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Ada Tepe Gold Deposit EIS, Krumovgrad, Bulgaria: Technical Comments

Summary.

1-The project will use tremendous volumes of water: roughly 2.9 billion liters per year. The validity of the claim that roughly 98% of this water will be recycled has not been demonstrated. Merely the proposed extraction well in the Krumovitsa gravels requires 5 liters per second, which equals 157,680,000 liters per year. Long-term pumping of this well would, in fact, be extracting water indirectly from the Krumovitsa River.

2-Long-term water extraction will increase local competition for water. It may also lead to declines in local ground water levels and cause spring flows to reduce or cease.

3-The EIS fails to provide any site-specific, quantitative testing of the local aquifers to determine the actual volumes of ground water available and the impacts from long-term pumping on other water resources.

4-BMM operations will crush and expose massive volumes of mineralized rock to chemical reaction; will use tremendous quantities of explosives, fuels, oils and greases, chemical process reagents, herbicides, pesticides, antifreeze, etc.---all of which are potential contaminants, and are routinely released into the environment at mine sites.

5-Contamination of local ground and surface waters will occur over the long-term.

6-Truly "closed-circuit" systems do not exist in fact in mining. All facilities leak to some extent, long-term.

7-Facility wastes will remain on site forever**---**requiring long-term maintenance.

8-BMM totally misrepresents (optimistically) the tendencies for these wastes (ore, waste rock, tailings, fuels, explosives, reagents, etc.) to contaminate the local environment, long-term. *No acid-base accounting (ABA) or kinetic test data are reported for the majority of the rocks to be mined.*

9-No reliable, statistically-useful baseline data set has been provided. Hence public and regulators will not be able to determine / "prove" the extent of any future changes in water quality, water quantity, flow directions, spring flows, etc. if future impacts occur.

10-The EIS fails to provide details on specific sampling and handling (including preservation, etc.) methods employed to acquire water quality samples. Also, there is no discussion of *field* measurements of water quality parameters (water temperature, pH, specific conductance, dissolved oxygen). Thus, the reliability of all such data is questionable.

11-There is a significant possibility that long-term water contamination would require construction and operation of a water treatment plant---possibly in perpetuity.

12-The costs for constructing and operating such treatment facilities will fall to the local citizens, and Bulgarian and EU taxpayers.

13- The overall EIS is poorly and misleadingly organized, with most of the inadequate, but supporting details, present only in appendices within other appendices---none of which are listed in the main EIS Table of Contents. This creates great confusion for the reader or regulator. In its present condition, the EIS is not suitable to allow the public or regulators to reasonably evaluate impacts.

14-The EIS reads like an advertising document, not a technical report. Large portions were

prepared by BMM; the EIS was compiled by parties paid and directed by BMM. Hence they are not independent of BMM. It is unclear, in most instances, which specific consultants / authors provided which specific opinions.

15-This EIS and it’s supporting documents are of inadequate quality and would not be acceptable if submitted in Canada, U.S.A., Australia, New Zealand, and Western Europe.

16-It appears that the regulatory agencies lack the capacity to adequately oversee the activities of such a complex project. Thus, it will be largely self-monitored and self-regulated.

Recommendations.

-Experienced investigators truly independent of BMM / Dundee should be involved in overseeing future activities at the site, and they should participate in any future monitoring activities to collect representative, statistically-reliable baseline data.

-Similar independent investigators should prepare truly conservative calculations of future project liabilities, assuming that construction and operation of an active water treatment plant will be required. Such financial information should be used to calculate an appropriate form of Financial Assurance (bond, environmental insurance, etc.). This Financial Assurance, regardless of form, should be held by a party independent of BMM or the Bulgarian government. BMM mine assets should not be considered as adequate collateral.

-BMM should be required to prepare a revised version of the EIS which has been rewritten in a concise manner where the important data are summarized in the main parts of the EIS in tables and figures, clearly identifying the sources of the data.

Introduction.

These comments were prepared for Environmental Association "Za Zemiata", with the support of the Center for Environmental Information and Education and Association "Life for Krumovgrad", within the framework of the EJOLT project - "Environmental Justice Organisations, Liabilities and Trade", funded by the Seventh Framework Programme - "Science and Society" of the European Union. The content reflects exclusively the author's point of view and does not necessarily reflect the opinion or position of the European Commission. The European Commission cannot be held responsible for any use which may be made of the information contained therein.

My opinions and comments are based on:

-Review of the Ada Tepe EIS (355 pages) and its Appendices (approximately 600 pages); review of the EIS Non-Technical Summary (96pg.); review of the Ada Tepe Feasibility Report (RSG Global, 2007), 414 pg.

-Travel to the proposed mine site and surrounding areas. Discussions with many of the local citizens and the mayors of three nearby villages, plus the mayor, deputy mayors and members of the Municipal Council of Krumovgrad (July 20-21, 2011).

-attendance and presentation of technical comments at the public meetings in Krumovgrad on July 22, 2011.

-More than 39 years of applied hydrogeologic and geochemical experience at hundreds of mines and other industrial and resource facilities around the world. This experience has been gained working for private investors, industrial clients, tribal and citizens groups, NGOs, law firms and governmental agencies at all levels. Countries worked in include: Australia, Greece, Bulgaria, Mali, Senegal, Guinea, Gambia, Ghana, South Africa, Iraqi Kurdistan, Oman, Pakistan, Kazakhstan, Kyrgyzstan, Mongolia, Romania, Russia (Buryatia), Papua New Guinea, Argentina, Bolivia, Chile, Colombia, Guatemala, Honduras, Mexico, Peru, El Salvador, Belgium, Canada, Great Britain, United States.

Members of Za Zemiata and local citizens accompanied me during my activities in the Krumovgrad area. Nevertheless, the observations and conclusions presented herein are entirely my own. I fully recognize that there is presently a broad spectrum of opinions concerning approval of this project in Bulgarian society. At one end of the opinion spectrum are citizens concerned predominantly about obtaining jobs, at the other end are landowners who totally oppose approval of the project. Many others are somewhere in the middle. All require reasonable information in order to understand the broader consequences and to form intelligent decisions. The present BMM EIS fails to provide such information.

My opinions presented here are neither pro- nor anti-mining. I have often worked for clients with both orientations. This report is not intended to tell the citizens and regulators what to do. Rather, it is intended to provide technical assistance to the general public, the Bulgarian government and the Krumovgrad Municipality so that better informed decisions can be made and to constructively influence the public review process. The ultimate choices, however, must be made by the citizens and their elected representatives. They are the ones who will be personally impacted and held responsible.

These comments focus on water availability and water quality-related issues, those issues that normally cause the most serious and expensive, unforeseen, economic impacts and public liabilities at mining sites.

Background.
Based on conversations with local citizens, it is clear that the Krumovgrad area already suffers from water shortages and water rationing during the dry seasons. Development of the Ada Tepe deposit (and likely other deposits) will obviously aggravate this situation.

At present, all project data are collected by BMM. As such, this is like most world mine sites; it is self-monitoring and largely self-regulating. All projects have negative impacts and this is especially true for mining projects (Extractive Industries Review, 2003). It is not possible to operate a large open-pit metal mine without some such impacts. To imply otherwise is simply untrue. That does not mean, however, that only two options exist: to have jobs or to oppose the mine.

<u>EIS Report---Major Inadequacies:</u>
1-The BMM EIS documents (main report and Appendices) lack the necessary reliable, technical data to make informed judgments on the likelihood or degree of potential impacts that may result if this project is permitted and operated. This EIS is inadequate to allow either the regulators or the public to develop truly informed decisions regarding the project.

2-The EIS fails to adequately define the volumes of water available in the Krumovgrad region. Because BMM proposes to extract ground water from the alluvial gravels of the Krumovitsa River for at least 9 years, detailed, long-term aquifer testing should have been performed to demonstrate the impacts that would result from such proposed pumping. No such quantitative, site-specific testing information or data are presented in the EIS. *[See* *further technical discussions below.]*

3-Geochemical data on the ores, waste rock and tailings presented in the EIS are totally inadequate to reliably evaluate the potential for these materials to release contaminants into the environment. BMM has failed to present Acid-Base-Accounting (ABA) data for the **majority of the rocks to be mined**, and has unrealistically interpreted the data provided. *[See further discussions below.]*

4-Baseline Data. This EIS fails to provide recent, statistically-reliable, site-specific, quantitative baseline data on the quantity of water available in the nearby ground and surface waters and on the detailed water quality of these waters. Without reliable, detailed, statistically-defensible baseline data, there is no way for citizens or regulators to substantiate that mine operations--or any other activity—have caused changes in the quantity or quality of waters or soils.

The EIS also fails to provide any detailed discussion of methods employed for sampling and preserving (plus general handling procedures) of water quality samples. Errors in these activities are the main source of data errors. Thus, most knowledgeable readers would discount the water quality information presented in this EIS. *[See further discussions below.]*

5-Experience from similar metal mines, worldwide, suggests that the greatest likely impact is that the project would generate greater competition for already-scarce water.

6-Experience from similar metal mines, worldwide, suggests that some degree of additional **contamination of nearby ground and surface waters** will result from project operation.

7-BMM is owned by Dundee Precious Metals, a Canadian company [http://www.dundeeprecious.com/], but this **EIS is of inadequate quality and would not be acceptable in Canada,** the U.S.A., Australia, or most of Western Europe.

<u>General Comments.</u>
Despite being roughly 355 pages, plus 96 pg. for Nontechnical Summary, and plus another roughly 600 pages of Appendices, the EIS and its confusing Appendices within Appendices fail to adequately answer the following basic questions:

How much water (ground and surface waters) is available within the site area? (Volumes must be identified using quantitative testing methods.)

What is the quality of the local waters (surface and ground waters, springs) prior to any mine development? (Ideally this site-specific baseline data collection would be conducted prior to any exploration activities, as they can change the water quality, etc.)

What are other baseline conditions? Ground water levels; flow directions; well production rates; spring and seep locations / spring flow rates / spring water quality?

What are the details of the *specific* proposed activities? [Presently there are too many uncertainties.]

EIS Not a Technical Report—More an Advertisement.
The EIS reads like an advertising or promotional document, not a disinterested, technical report. It repeatedly contains unsubstantiated, overly optimistic statements that no negative impacts will occur from the proposed actions, without providing reliable, technical support data for these assurances and promises. It implies that: if we (the EIS preparers) say it is so, it is so! Almost none of the EIS contains citations to supporting technical literature.

The EIS was compiled by parties paid and directed by BMM; they are not independent of BMM. Some of the most important sections were directly prepared by BMM, i.e. EIS Appendix 6, the Mine Waste Management Plan.

Throughout the EIS, it is unclear, which specific consultants / authors provided which specific opinions, thereby avoiding any direct responsibility for authorship. The technical terms and language used throughout the EIS indicate that the authors, or at least the final EIS editors, come from mining / mineral processing backgrounds and *not* environmental hydrogeological / environmental geochemical backgrounds. [One exception to this observation is Golder Associates, which prepared only the theoretical water balance, which was based entirely on information supplied by BMM and its consultants.]

EIS Disorganization
The overall EIS is poorly and misleadingly organized, with most of the inadequate, but supporting details, present only in appendices within other appendices---none of which are listed in the main EIS Table of Contents. This creates great confusion for the reader or regulator. Also, the EIS routinely fails to tell the reader which appendices contain the supporting information. Often information the EIS claims is present cannot be found anywhere. Most of the EIS and MWMP sections provide no references or data to support their statements. *In its present condition, the EIS is not suitable to allow the public or regulators to reasonably evaluate impacts.*

Technical Comments: Additional Support.
Water Use.
The BMM project will use tremendous volumes of water. While the precise volumes of water required are inconsistently described in various parts of the EIS, the following hints are obtained:
--roughly 2,894,000 cu. meters / year (about 2.9 billion liters per year) will be required to operate the process plant (pg.35-36);
--ground water seepage into the pit is estimated to be about 18,000 cu. meters per year (pg. 176).
The validity of the claim that roughly 98% of this water will be recycled has not been demonstrated, and is not demonstrated at comparable gold sites worldwide. What has been clearly demonstrated, however, is the **increased competition for water** that develops in such situations.

Water Sources.
The EIS mentions several “possible” sources for the water needed to operate the project---the Krumovitsa or Kessibirdere gravels and some surface water extraction from the Krumovitsa, or possibly the Kaldzhik valley watershed (pg.35, pg. 176). The reader is not told whether the latter refers to ground or surface water extractions. Apparently undefined

volumes of surface water may also be taken from the Krumovitsa River.

The Ada Tepe Feasibility Study (RSG Global, 2007) concluded that the Krumovitsa River gravels contained *inadequate volumes* of ground water. On pg. 136 (23.4.2 Project Water Supply Options) it states:
"The available groundwater storage in the Krumovitsa River gravels was not considered sufficient to guarantee reliable supplies to all parties under all climatic conditions."

Considering simply the proposed extraction well in the Krumovitsa gravels, which is expected to be pumped at a rate of 5 liters per second, roughly 157,680,000 liters per year of water would be removed from the current resources. Long-term pumping of this or any similar well constructed near the river in the alluvial gravels would, in fact, be extracting water indirectly from the Krumovitsa River.

Long-term water extraction of such magnitudes will increase local competition for water. In such a semi-arid region, with much of the local population dependent on agriculture and where water rationing already occurs during some dry months, one can expect significant water conflicts to be aggravated by the proposed project water withdrawals.

Such water use is likely to cause declines in local ground water levels, lowering levels in some wells, possibly requiring them to be deepened in order to provide adequate supplies. Under similar conditions, spring flows are often reduced or cease entirely due to long-term mine pumping.

Water Availability: Ground Water: Quantity / Hydrogeologic properties.
The EIS fails to present any site-specific, detailed hydrogeologic studies based on recent data. Similar EISs routinely involve the drilling and completion of monitoring wells and piezometers in all of the relevant aquifers and in areas potentially impacted by the proposed facilities. Such studies include: hydrogeologic cross sections showing water-bearing units; water-level maps; well completion details; and, most importantly, aquifer tests (as described in
Freeze & Cherry, 1979; Kruseman & De Ridder,1979; Mazor, 1991). The EIS mentions boreholes, wells, and aquifer tests in the area of the proposed IMWF(pg. 79). *Specific data on these boreholes / wells and pump tests could not be located in any of the publicly-available EIS documents.*

Mine Waste Management Plan, Appendix 6 provides some theoretical descriptions of regional ground water characteristics, but this information appears to come from other, older studies, possibly Bulgarian government studies (p. 15—16). No site-specific ground water data are provided. It states, for example: "The Krumovitsa alluvial layer varies between 6.0 m and 10.0 m,….." --which apparently refers to the thickness of the alluvial gravels.

Given the presence of fractured / faulted bedrock and karst formations in the region (pg. 184 & 189), the potential migration of contaminants from the mine facilities into various site surface and ground waters is of concern, and should be investigated thoroughly. No such investigations have been presented. The Feasibility Study (2007) states that over 1000 site boreholes and trenches existed as of 2004. The EIS says nothing about the plugging of such boreholes. Thus, the boreholes also provide potential pathways for the movement of ground water vertically and horizontally.

BMM proposes to extract ground water from the alluvial gravels along the Krumovitsa River, which will obviously be extracting water from both the gravels and the river flow, indirectly, over the long-term. The EIS also indicates (pg. 173) that ground water may be taken from the Kessibirdere alluvium. However, no quantitative hydrologic data are provided supporting the quantities of available ground water in any of these drainages.

Springs and Seeps. The EIS Appendix 6, Mine Waste Management Plan (MWMP pg. 16) mentions the presence of several springs with flows of over 10 liters per second, but no data (location maps, flows, water quality data, field measurements) are provided.

Where ground water will be extracted, long-term, at significant rates, it is common for ground water levels to decline and springs to have flows reduced or stop entirely---especially during dry seasons. This is especially important in agricultural areas where livestock, etc. may depend on the springs for water. At such mine sites when springs dry up, it is common for citizens to complain, but to have no ability to receive compensation because a reliable spring / seep survey had not been conducted. When correctly conducted, such studies integrate the hydrogeologic / spring information with the relevant water quality data. No such integration has been performed by the EIS authors.

Surface Water Hydrology Information.
Some historical river flow and very limited surface water quality information are discussed in EIS Appendix 6, Appendix 8. None of these data are recent or site-specific. Pages 51 through 56 (plus tables) of this same appendix provide limited old, regional information on surface water quality. None of it is recent, mine site-specific. Most of the chemical constituents of interest in mine-impacted waters are not reported. No field measurements are included and sampling and preservation methods are not described. Hence, such data are of no use as baseline data. It appears these data come from past regional government studies, not efforts conducted by BMM.

Water Quality Baseline: Reliable Data Are Not Presented.
As discussed above, the EIS fails to present adequate, reliable statistically-meaningful baseline data for either surface or ground waters. Hence the public and regulators will not be able to determine / “prove” the extent of any future changes in water quality, water quantity, flow directions, spring flows, etc.

A few individual analyses of surface and ground water samples are presented in Appendix 3 to the MWMP (EIS Appendix 6). *However, these are inadequate as a reliable baseline data set for the following reasons:*
--sites were sampled only once, thus show no seasonal variability and cannot be evaluated statistically;
--the data are not summarized any form of table anywhere in the EIS;
--no descriptions of the sampling / preservation methods are presented;
--the analyses do not include field measurements.
Likewise, a few ground water samples are “hidden” in Appendix 3 to the MWMP (EIS Appendix 6). Apparently these same data are also presented on EIS pg. 185, Table V.2.1-13. These ground water analyses suffer from all the same inadequacies mentioned above for the surface water data. In addition--and crucially for ground water data--no specific descriptions of the sample sources (wells, piezometers, springs, production depths, methods for lifting the water (pump details, gas-lift, bailer, etc.) are provided. *Again, the*

ground water data provided in the EIS are not adequate to provide a reliable baseline data set.

Useful baseline data should reflect seasonal variations over at least one full calendar year. These activities should include field measurements of water temperature, pH, specific conductance (SC) and dissolved oxygen (DO), together with collection of both filtered and unfiltered samples for the analysis of water quality. Analyses should include the determinations of a broad range of constituents, both organic and inorganic. The following references describe the details of collecting such reliable baseline data: Moran (2011), U.S. Geological Survey (2008).

Methods for Water Sampling and Sample Preservation / Handling Lacking.
The EIS fails to provide details on specific sampling and handling (including preservation, etc.) methods employed to acquire water quality samples. Also, there is no discussion of *field* measurements of water quality parameters (water temperature, pH, specific conductance, dissolved oxygen). Thus, the reliability of all such data is questionable.

Inadequate sampling and sample handling procedures are the primary source of data error in water quality sampling programs (Moran, 1976; Hem, 1985; U. S. Geological Survey, 2008).

Operations and Waste Facilities Details.
Open pit depths = 120m at deepest point; 40 to 100m in other portions of the pit.

Mine drainage volumes will vary from 68,383 to 117,728 cubic meters per year (pg. 184, which cites a table that does not exist in the EIS, Table V.2-13).

Process plant is expected to operate at 850,000 tons per year for 8 years.
[Appendix 6 Mine Waste Mgmt. Plan, p. 21-26]

Waste rock produced during operations = 14,630,000 tons
(Life of Mine: pg. 211-212)

Tailings produced: 7,235,000 tons (total) = 849,500 tons per year
Tailings estimated to be 40m high
[If tailings impoundment (TMF) is constructed (pg. 221).]

Water Storage Dam = 16 m high, filled with water covering a 7 hectare area (pg. 37).

Ores, Tailings and Waste Rock: **Detailed Chemical Compositions.**
Pages 48-49 of the MWMP, EIS Append. 6, Table 16 present data on the chemical composition of site rock ores. The language describing the specific materials being analyzed is unclear; the data represent either crushed ores or processed tailings. Nevertheless, these data confirm that the site rocks contain significant concentrations of many trace and minor elements. They report potentially environmentally-significant concentrations of molybdenum, copper, zinc, nickel, manganese, arsenic, strontium, antimony, vanadium, chromium, barium, scandium, thallium, mercury, selenium, lanthanum, rubidium, yttrium, and cerium. These data include only one sample from the unoxidized zone ore.

Limited chemical analyses of the tailings and waste rock solids are presented in EIS, MWMP, Appendix 6, Tables 17 and 18, pg. 50-51. *No chemical data are presented for the liquid portions of the tailings.* Environmentally-significant constituents such as sulfate, sulfide, nitrate, ammonia, chloride, fluoride, bromide, organic carbon, oils and greases, etc. should also be reported, along with lab determinations for pH, specific conductance and total dissolved solids (TDS).

Release of Rock Contaminants.
BMM operations will expose massive volumes of mineralized rock to air, water and numerous kinds of specialized bacteria, changing the chemical composition of the original rock and the waters in contact with the rock. Blasting greatly increases the reactive surface area of the rock minerals, which, together with the bacteria, air and water, greatly increases the rate of numerous chemical reactions, causing the rock components to dissolve and become mobile.

Such mineralized rock may only contain economically-valuable concentrations of gold and silver, but it also contains low, but environmentally-significant concentrations of dozens of other natural rock components such as: molybdenum, copper, zinc, nickel, manganese, arsenic, strontium, antimony, vanadium, chromium, thallium, mercury, selenium, etc., which are mobilized into the local soils, ground waters and surface waters (see MWMP, EIS Append. 6, Pages 48-49). Such increased mobilization of these trace elements is greatly increased under acid conditions, but can also occur under near-neutral pH and alkaline conditions. Several of the trace elements in the BMM ores, such as arsenic, antimony, selenium, chromium, nickel, molybdenum, uranium, etc. are known to become more soluble (and mobile) under both low and high pH conditions. Regardless of the specific minerals present in the originally-buried rock, once the chemical processes described above begin, the minerals react with the water, dissolved gases and bacteria, releasing numerous chemical constituents into the environment (Chapelle, 1994; Gotkowitz, et.al, 2004; Moran & Wentz, 1974; Straskraba & Moran, 1990; Slowey et.al., 2007, Vance, 1995).

Blasting and crushing of rock also increases the volumes of sediment particles released into the environment---both into air and waters. When suspended sediment loads increase unacceptably, surface waters can become significantly toxic to aquatic organisms.

Many constituents present in these ores and wastes are mobile under both low and high pH conditions---and can be toxic to humans and aquatic life. Also, most chemical constituents are more mobile in water at increased temperatures. The EIS fails to discuss the temperatures of the site ground waters at various depths.

Incorrect Use and Interpretation of Leach Tests.
The EIS provides no defensible support for the claim that the arsenic and other trace elements are present in insoluble forms. In fact, the EIS totally misuses the leach tests cited on pg.98 to argue that the effluents coming out of the ores and waste rocks will be benign. Unfortunately, these short-duration (24-hour or less) leach tests [EPA Method 1312 / SPLP 2004] were originally (in the 1970's) intended **only** to provide an approximate indication of what constituents can be mobilized from industrial wastes impacted by short-term rainfall. They were never intended to predict long-term contaminant releases from mine wastes.
My experience indicates that mine companies frequently further misuse such leach tests

by failing to add preservative to the effluents collected from the tests, thereby allowing much of the dissolved constituents to settle to the bottom of the container prior to analysis. Regardless, use of such leach tests is essentially useless to define the chemical composition of the constituents in waters released from mine ores, waste rocks, or tailings---and were never intended to be used for such purposes.

Will the Rock Release Acid? Sulfide Content of Rocks and ABA Testing.
In general, metal-bearing rocks may form and release natural acid if they contain significant amounts of iron sulfide minerals (i.e. pyrite) and a few other metal sulfides (Hem, 1985; Frey, 2003)**.** A standard method for estimating the volumes of sulfide in prospect ores and waste rocks is to collect samples of rock from the exploration boreholes and subject them to Acid-Base-Accounting (ABA) tests. The general measure of the rock's theoretical tendency to release acid is indicated by the percentage of sulfur or sulfide-sulfur (Price, 1997). Such tests provide an estimate of the acid and the acid-neutralizing constituents that may be released by the rock. These tests have many inaccuracies and uncertainties, but can be quite useful when applied correctly. It is routine in gold mine EISs to report results from hundreds or even thousands of ABA tests from one deposit.

The EIS authors claim repeatedly (i.e. EIS, pg.18, pg.44; MWMP pg. 38) that the Ada Tepe rocks will not release acid or any contaminants. In fact, the EIS water and geochemical analyses, while severely flawed, report detectable arsenic and other metals and metal-like elements in the samples. *Hence, these minerals are not insoluble, even in the short-term.*

More importantly, it is not possible to make an informed, defensible decision on the basis of the Acid-Base-Accounting (ABA) tests or any other geochemical information presented in this EIS, because adequate ABA data are lacking for the majority of the rocks to be mined.

If a reader searches very carefully, it is possible to discover ABA test data in the EIS Appendices---which are not listed in the EIS table of contents. The EIS Table of Contents fails to present the names of any of the Appendices or their page numbers. Appendix 6 to the EIS, which contains the Mine Waste Management Plan (MWMP), was actually prepared by BMM. Then, if one searches further, one discovers another appendix (Appendix 4) to this Appendix 6, which contains the ABA laboratory data.

A copy of the Appendix 4 ABA data (three pages) are included at the end of this report.

Appendix 4 of Appendix 6 contains ABA data for 81 Ada Tepe mine rock samples, but the data and their presentation are seriously flawed and largely useless for drawing reliable conclusions. Firstly, the EIS fails to specify the rock types for these samples and whether they represent ore zones or waste rock. Secondly, the EIS fails to present any cross-sections (or map views) that show the positions of these boreholes relative to the proposed pit outline. The reader has no way of evaluating whether these samples adequately represent all of the variability in lithology and sulfur content within the prospect. As mentioned above, 81 samples is a very small number when compared to most similar EISs. Thirdly, the table fails to present any indication of the full depth of each borehole from the land surface. **Lastly, and most importantly, the borehole data fail to include any data for most of the rock to be mined in the pit.**

For example, if the column entitled “Borehole No.” is examined (See data at end of report), one notes that only one or two samples are presented for each hole. Examine data for the first borehole (ATDD009) and one notes that only two rock intervals were sampled---or at least only two intervals are reported in this table: from “10.0 to 13.0 meters”, and from “79 to 82 meters”. We are not told the full depth of the borehole, but it must be at least 82 meters. So, out of a depth of at least 82 meters, Appendix 4 reports sulfur data, (%S) for only 6 meters in this borehole. Hence the reader is told nothing about the ABA characteristics of the other 74 meters, or more. Data from the other boreholes in Appendix 4 show the same data inadequacies as are exhibited for Borehole ATDD009.

Since this will be an open pit operation, all rock within the proposed pit must be removed and treated as either ore or as waste rock---both of which must be evaluated for their potential to form acid and release contaminants. **Here, however, for the majority of the rocks to be mined, the reader is told nothing about the acid-generating potential or the tendency to release chemical constituents.** Nevertheless, as stated above, the EIS authors repeatedly assert that no contaminants will be released from the site ores, waste rock or tailings.

Throughout the EIS and related documents, we receive hints that the rock actually does contain pyrite and related sulfides---as almost all such rock does--- but the percentages are not clearly revealed. A technical paper on the geology of the site (Marchev, et.al., 2004) notes the presence of pyrite. Page 212 provides only two pyrite concentrations for all the pit rock: Fresh Wall Rock = 1.7 %; fresh Host Rock = 0.8 %. Such minimal and undefined data are essentially useless for drawing specific conclusions about the tendency of the specific rock zones to generate acid. Normally, there would be at least hundreds of ABA determinations and they would be organized by rock lithology and whether they were considered ore or waste rock. Furthermore, the data would be organized in a statistically-reliable fashion showing for each ABA category: n (number of determinations); minimum, maximum, range, mean, median, standard deviation.

The EIS authors misuse and misinterpret the totally-inadequate ABA data presented. They imply, incorrectly, that if the rock minerals that release neutralizing substances, the neutralizing potential (NP), balance or slightly exceed the acid generating potential (AP), free acid will not be generated. Numerous authors and applied experience demonstrate this is far too optimistic [see references for Frey, Lapakko, Morin, Price, Robertson, etc.].

In practice, while the NP may be present in the rocks, if the local water does not contact it, no neutralization reactions can occur. More importantly, it is well known that the sulfide minerals, when exposed to air, water and bacteria (Lapakko, Morin) often decompose much more rapidly (kinetics) than the NP-producing minerals, resulting in production of mobile acid, even when the concentrations of AP producing minerals is much lower than that for the NP-producing minerals. Lastly, many of the common minerals present in the Ada Tepe rocks contain aluminosilicate minerals that yield high analytical concentrations of NP, but this neutralizing potential is, in fact, released very slowly, so is effectively unavailable to buffer the acid (Frey, Lapakko, Morin, Price).

Contamination problems at the Zortman-Landusky gold mine in Montana, U.S.A. serve as practical example (U.S. Dept. of Interior, 1995, 1996). We found that waste rock containing total sulfur percentages as low as 0.2% sulfur became acid, often after a delay of months or years. The federal and state governments have spent several hundred millions of U.S.

dollars building and operating a full time, active water treatment plant to remedy the water contamination, which the mining company predicted would not occur.

Given these data inadequacies, it is exceedingly misleading to compare these wastes to EU Criteria for Inert Material [see EIS Appendix 6, MWMP, Table 10, pg.39-40]. *There is no reliable evidence presented that these wastes are inert.*

Will Waste Rock, Ores or Tailings Release Contaminants, Long-term?

Neither ABA nor short-term (i.e. 24-hour or similar tests; see MWMP pg. 44) leach tests provide reliable information on the chemical quality of waters that will be leached from mine rocks and wastes into the environment, *long-term* (Kempton, 2000 and 2009). Routinely, international mine operations utilize long-term kinetic tests to evaluate the long-term leachability of the various site geologic materials. This EIS fails to present any kinetic testing. In fact, the EIS disingenuously states: "III.2.1.3.1.11 Kinetic testwork: The applied processing method does not require kinetic testing." (Appendix 6, MWMP, pg. 41).

Long-term kinetic testing of most mine wastes is recommended as part of standard mining practice in most developed countries, and is specifically required in Dundee's home country, Canada. Ironically, one of the few literature sources cited anywhere in the EIS is Price (2009). Price is one of the most quoted Canadian government mining-related scientists who has authored the standard guidelines on mine geochemical testing and has called for the use of kinetic testing over many decades. Such tests have their limitations, but when conducted responsibly over extended time durations, they can provide extremely useful information on the chemical composition of future waste effluents. Yet Dundee has failed to conduct any kinetic tests on any of their ores, waste rocks or proposed tails.

This is a proposed mine / mineral processing operation, thus no tailings actually exist. However, similar sites inevitably collect bulk rock samples that are sent to specialized testing labs that develop pilot plants to simulate on a smaller scale the operations of the proposed processing plant. Such testing evaluates the metallurgical properties and geochemical behavior of the ores, produces simulated tailings and reports the percentages of gold and silver extracted, and the chemical characteristics of the liquid and solid wastes. Such results are normally presented in Feasibility Studies that are required information for prospective investors. Often such information is released in EISs to demonstrate the potential chemical characteristics of the tailings solids and liquids. Regardless, such data only report the chemical compositions of the newly-generated tailings solids and liquids, which are often quite different from the compositions of tailings liquids and solids that have chemically reacted over months or years (Ripley, et.al. 1996; Lottermoser, 2007).

Pages 43 through 50 of the MWMP (Appendix 6) describe various chemical tests performed on simulated tailings, but these discussions are unclear in terms of what was actually done. The MWMP (*prepared by BMM*) states: "Sulfide sulfur in both samples is below 0.1%,…" (Appendix 6, MWMP, pg. 43-44). Firstly, does this describe results from merely two samples? Secondly, these results are reported in mg / kg, so they must be for only the solid phases of the samples; *no data for the liquid phases are shown.* Despite claiming that the sulfide-sulfur and most of the arsenic and other metals are extracted into the concentrate, the EIS fails to show the actual, detailed data for any of these tests. Thus it is not possible to verify the claims that the tailings will have little or no acid-generating capacity, will release no mobile contaminants, and will have no impact on the ground and surface waters.

Pg. 44 of the MWMP states:
"Leaching test results show that elements leach to insubstantial concentrations, i.e. their mobility is ate (sic) the minimum level, especially As, Sb, Cd, Cr, Cu, Pb, Hg, Ni, Se, Ba. That confirms the exploration results, namely that most elements are present in the mineral composition of the waste (and ore respectively) and have inert properties. The data show that the concentration of microelements is
very low compared to the threshold values of hazardous waste concentrations (Appendix 3 of Regulation 3/2004)."

The reader is told nothing about these leaching procedures or the duration (time) of the tests, and the test data are not shown! No technical explanations or data presented here support the argument that tailings leachates generated over long periods of time will not release contaminants into the nearby waters and the environment in general. If anything, these statements indicate that the tailings contain leachable sources of arsenic, antimony, cadmium, chromium, copper, lead, mercury, nickel, selenium, and barium, as a minimum.

MWMP pg. 47 states: "Quartz and aluminum silicates (which are inert) dominate in tailings." This statement is simply false when considering environmental chemistry rather than mine process chemistry. These minerals often release aluminum and silicate ions into mine waters(Hem, 1985). The former may be highly toxic to fishes (US EPA, 2009).

Finally, the reader should be reminded that the EIS presents no ABA data for the majority of the rock that will be mined from the pit. Which specific rock zones are represented in the testing results discussed in MWMP, pg. 43-50? The answer is undefined. **The EIS data fail to justify the conclusion that a Category B disposal facility would provide adequate containment for the Ada Tepe wastes (EIS pg. 213).**

Process Reagents / Explosives / Fuels, etc.—Released to the Environment.
The BMM project will use tremendous quantities of explosives, fuels, oils and greases, chemical process reagents, herbicides, pesticides, antifreeze, etc.---all of which are potential contaminants, and are routinely released into the environment at mine sites. In contrast to what is reported / implied in the EIS (and which was stated by the BMM ecologist at the Krumovgrad public meeting), most of the substances listed above are toxic to many forms of aquatic and other life, including several of the process reagents. (i.e. Australian Gov. Publ. Service, 1995; Norwegian Institute for Water Research, 2010).

Explosive use leaves chemical coatings of nitrate, ammonia and diesel on the pit wall rocks, waste rocks, and ores. When rainfall occurs, these potentially-toxic compounds wash into the local soils, rivers and ground waters. BMM proposes to use roughly 56 tons of blasting compounds per month (pg. 226—227).

Dissolved ammonia is roughly as toxic to many forms of fish as is dissolved cyanide (Moran, 1998, 2000). In agricultural areas, nitrates and ammonia may already be present in local waters at elevated concentrations due to the addition of fertilizers and animal wastes.

The EIS reports that 5,675 tons of diesel fuel will be used per year.

Long-term Water Treatment.

There is a significant possibility that long-term water contamination would require construction and operation of a water treatment plant---possibly in perpetuity.
The costs to construct and operate such a facility are often in the range of hundreds of millions of U.S. dollars, long-term, and would likely be borne by local citizens, and Bulgarian and E.U. taxpayers.

Pit Lake and Pit Drainage:
The EIS is confusing in its statements about whether a pit lake will remain following closure. Given that the EIS estimates that ground water will flow into the pit at a rate of 18,000 cubic meters per year (which = 18 million liters per year), it appears obvious that a pit lake will remain, unless BMM decides to backfill the pit with mine wastes, which is highly unlikely (p. 176: Table V.2.1-8).

Mine drainage volumes will vary from 68,383 to 117,728 cubic meters per year (pg. 184, EIS Table V.2-13). The EIS states that this water will be of acceptable quality and will be discharged to the Krumovitsa River.

The EIS authors state that the pit is not expected to generate either acid or contaminants (pg. 184), but fails to supply reliable technical support for this statement. In fact, based on the limited geochemical data presented, the local climatic conditions, and the experience from numerous similar pits around the world, this conclusion appears incorrect. It is likely that the open pit would, long-term, develop degraded water quality if untreated. *Thus, it is likely that any water discharged to the local rivers would also have degraded water quality.*

Soils:
At numerous places, the EIS authors attempt to disingenuously show that the local soils are a potential source of contamination (Appendix 6 Mine Waste Management Plan, pg. 25-26), but that mine wastes are not! This suggests that BMM should not be held responsible for any future soil contamination. Unfortunately, they fail to state that the soils are formed predominantly by erosion of the nearby, mineralized bedrock that BMM proposes to mine, and which contains all of the same trace constituents as the soils. Clearly these soils are already somewhat acidic having pHs between 5.0 and 6.0 (Appendix 6 Mine Waste Mgmt. Plan, p. 16 to 18), and highly susceptible to contamination as they lack the minerals necessary to buffer additional acids (pg. 17). Then, the EIS authors inconsistently state that the metals are not present (in the site rocks) in mobile forms (MWMP pg. 26), which avoids the question of how they appeared in the soils. The EIS provides no reliable geochemical test data to support this statement, and given that such metals are environmentally-mobile at similar mine sites around the world, this claim seems fantastic.

Seismic Studies
Similar mine EISs routinely contain sections that evaluate historic seismic activity locally and regionally. This EIS contains no discussion of historic seismic activity or potential related risks. The Rhodope Mountains and the surrounding areas clearly have experienced significant historic seismic events. Dimitrov et.al. (2004) describe two destructive earthquakes (M=6.8 and M=7.0) in 1928 in the Plovdiv area—thus they do occur regionally. Because the TMF is expected to be about 40 m high, filled with materials having roughly 56% water content [and the water storage dam will be 16 m high, filled with water covering a 7 hectare area (pg. 37)], seismic studies should obviously have been conducted and included in the EIS.

Uncertainties:
The EIS fails to provide definitive descriptions regarding many proposed actions, leaving great uncertainty about which actual options will be employed. For example:
What will be the *specific* sources of project-related water?

Do adequate quantities of water exist to satisfy both the present public and proposed mining needs---including those likely required if additional deposits are operated?

What will be the *specific* mineral extraction processes employed? (Will cyanide be used?)

Will there ultimately be a pit lake remaining on the site? What will its water quality?

Will other, nearby deposits be approved within relatively short periods of time, creating significant additional demands (cumulative impacts) on the water resources and general environment?

Will BMM store mine wastes in the tailings impoundment (TMF) or combine the tailings and waste rock in one facility (IWMF)? In either case, will such facilities be constructed with engineered liners?

What are the seismic risks to mine structures? [No studies have been presented.]

Will long-term water quality degradation occur—possibly after closure---requiring operation of an active water treatment facility?

What are the specific closure plans for the facilities? Such a plan has not been prepared.

What are the detailed conditions for providing Financial Assurance (bonds, environmental insurance, etc.) to the public? [Including: Who will calculate the amounts? What are the specific assumptions about future water quality, and are they conservative? How will the funds be held?]

Cumulative impacts
BMM has defined at least five other local gold prospects in the Krumovgrad region (pg.260 to 262). If the Ada Tepe site is permitted and operated, it is likely the others will receive approval, encouraging other companies to explore and possibly operate in this immediate region. Hence it is imperative that detailed hydrogeologic studies be performed *regionally* to evaluate quantitatively the volumes of water potentially available in the various aquifers and the likely hydrogeologic pathways / connections between aquifers and surface waters (faults / fractures / karst features / leakage between formations during pumping).
Such information is absolutely necessary in order to plan for sustainable development of these resources.

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ДИРЕКЦИЯ ИЗПИТВАТЕЛНА ЛАБОРАТОРИЯ
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Сертификат за одобрение по ISO 9001/2008 No. SOF0207186 LRQA

Отдел „Елементен състав"

Протокол № 6.1-015/27.01.2010 г.

Company: „Balkan Mineral end Mining" EAD
Object: geotechnical samples with content of Au < 0.3 g/t
Type and number of samples: sulfide waste – 81 numbers
Requisition: вх. № 2080 / 22.12.2009 г.

Results from Chemical Ananlyses

Lab. №	Sample №	Borehole №	Interval: from m to m	S_{total} %	$S_{sulfide}$ %	C inorganic %	Acid Potential (AP) expressed as H^+ mol/kg	Neutralization Potential (NP) expressed as H^+ mol/kg	Net Neutralization Potential (NNP) expressed as H^+ mol/kg	Neutralization Potential Ratio (NPR= NP/AP)
6544	292101	ATDD009	10.0÷13.0	<0.005	<0.10	1.53	-	-	-	*
6545	292102	ATDD009	79÷82	1.14	0.58	1.69	0.363	4.009	3.646	11.04
6546	292103	ATDD010	15÷18	<0.005	<0.10	1.97	-	-	-	*
6547	292104	ATDD010	72÷75	1.42	1.26	1.20	0.788	2.161	1.373	2.74
6548	292105	ATDD071	38÷41	1.10	0.65	1.47	0.406	2.843	2.437	7.00
6549	292106	ATDD050	11÷12.4	0.35	0.10	0.37	-	-	-	*
6550	292107	ATDD050	76÷78.5	1.08	0.79	1.09	0.494	2.029	1.535	4.11
6551	292108	ATDD042	71.5÷74	0.57	0.44	1.47	0.275	1.777	1.502	6.46
6552	292109	ATDD047	31÷33.4	1.14	0.87	1.58	0.544	3.002	2.458	5.51
6553	292110	ATDD047	107÷111	1.07	0.77	1.75	0.481	2.930	2.449	6.09
6554	292111	ATDD006	111÷113	0.77	0.50	1.04	0.313	2.016	1.703	6.44
6555	292112	ATDD037	16÷18.8	<0.005	<0.10	0.05	-	-	-	*
6556	292113	ATDD037	133÷135	0.86	0.64	1.75	0.400	2.601	2.201	6.50
6557	292114	ATDD041	31÷33.5	<0.005	<0.10		-	-	-	*
6558	292115	ATDD041	131÷134	1.26	0.75	3.17	0.469	5.040	4.571	10.75
6559	292116	ATDD005	36÷39	0.60	0.26	1.09	0.163	1.401	1.238	8.60
6560	292117	ATDD061	13.2÷14.2	1.02	0.78	0.33	0.488	0.775	0.287	1.59
Lab.	Sample	Borehole	Interval:	S_{total}	$S_{sulfide}$	C	Acid Potential (AP) expressed as	Neutralization Potential (NP)	Net Neutralization Potential (NNP)	Neutralization Potential Ratio

№	**№**	**№**	**from m to m**	**%**	**%**	**inorganic %**	**H^+ mol/kg**	**expressed as H^+ mol/kg**	**expressed as H^+ mol/kg**	**NP (NPR= —) AP**
6561	292118	ATDD061	52÷53	1.56	1.34	1.09	0.838	3.120	2.282	3.72
6562	292119	ATDD087	4÷5.5	<0.005	<0.10		-	-	-	*
6563	292120	ATDD087	80÷82.2	1.85	1.54	1.69	0.963	3.753	2.790	3.90
6564	292121	ATDD033	6.0÷9.0	<0.005	<0.10		-	-	-	*
6565	292122	ATDD033	107.4÷110	0.86	0.67	1.42	0.419	2.471	2.052	5.90
6566	292123	AT1060	8.7÷11.7	<0.005	<0.10		-	-	-	*
6567	292124	AT1060	127.9÷131.3	1.30	0.77	2.95	0.481	6.187	5.706	12.86
6568	292125	ATDD001	86÷88.2	1.46	1.34	1.20	0.838	2.333	1.495	2.78
6569	292126	ATDT203	113÷118	1.25	0.82	1.42	0.513	2.898	2.385	5.65
6570	292127	ATDD039	29÷33	<0.005	<0.10		-	-	-	*
6571	292128	ATDD039	129÷133	0.38	0.29	3.60	0.181	7.099	6.918	39.22
6572	292129	ATDD040	10.0÷13.0	<0.005	<0.10		-	-	-	*
6573	292130	ATDD040	130÷134	0.61	0.54	2.51	0.338	5.389	5.051	15.94
6574	292131	ATDD038	33÷36	<0.005	<0.10		-	-	-	*
6575	292132	ATDD038	132÷137	1.32	0.96	1.64	0.600	3.071	2.471	5.12
6576	292133	AT1038	4.7÷7.7	<0.005	<0.10		-	-	-	*
6577	292134	AT1038	86.9÷90.9	0.02	<0.10	3.49	-	-	-	*
6578	292135	ATDT176	83÷85	0.85	0.56	2.62	0.350	4.647	4.297	13.28
6579	292136	ATDD101	15÷16.5	0.03	<0.10		-	-	-	*
6580	292137	ATDD002	40÷42	0.03	<0.10	2.78	-	-	-	*
6581	292138	ATDD002	62÷64.5	1.30	0.89	0.87	0.556	2.004	1.448	3.60
6582	292139	ATDD021	5÷7.5	<0.005	<0.10		-	-	-	*
6583	292140	ATDD021	48÷50.5	1.27	0.79	1.26	0.494	2.442	1.948	4.94
6584	292141	ATDD080	5.0÷8.0	<0.005	<0.10		-	-	-	*
6585	292142	ATDD079	70.2÷73	0.54	0.29	0.27	0.181	0.355	0.174	1.96
6586	292143	ATDD079	133÷137	0.85	0.57	2.24	0.356	4.174	3.818	11.72
6587	292144	AT1023	6.1÷10.6	<0.005	<0.10		-	-	-	*
6588	292145	ATDD086	64÷66.5	1.04	0.81	1.09	0.506	1.699	1.193	3.36
6589	292146	AT1070	59.4÷63.4	<0.005	<0.10		-	-	-	*
6590	292147	AT1070	123.8÷125.6	0.22	0.20	2.62	0.125	4.564	4.439	36.51
6591	292148	ATDD043	40.4÷43	0.02	<0.10		-	-	-	*
6592	292149	ATDD028	11.0÷14.0	<0.005	<0.10		-	-	-	*
6593	292150	ATDD028	102÷104	0.69	0.48	3.60	0.300	5.935	5.635	19.78
6594	292151	AT1030	60.7÷63	1.32	1.17	0.98	0.731	1.935	1.204	2.65
6595	292152	AT1067	8.8÷11.5	<0.005	<0.10		-	-	-	*
6596	292153	AT1067	74.4÷76.9	0.72	0.30	2.35	0.188	3.908	3.720	20.79
6597	292154	ATDD069	10.0÷13.0	<0.005	<0.10		-	-	-	*
6598	292155	ATDD069	92÷95	0.94	0.69	1.58	0.431	2.686	2.255	6.23
6599	292156	ATDD051	28÷29.5	0.02	<0.10		-	-	-	*

Lab. №	Sample №	Borehole №	Interval: from m to m	S total %	S sulfide %	C inorganic %	Acid Potential (AP) expressed as H^+ mol/kg	Neutralization Potential (NP) expressed as H^+ mol/kg	Net Neutralization Potential (NNP) expressed as H^+ mol/kg	Neutralization Potential Ratio (NPR= NP/AP)
6600	292157	ATDD024	5.0÷10.0	<0.005	<0.10		-	-	-	*
6601	292158	ATDD024	58.5÷61	0.010	<0.10		-	-	-	*
6602	292159	ATDD083	2.0÷3.5	<0.005	<0.10		-	-	-	*
6603	292160	ATDD058	11÷14.5	0.010	<0.10		-	-	-	*
6604	292161	ATDD026	73÷75.3	1.08	0.77	1.75	0.481	2.916	2.435	6.06
6605	292162	ATDD077	8÷10.2	<0.005	<0.10		-	-	-	*
6606	292163	ATDD077	64÷67	0.53	0.20	0.55	0.125	1.043	0.918	8.34
6607	292164	ATDD092	64÷67	<0.005	<0.10		-	-	-	*
6608	292165	AT1018	4.8÷7.7	<0.005	<0.10		-	-	-	*
6609	292166	AT1080	12.8÷15.8	<0.005	<0.10		-	-	-	*
6610	292167	ATDD016	10.0÷13.0	<0.005	<0.10		-	-	-	*
6611	292168	ATDD016	3.0÷6.0	1.64	1.12	3.55	0.700	6.595	5.895	9.42
6612	292169	AT1033	9.9÷12.7	<0.005	<0.10		-	-	-	*
6613	292170	AT1033	64.3÷67.7	0.02	<0.10		-	-	-	*
6614	292171	AT1020	20.8÷24.2	0.02	<0.10	0.22	-	-	-	*
6615	292172	ATDD085	17÷18.8	<0.005	<0.10		-	-	-	*
6616	292173	ATDD011	3÷5.8	0.02	<0.10		-	-	-	*
6617	292174	ATDD088	22÷25	<0.005	<0.10		-	-	-	*
6618	292175	ATDD013	6.0÷9.0	0.010	<0.10		-	-	-	*
6619	292176	ATDD013	53÷56.4	0.010	<0.10		-	-	-	*
6620	292177	ATDD018	3.0÷6.0	<0.005	<0.10		-	-	-	*
6621	292178	ATDD060	6÷7.6	<0.005	<0.10		-	-	-	*
6622	292179	ATDD060	41÷42.9	0.87	0.33	1.09	0.206	2.704	2.498	13.13
6623	292180	AT1037	6.7÷10.4	<0.005	<0.10		-	-	-	*
6624	292181	AT1037	61÷63.2	0.80	0.43	2.67	0.269	4.391	4.122	16.32

* if content of **S** sulfide < 0.10 % , the samples are not with acid potential

Note. **NPR** < 1 - there is not enough potential capacity to neutralize all potentially released acidity.

NPR > 1 - there is potential capacity to neutralize all potentially released

Провели изпитването:…………………….
/Ел. Величкова/
…………………….
/инж. С. Димитрова/
…………………….
/инж. Сн. Таскова/
…………………….
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