified	-	YES	NO
8	NO – Gorayk	None identified	High Potential – Site 8 has neither been visited nor assessed via remote sensing, but it lies in close proximity to Site 6, which has a high number of known archaeological resources. Further, there is one potential archaeological site that falls within Site 8, although this site has neither been visited nor confirmed. <i>Accordingly, it is believed that Site 8 has high potential to not be free of archaeological resources.</i>	YES	NO
9	NO	None identified	High Potential – Site 9 has neither been visited nor assessed via remote sensing, but it lies in close proximity to known archaeological resources. <i>Accordingly, it is believed that Site 9 has high potential to not be free of archaeological resources.</i>	YES	NO
10	NO – Gorayk	Community water pipe	High Potential – Site 10 has neither been visited nor assessed via remote sensing, but it lies in close proximity to known archaeological resources. <i>Accordingly, it is believed that Site 10 has high potential to not be free of archaeological resources.</i>	YES	NO
11	YES	Gndevaz canal and pipeline	Low Potential – Site 11 has been visited and no archaeological resources were encountered. However, Site 11 lies in close proximity to known archaeological resources. <i>Accordingly, it is believed that Site 11 has low potential to not be free of archaeological resources.</i>	YES	NO
12	YES	None identified	Within – Site 12 contains a number of confirmed archaeological sites. <i>Accordingly, Site 12 is not free of archaeological resources.</i>	YES	NO
13	YES	None identified	Low Potential – Site 13 has been visited. Potential archaeological features of negligible importance were visited and recorded. However, it is uncertain if those sites in Site 13 are actual archaeological features or not. Further, while the landscape is sub-optimal for ancient populations, it does lie within proximity of known archaeological resources. <i>Accordingly, it is believed that Site 13 has low potential to not be free of archaeological resources.</i>	YES	NO: herders
14	YES	Agricultural reservoir, Gndevaz canal and pipelines	-	YES	NO: Gndevaz water supply; grazing and hay



WDF Site	Site is not highly or widely visible from key areas of settlements (by day, and nighttime lighting)?	Presence of community water supply point/source	Outside of area with known immovable cultural/archaeological sites (i.e., is the Site free of archaeological resources?)	Avoids Physical resettlement of local human inhabitants	Avoids economic displacement?
15	NO – Gndevaz	Spring catch pit	-	YES	NO: herders
16	NO – Gndevaz	None identified	-	YES	NO: herders
17	NO – Saravan	None identified	Low Potential – Site 17 has been visited and no archaeological resources were encountered. However, the field walkover at Site 17 was quite expedient, and it is possible that potential resources were missed, even if Site 17’s location is sub-optimal for ancient populations. Accordingly, it is believed that Site 17 has low potential to not be free of archaeological resources.	YES	NO: herders
18	NO – Saravan	None identified	Low Potential – Site 18 has been visited and no archaeological resources were encountered. However, the field walkover at Site 18 was quite expedient, and it is possible that potential resources were missed, even if Site 17’s location is sub-optimal for ancient populations. Accordingly, it is believed that Site 18 has low potential to not be free of archaeological resources.	YES	NO
19	NO – Saravan and Saralanj	None identified	Within – Site 19 contains a number of confirmed archaeological sites. Accordingly, Site 19 is not free of archaeological resources.	NO	NO
20	NO – Saravan, Saralanj and Ughedzor	None identified	Low Potential – Site 20 has not been visited, but a remote sensing analysis was conducted. No potential archaeological features were identified from the satellite imagery. Site 20 is also heavily disturbed from agricultural activity. However, this Site cannot be considered free of archaeological resources until a field visit occurs that searches for archaeological resources commonly not found through remote sensing techniques. Accordingly, it is believed that Site 20 has low potential to not be free of archaeological resources.	NO	NO: herders
21	NO – Gorayk and Tsghuk	None identified	-	YES	NO: herders
22	NO – Tsghuk	HEP/Community pipelines	-	MAYBE	NO: herders
23	NO – Sarnakunk	HEP/Community pipelines	-	NO	NO
24	NO – Ughedzor	Community supply pipeline and agricultural collection system	-	NO	NO
25	NO – Ughedzor	None identified	-	NO	NO
26	NO - Visible at a distance (over 5km) from Jermuk, but this would not be widespread across the town or affect key areas.	Gndevaz canal and pipelines	-	YES	NO
27	YES	None Identified	-	YES	NO

Note 1: Significant adverse conditions (orange shading) for visual impacts of the social and cultural screening criteria were considered with respect to visibility from the local effected communities. A fatal flaw (red shading) was considered with respect to the potential for close (under 5km) or widespread visual impacts from key areas of the tourist town of Jermuk. The water fountains, waterfall and associated areas of the town Centre are considered to be the key tourist areas, and from which visibility should be minimized.

Note 2: Significant adverse conditions (orange shading) for immovable cultural/archaeological sites were considered where there was high potential or where confirmed sites were known to occur on the site.

Note 3: Significant adverse conditions (orange shading) were considered where there was potential for the need to resettle local human inhabitants because of the planned WDF development.



Table 2e Initial Screening Criteria – Technical

WDF Site	Does site have suitable topography & space to collect and manage ARD & for WWTP?	No apparent significant geotechnical flaws (e.g., foundation conditions, general site gradient and/or avalanche zones)	Constructability	Acceptable Haul Road Route Topography (i.e., 10% Maximum grade; Road Width 25m)	Does site have capacity for 180 Mt with potential increase to 240 Mt?	Does site have capacity for 100 Mt assuming a 2-site scenario	Avoids management of shallow groundwater or significant (perennial) seeps and springs?	Avoids potentially difficult closure constraints (i.e., upgradient surface-water conditions and long-term groundwater issues)?
1	NO	NO – landslides	Difficult	NO	NO/NO	NO	YES	NO
2	NO	NO – landslides	Moderate	YES	NO/NO	NO	NO	YES
3	YES	YES	Good	YES	NO/NO	NO	NO	NO
4	YES	YES	Good	YES	YES/NO	YES	YES	YES
5	YES	NO – some landslides but moderate slopes, could buttress	Moderate	YES	YES/YES	YES	YES	NO
6	YES	YES	Good	YES	YES/NO	YES	YES	YES
7	YES	NO – extensive lava flows, but could bridge with extensive basal earthwork development	Difficult	NO	YES/YES	YES	YES	NO
8	YES	YES	Good	NO - too far for trucking	NO/NO	YES	YES	YES
9	YES	YES	Difficult	YES	NO/NO	YES	YES	NO
10	NO	YES	Moderate	NO	NO/NO	NO	NO	NO
11	YES	YES	Moderate	YES	YES/NO	YES	YES	YES
12	YES	YES	Good	YES	YES/NO	YES	YES	YES
13	YES	NO – foundation problematic, but could buttress	Moderate	YES	YES/NO	YES	NO	NO
14	YES	YES	Good	YES	YES/NO	YES	YES	YES
15	NO	NO – landslides, no buttress	Difficult	NO	YES/YES	YES	YES	NO
16	NO	NO – landslides, no buttress	Difficult	NO	NO/NO	YES	NO	NO
17	NO	NO – landslides, no buttress	Difficult	NO	NO/NO	YES	NO	NO
18	NO	NO – landslides, no buttress	Moderate	NO	NO/NO	YES	NO	NO
19	YES	NO – landslides, but could buttress	Difficult	NO	YES/NO	YES	NO	NO
20	NO	NO – landslides, no buttress	Moderate	YES	YES/NO	YES	YES	NO
21	YES	YES	Good	NO - too far for trucking	YES/NO	YES	YES	NO
22	YES	YES	Good	NO - too far for trucking	YES/YES	YES	YES	NO
23	YES	YES	Good	NO - too far for trucking	YES/YES	YES	YES	NO
24	YES	YES	Moderate	YES	YES/NO	YES	YES	NO
25	NO	NO – wet ground, no buttress. Darb headwaters	Difficult	YES	YES/NO	YES	YES	NO
26	YES	YES	Difficult	YES	YES/NO	YES	YES	NO
27	YES	YES	Moderate	YES	NO/NO	YES	NO	NO

- Note 1:** A fatal flow condition (red shading) was considered if suitable space was not available for construction of infrastructure required to manage ARD (i.e., Influent-Equalization Basin and Wastewater Treatment Plan).
- Note 2:** Significant adverse conditions (orange shading) were considered for sites with a moderate amount of problematic foundation conditions, while a fatal flaw (red shading) was considered for sites where the presence of landslides or other conditions (e.g., lava flows) were observed to an extent that would be prohibitive to development of a WDF at this site.
- Note 3:** Significant adverse conditions (orange shading) were considered where the site conditions would result in difficult construction conditions typically defined as a site where extensive earthworks, steep slopes, or problematic foundation conditions were present (i.e., extensive landslides or lava flows to remediate).
- Note 4:** Significant adverse conditions (orange shading) were noted on haul routes where the presence of multiple river crossings, road crossings or a combination of steep terrain were present with a fatal flaw (red shading) considered when the combination of adverse conditions and a distance greater than 10km would result in non-economically viable conditions.
- Note 5:** Significant adverse conditions (orange shading) were considered for smaller sites if the site could not provide capacity for at least 180Mt as a stand-alone site, while a fatal flaw (red shading) was considered if the site did not have capacity for at least 100Mt in a multiple-site scenario.
- Note 6:** Significant adverse conditions (orange shading) were considered for sites where shallow groundwater, significant seeps and springs, and difficult closure constraints were noted.



6.0 SEMI-QUANTITATIVE ASSESSMENT

The *screening assessment* resulted in 23 sites being eliminated, with 12 sites eliminated based on fatal flaws, 10 sites eliminated based on multiple significant adverse impacts, and one site (Site 14) eliminated due to its selection as the preferred HLF site. Table 3 presents an overview of the sites excluded in the *screening assessment* and the basis for their exclusion.

**Table 3 Screening Assessment – Sites Eliminated from Consideration**

Site	Basis for Elimination During the Screening Assessment
1	2 fatal flaws: adverse geotechnical conditions and insufficient space to manage ARD and for WWTP
2	2 fatal flaws: adverse geotechnical conditions and insufficient space to manage ARD and for WWTP
3	Multiple adverse conditions: within IBA and Lake Sevan non-immediate catchment, visible from multiple communities, would require a multiple WDF site development scenarios, greater than 3km from the open pit, close proximity to main road, shallow groundwater/seeps, and adverse closure conditions
4	Multiple adverse conditions: within IBA and Lake Sevan non-immediate catchment, visible from multiple communities, would require a multiple WDF site development scenario, greater than 3km from the open pit, close proximity to main road
5	Multiple adverse conditions: within IBA and Lake Sevan non-immediate catchment, visible from Gorayk, greater than 3km from the open pit, close proximity to main road, potential for archaeological findings, adverse geotechnical conditions, and difficult closure conditions
6	Multiple adverse conditions: within IBA and Lake Sevan non-immediate catchment, greater than 3km from the open pit, requires a river crossing
7	Multiple adverse conditions: within Lake Sevan non-immediate catchment, greater than 3km from the open pit, requires a river crossing, extensive recent lava flows, and difficult construction
8	2 fatal flaws: greater than 6km from the open pit and too far for trucking
9	Multiple adverse conditions: within Lake Sevan non-immediate catchment, greater than 3km from the open pit, requires a river crossing, difficult construction and closure conditions
10	Multiple adverse conditions: within Lake Sevan non-immediate catchment, visible from Gorayk, greater than 3km from the open pit, would require a multiple WDF site scenario, requires a river crossing, unacceptable haul route, shallow groundwater/seeps, difficult construction and closure conditions
12	Multiple adverse conditions: within Lake Sevan non-immediate catchment, would require a multiple WDF site scenario, requires a river crossing
14	Selected site for the HLF, therefore not considered further
15	2 fatal flaws: adverse geotechnical conditions and insufficient space to manage ARD and for WWTP
16	2 fatal flaws: adverse geotechnical conditions and insufficient space to manage ARD and for WWTP
17	2 fatal flaws: adverse geotechnical conditions and insufficient space to manage ARD and for WWTP
18	2 fatal flaws: adverse geotechnical conditions and insufficient space to manage ARD and for WWTP
20	2 fatal flaws: adverse geotechnical conditions and insufficient space to manage ARD and for WWTP
21	2 fatal flaws: greater than 6km from the open pit and too far for trucking
22	2 fatal flaws: greater than 6km from the open pit and too far for trucking
23	2 fatal flaws: greater than 6km from the open pit and too far for trucking
24	Multiple adverse conditions: within 1km sanitary zone and visible from Ughedzor, potential resettlement of local residents, greater than 3 km from the open pit, requires both a river and road crossing, difficult closure conditions
25	2 fatal flaws: adverse geotechnical conditions and insufficient space to manage ARD and for WWTP
26	Multiple adverse conditions: difficult constructability and access from heavy equipment, difficult closure conditions, and visible at a distance (over 5km) from Jermuk, but not widespread across the town or affecting key areas



The four remaining potentially viable sites (11, 13, 19, and 27) were advanced to the *semi-quantitative* assessment phase with a formal site ranking evaluation completed. This process consisted of ranking each site using a numeric system that included a weighting evaluation based on relative importance for a variety of sub-categories. The team agreed to a list of 27 indicators capturing the main issues for the decision-making process to select a suitable site. The ranking system agreed upon included both a binary and specific ranking depending on the indicator as decided by the discipline specialists. The result of the Semi-Quantitative Ranking Assessment is presented on Table 4. The basis for the scoring criteria used to rank each site indicator consideration is provided in the Notes column on Table 4.

The scoring system used was as follows:

- -3 where the criteria was considered to have a highly unfavorable impact on site selection (e.g., inside the Lake Sevan Non Immediate Impact Zone)
- -2 where the criteria was considered to have a moderate adverse impact on site selection (e.g., two major river crossings)
- -1 where the criteria could be considered to have a slight adverse impact on site selection (e.g., shallow groundwater and minor springs)
- 0 where no negative criteria were identified

The binary ranking provided for a -3 rating for highly unfavorable conditions and a 0 rating for neutral conditions. The more specific ranking provided for a -3, -2, -1, and 0 rating based on specific criteria developed and agreed upon by the specialists. The unidirectional -3 to 0 scale captures the idea that potential impacts in all areas considered in the matrix are negative with regards to social and environmental receptors. Weighting factors were then developed on a 1 to 5 scale with a 5 carrying the most weight and 1 carrying the least. The selection of the weighting factor for each indicator was decided through a participative process involving all specialists that considered the relative significance of each primary indicator. For example, the location of a site within the Lake Sevan non-immediate impact zone was weighted higher (more important) than the presence of natural habitat. Similarly, the presence of adverse geotechnical conditions was weighted higher than the available site capacity. Similarly, the rankings applied to each site for each indicator were identified firstly through specialist input, and then through participatory review with the group to reach consensus. The results were tabulated for each site and the scores assessed.

Of the four remaining sites, Sites 13, 27, 11, and 19 were ranked in order of preference as viable WDF sites for consideration by Lydian and the various stakeholders as the location for the Amulsar project WDF with Sites 13 and 27 selected as the preferred sites for WDF development.



It is noted that those ranking factors that were assigned negative values should be further evaluated during the design and ESIA studies for identification and inclusion of potential mitigation, management, and on-going monitoring measures as appropriate.



Table 4 Scoping Assessment and Selection for Semi-Quantitative Assessment

Factor	Indicator	Rating Scale	Weighting	Site 11	Site 13	Site 19	Site 27	Site	Site	Site	Site	Notes
Biodiversity Environmental	Outside of Lake Sevan Non-Immediate Impact Zone	-3 or 0	3	-3 -9	-3 -9	0 0	-3 -9	0	0	0	0	Yes or No - binary
	Beyond 1km Sanitary Protection Zone for Communities	-3 or 0	3	0 0	0 0	0 0	0 0	0	0	0	0	Yes or No - binary
	Outside Area of Supporting Habitat for IBA	-3, -2, -1 or 0	3	-1 -3	-3 -9	0 0	-1 -3	0	0	0	0	Specialist Assessment
	Outside Natural Habitat	-3, -2, -1 or 0	2	-1 -2	-3 -6	0 0	-1 -2	0	0	0	0	Specialist Assessment
	Outside Potential Critical Habitat	-3, -2, -1 or 0	3	-2 -6	-3 -9	-1 -3	-1 -3	0	0	0	0	Specialist Assessment
General Location	Within Rock Allocation Area	-3 or 0	1	-3 -3	0 0	0 0	-3 -3	0	0	0	0	Yes or No - binary
	Within Exploration License Area	-3 or 0	2	-3 -6	0 0	0 0	0 0	0	0	0	0	Yes or No - binary
Infrastructure	Radial Distance from the Open Pit	-3, -2, -1 or 0	5	-2 -10	-1 -5	-1 -5	-1 -5	0	0	0	0	-3=>6km, -2=3-6km, -1=1-3km, 0=< 1km
	Haul Route Avoids River Crossing	-3, -2, -1 or 0	4	0 0	0 0	0 0	0 0	0	0	0	0	-3=2 or More Rivers, -2= One River, -1=Stream, 0=No
	Haul Route Avoids Impacts Near or Crossing a Paved Road	-3, -2, -1 or 0	4	0 0	0 0	0 0	0 0	0	0	0	0	-3=3 Roads, -2=2 Roads, -1=1 Road, 0=No
	Avoids Gas Pipeline Crossing	-3 or 0	1	-3 -3	0 0	0 0	0 0	0	0	0	0	Yes or No - binary
	Avoids Spandaryan-Kechut Tunnel Crossing by Conveyor	-3 or 0	1	0 0	0 0	0 0	0 0	0	0	0	0	Yes or No - binary
	Adequate Heavy Equipment Access	-3, -2, -1 or 0	4	-1 -4	0 0	-3 -12	0 0	0	0	0	0	-3=Difficult, -2=Moderate, -1=Reasonable, 0=Nearby
Social and Cultural	Proximity to Settlements	-3, -2, -1 or 0	4	0 0	0 0	-3 -12	0 0	0	0	0	0	-3=< 2km, -2=2-5km, -1=5-10km, 0=>10km
	Visibility to Settlements	-3, -2, -1 or 0	3	-3 -9	0 0	-3 -9	0 0	0	0	0	0	Yes or No - binary
	Presence of Community Water Supply Point/Source	-3 or 0	2	-3 -6	0 0	0 0	0 0	0	0	0	0	Yes or No - binary
	Potential to affect Cultural Heritage/Archeological Sites	-3 or 0	3	0 0	0 0	0 0	0 0	0	0	0	0	-3=Confirmed Arch Sites Present, -2=High Arch Potential, -1=Medium Arch Potential, 0=Low Arch Potential
	Avoids Physical Resettlement of Local Human Inhabitants	-3 or 0	5	0 0	0 0	0 0	0 0	0	0	0	0	Yes or No - binary
	Avoids Economic Displacement	-3, -2, -1 or 0	3	-2 -6	-3 -9	-2 -6	-1 -3	0	0	0	0	-3=LACP/Herders, -2=Herders, -1=minor, 0=No
Technical	Suitable Space for ARD Management & WWTP	-3, -2, -1 or 0	5	-2 -10	0 0	-1 -5	-2 -10	0	0	0	0	-3=No Suitable Locations, -2=Multiple Locations, -1=Poor Location, 0=Yes
	No Apparent Geotechnical Flaw s	-3, -2, -1 or 0	3	0 0	-2 -6	-3 -9	-1 -3	0	0	0	0	-3=Landslides, -2=Poor, -1=Localized Wet Conditions, 0=Favorable Conditions
	Constructability	-3, -2, -1 or 0	3	-2 -6	-2 -6	-3 -9	-2 -6	0	0	0	0	-3=Very Difficult, -2=Moderate, -1=Localized Challenges, 0=Good
	Acceptable Haul Road Route	-3, -2, -1 or 0	3	0 0	0 0	-3 -9	0 0	0	0	0	0	-3=Steep Topo, -2= Moderate Terrain, -1=Reasonable, 0=Yes
	Capacity for 180 Mt w ith Potential Increase to 240 Mt	-3 or 0	5	0 0	0 0	0 0	-3 -15	0	0	0	0	Yes or No - binary
	Does Site have Capacity for 100 Mt Assuming Multi-Site Scenario	-3 or 0	5	0 0	0 0	0 0	0 0	0	0	0	0	Yes or No - binary
	Avoids Management of Shallow Groundwater, Seeps, Springs	-3, -2, -1 or 0	3	0 0	-3 -9	-3 -9	-3 -9	0	0	0	0	-3=Extensive Seeps & Shallow GW, -2=Moderate, -1=Localized Springs & Seeps, 0=None
	Avoids Potentially Difficult Closure Constraints	-3, -2, -1 or 0	3	0 0	-3 -9	-3 -9	-2 -6	0	0	0	0	-3=Extensive Underdrain System, -2=High Visibility/Moderate Seeps, -1=Localized Seeps, 0=No Constraints
GRAND TOTAL				-83	-77	-97	-77	0	0	0	0	
SITE RANK				3	1	4	1					

Site 11	Site 13	Site 19	Site 27	Site	Site	Site	Site
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7.0 CONCLUSIONS AND USE OF THIS REPORT

This revised WDF SAA has been prepared with an unbiased assessment of all alternatives based on the recent baseline data and impact assessment information. The revised SAA objectively quantifies and qualifies the various site alternatives and considerations to rank each of the potentially viable sites to select the sites with the most favorable technical, economic, environmental, and social attributes. In this regard, additional sites were included to address PS1 and PS6 requirements of avoiding siting the WDF in critical habitat and to consider the impacts of the Lake Sevan Law.

The results of this revised WDF Site Alternatives Analysis for the Amulsar project indicate that **Sites 13 and 27 are considered as the most optimal and preferred sites for WDF development.**

This report has been prepared by Golder with input from others as noted in Section 1.0, exclusively for the use of Lydian for the specific application to siting of the WDF for the Amulsar project. The analyses reported herein were performed in accordance with accepted standard of care practices, based on the information available at the time the study was completed. No third-party entity shall be entitled to rely on any of the information, conclusions, or opinions contained in this report without the written approval of Lydian and Golder.

Golder appreciates the opportunity to support Lydian on this task. Please contact the undersigned with any questions or comments on the information contained in this report.

Sincerely,

GOLDER ASSOCIATES INC.

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REK/GDLT/BRB/rjg



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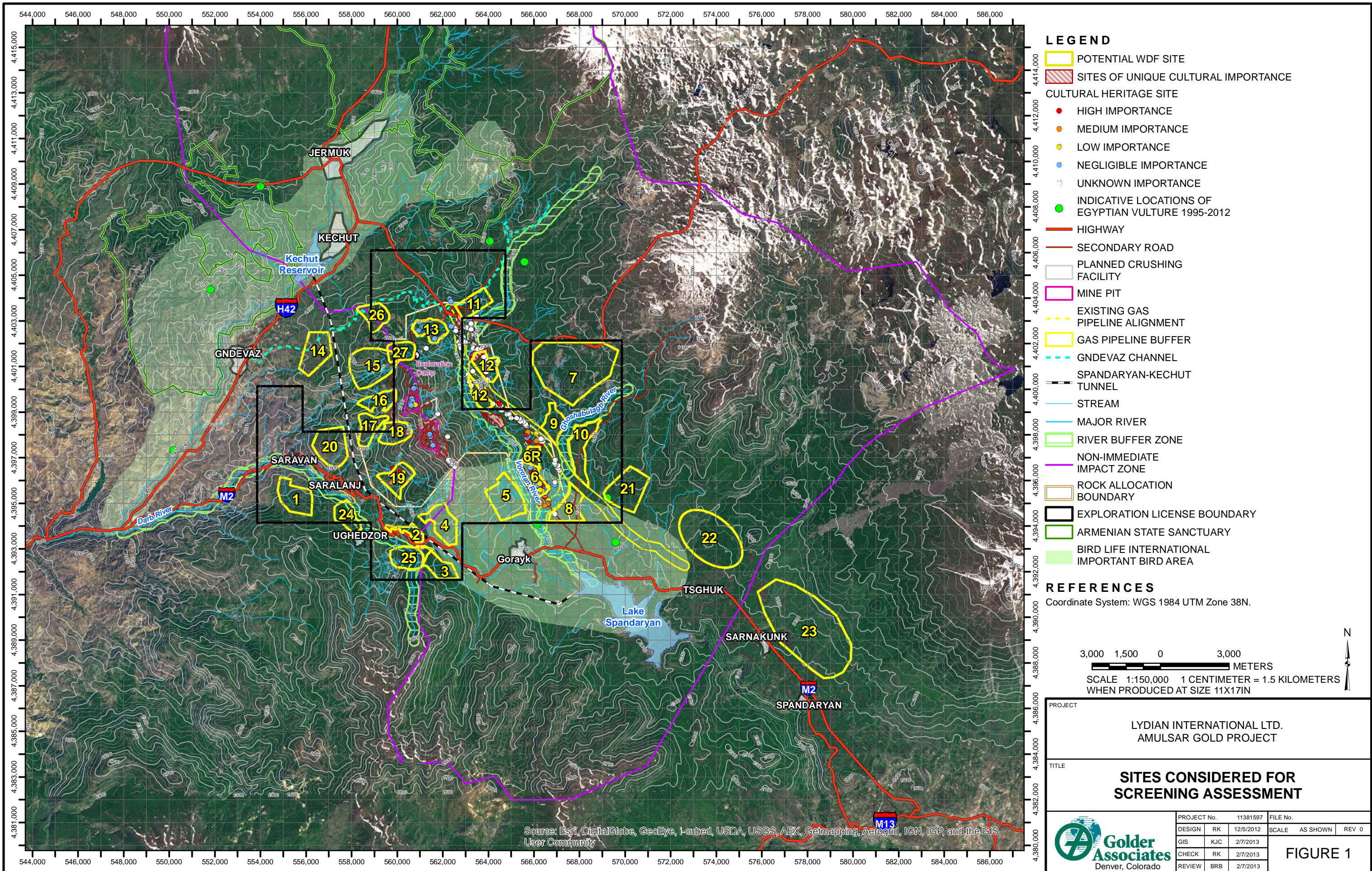
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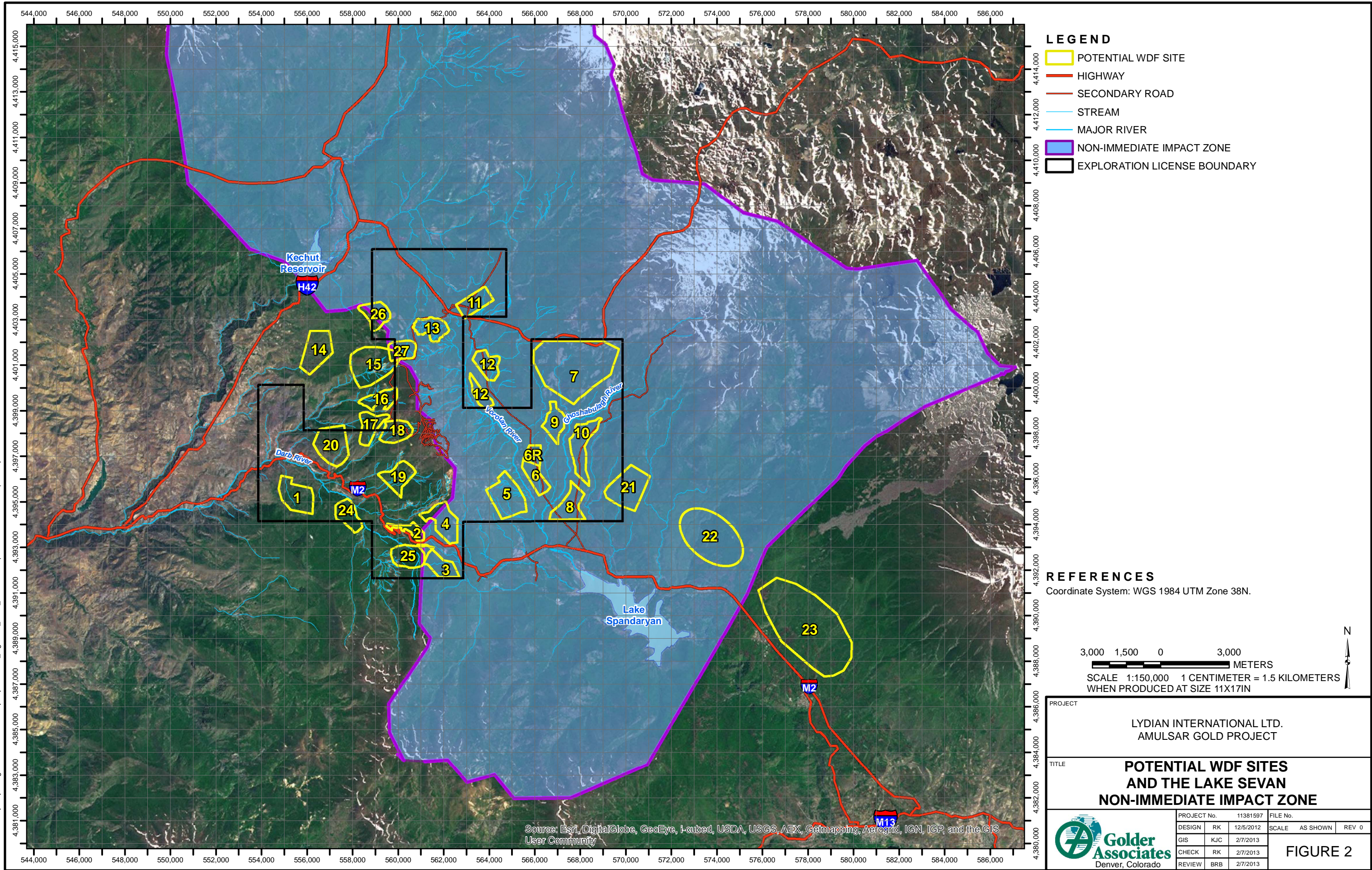
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FIGURES

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APPENDIX A
FIELD RECONNAISSANCE REPORT – SITE 27

FIELD RECONNAISSANCE REPORT

Date:	Summer/Fall, 2011	Project:	Amulsar WDF Site Alternative Assessment
Site:	HLF Site #27	Job No.:	11381597SS.0001

Low Temp:	N/A	High Temp.:	N/A	Wind:	N/A
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Cloud Cover:	N/A	Precipitation:	N/A
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Personnel On Site	Company
Various site visits in June, 2011 (C. Khoury/R. Kiel); Fall (Alexander/Kiel)	Golder

1.0 BASIC DESCRIPTION OF THE SITE

Site 27 is located on the eastern side of Amulsar Mountain approximately 2 km north of the open pits in Syunik Marz providence. The site is located immediately north of the current Amulsar exploration camp. The site is located within the Lake Sevan Non-immediate impact zone and approximately 4 km SE of Kechut and Lake Kechut and drains toward a minor watercourse that passes the current burn dump (landfill) used by the local communities, which then drains towards Lake Kechut.

2.0 TECHNICAL OPPORTUNITIES AND RISKS

- Potential small waste dump site with moderate to slightly difficult ground conditions; presence of some late stage basalt blocky flow deposits on the northern slopes, weathered and altered andesites on the southern slopes and clayey deposits in the valley bottom
- ARD management and WWTP facilities could be located in the open area downstream of the valley to the northeast
- Closed valley within close proximity to the open pit and crusher area; well suited for a small WDF, to develop a laydown area to support maintenance shops, infrastructure requirements, site low grade ore stockpiles, etc.

3.0 ENVIRONMENTAL AND SOCIAL CONSIDERATIONS

- No significant cultural heritage issues identified
- Minor ephemeral drainages with suspected seasonal springs and seeps within the base of the valley
- Drains to Lake Kechut after passing the drainage where local communities have an existing burn dump (landfill)
- Potential for limited visibility from Jermuk

FIELD RECONNAISSANCE REPORT

Project: 11381597SS.0001

Date: Summer/Fall, 2011

4.0 SELECT PHOTOGRAPHS

PHOTO 1

Site 27 looking from above the exploration camp towards Jermuk

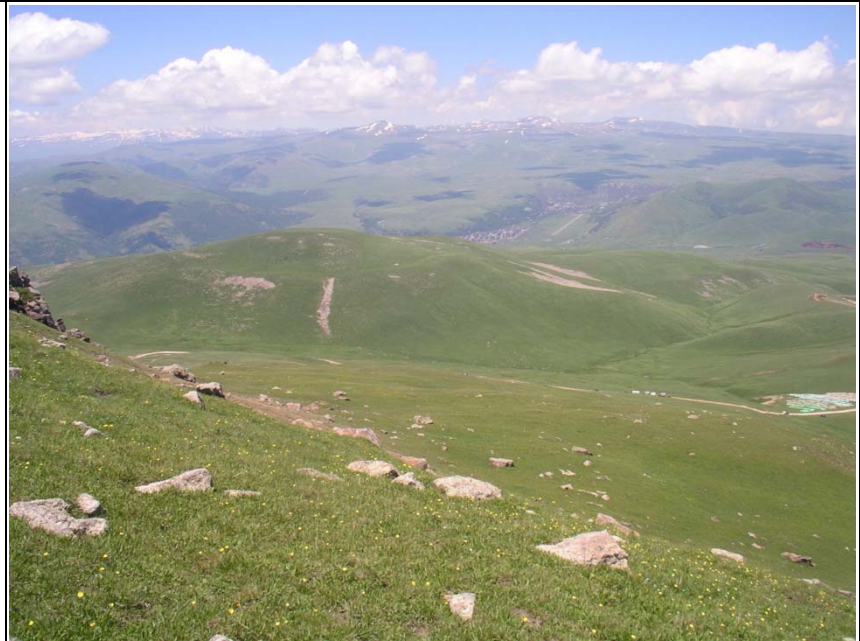


PHOTO 2

North of Site 27 with view of western spoils pile present from historic exploration adit works (at Site 13)



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