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Scoping Study
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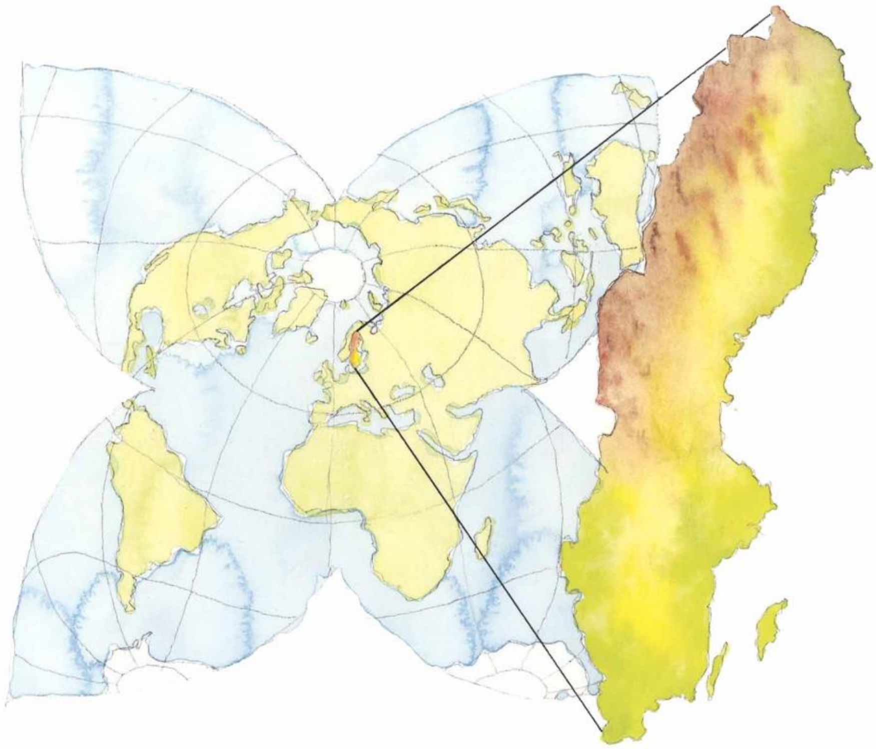

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Executive summary

On behalf of Grängesberg Exploration Holding AB (GRANGEX), GeoVista AB has compiled this independent statement and report of the results of a scoping study, aiming at the recovery of Apatite and Magnetite from tailings, previously deposited in the Jan-Matts tailings repository in Grängesberg, Sweden.

GRANGEX controls the tailings facility, which through a mineral resource estimation, based on sampling and assaying, has been shown to contain at least 2.8 million tonnes of sand, with a grade of 5.4 % of P_2O_5 and 10.1 % of Fe. The Swedish Mining Act does not recognize tailings as mineral resources and no mining concession will be required for its exploitation. The project is thus not considered to be a mineral resource project and does thus not require a formal Mineral Resource Estimation. However, the company has decided to base its assessment on tonnages and grades on the Australasian reporting code JORC-2012 edition. The resources have been estimated by M.Sc. Thomas Lindholm GeoVista AB, Sweden, is a Fellow of AusIMM and a competent person to report on mineral resources based on his education, relevant experience, and affiliation with a professional association.

The market for Apatite and Magnetite concentrates has been investigated and potential clients for off-take have been contacted, thereby allowing for estimation of reasonably expected product prices.

Metallurgical testing in bench-scale has shown that an Apatite concentrate, containing 37,3 % P_2O_5 can be produced at a 76,7 % recovery and that a Magnetite concentrate containing 70 % Fe can be produced, the potential for both higher grade and higher recovery of Apatite was observed. This will be further investigated in the next phase of test work, which is already underway, based on a 20-ton bulk sample.

A flowsheet for annual industrial-scale production of 62 000 tonnes of Apatite and 33 000 tonnes of Magnetite concentrates respectively has been developed. The process plant will be installed in an existing building, located close to the tailings dam as well as close to the existing rail yard.

The sand will be loaded out from the dam by the use of an excavator and trucks and transported 1100 meters to the process plant. The process will consist of re-grinding mills, flotation, and magnetic separation circuits to produce an Apatite concentrate and a Magnetite concentrate. The tailings will be disposed of in the old open pit, located some 1,6 km to the north.

Two test pits have been excavated during the study, this to secure material to meet customers' requirements of bulk samples of the Apatite concentrate. The excavation did also make it possible to better understand the sand and its properties, wet and dry. A piece of knowledge that will be important for the excavation of the sand during production.

The concentrate will be transported to the railway and loaded into containers on railcars. Approximately 3 trains will be sent to the harbour in Kristinehamn every 2 weeks. The concentrate will be shipped to customers in Scandinavia and northern Europe. Kristinehamn port works well for the shipments from Grängesberg with the size of planned production and where the customers are located.

Contacts with known customers have confirmed the great interest in the high grade and low impurity Apatite concentrate that is planned to be produced in Grängesberg.

The high-quality Magnetite concentrate planned for production in Grängesberg is in high demand from the steel industry. The steel industry is today making great efforts to find the supply of Iron ore with high levels of iron, to reduce/minimize the carbon footprint. There are also possibilities to sell the Magnetite concentrate from Grängesberg to customers asking for special grades with possibilities to achieve even better prices. The quantity of sand in the Jan-Matts tailings facility is limited and production based on material from this facility will be limited to five to six years. There are, however, further opportunities in the area, with other tailings facilities containing value minerals, making it possible to extend the life of the planned recycling operation substantially and at the same time increasing the possibility to produce minerals in high demand through recycling.

The estimated financial result of a project as presented in the scoping study is presented below,

- Planned total production:

  -Apatite concentrate 304 000 tonnes containing 16,3 % phosphorous

  -Magnetite concentrate 162 000 tonnes containing including 70% iron
- Total revenues for the project are estimated to be MSEK 638
- Total EBITDA is estimated to be MSEK 318
- Production time is estimated to be five years
- Initial CAPEX is estimated to be MSEK 120
- OPEX FoB Kristinehamn, is estimated to 675 SEK/ton
- Pay-back time is estimated to be 21 months
- Net Present Value (NPV) at 8% discount rate is estimated to be MSEK 170
- Internal Rate of Return for the project is estimated to be ~80%
- The study is assuming the exchange rate of SEK 8:50/USD

It should be noted that the CAPEX has been based on buying new equipment. There is, however, a possibility that a substantial part of the equipment that can be acquired on the second-hand market and by buying such equipment it should be possible to noticeably reduce the initial CAPEX.

Luleå 2021-11-30

Thomas Lindholm

GeoVista AB

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1 Introduction and project description

1.1 Background

In February 2021, Grängesberg Exploration Holding AB, GRANGEX, commissioned GeoVista AB to undertake a Scoping Study (SS) for the extraction of Apatite from the tailing facility, the Jan-Matts dam, in Grängesberg, see Figure 1, which is located in the old traditional mining area of Bergslagen in central Sweden.

The Apatite project is a recycling project where the plan is to extract Apatite as the main product, a phosphate mineral with a high content of phosphorus but also rare earth elements, (REE) and Magnetite.

GRANGEX controls the tailing facility, the Jan-Matts dam, which contains close to 3 million tonnes of tailing sand from the time of Fe-ore production in Grängesberg in the middle of last century.

According to SSAB's (the previous owner and operator of the mine) final report, the sand contains about 2.4% phosphorus. The sand also contains interesting levels of Magnetite and REE.

In December 2020/January 2021, the new Grängesberg Exploration Holding AB raised MSEK 47 to restructure the business of the company and to exercise a study with the objective to restart the Dannemora Mine, as well as completing a SS to produce Apatite from the old tailings facility in Grängesberg.

The Jan-Matts tailings facility is located in Grängesberg in the central of Sweden, see Figure 2. This being part of the heart of the mining in Sweden during many centuries.

The project has the potential to produce a high-grade Apatite of interest for the key customers in northern Europe. The Magnetite produced, being of high grade, will most probably be sold for special use and by that achieving a price higher than Fe-ore going to the Steel plants. The SS has also identified the possibility to recover and produce REE. This has anyhow not been fully developed in the SS but it is recommended to pursue this product in the next stage, the Definitive Feasibility Study, (DFS).

The plan is to reclaim the tailing sand from the Jan-Matts dam. In the first stage this will be done by excavators and the material will be trucked to the process plant. The process plant will be located in an already existing building. The finished products, Apatite and Magnetite concentrates will be transported by rail to Kristinehamn harbour for further shipment with vessel to the customers. Planned production of Apatite is 62 000 tonnes and Magnetite 33 000 tonnes.

The time to production is estimated to be three years including permitting, design and construction. Based on the Resource estimate performed the production based on tailing sand from the Jan-Matts dam will continue for 5 years. The plan going forward is to investigate and study other existing tailing facilities in the Grängesberg area to study the possibility to recover REE and possibly also Apatite, Iron ore and other value minerals.

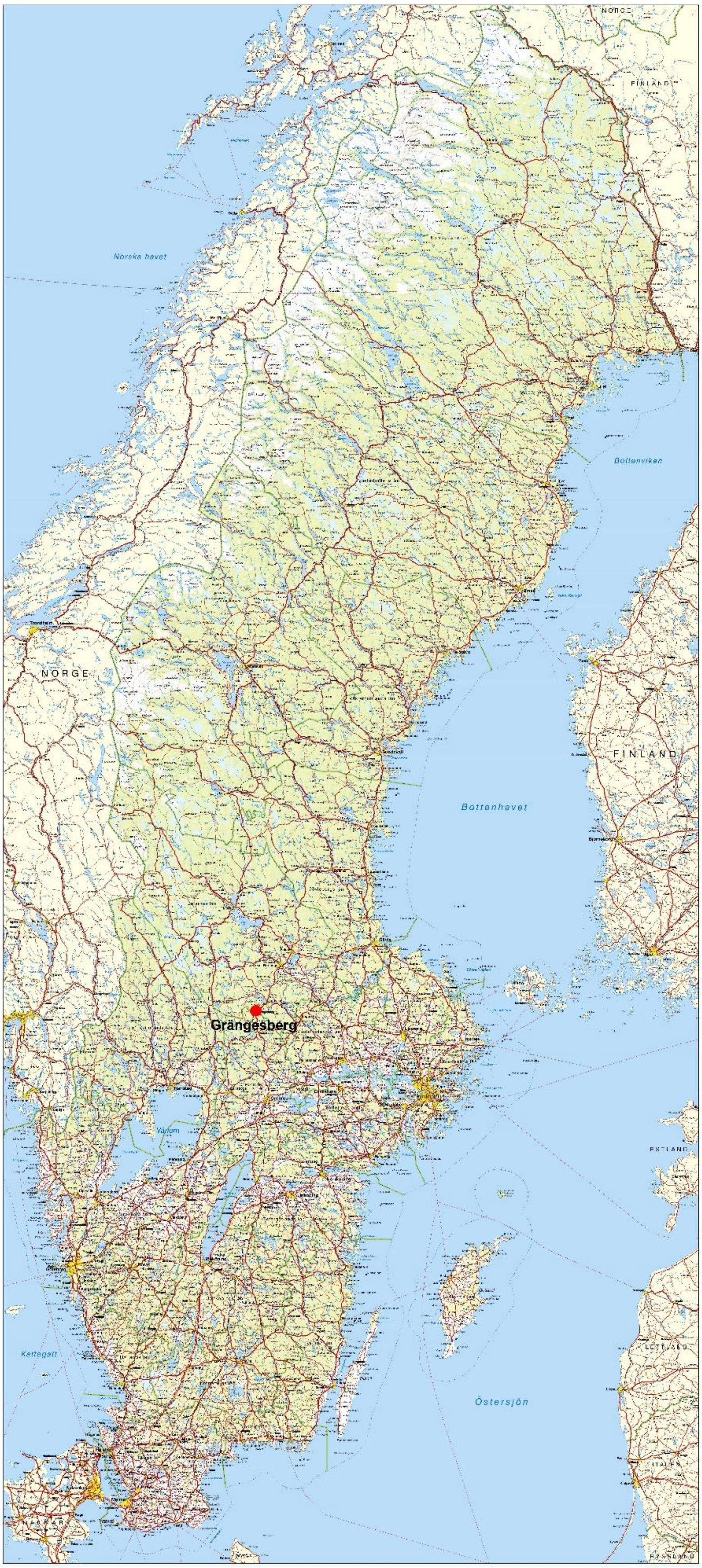

Figure 1. Location of Grängesberg.

1.2 History

Iron ore mining has been done for more than hundred years in Grängesberg and many hundred years in the region. The Run of Mine (ROM) in Grängesberg did in most cases contain high levels of Phosphorous. The high Phosphorous contents became an issue for the steel plants when the steel making technology changed mid last century and the Iron ore producers had to reduce the phosphorous content in the ore. This was achieved by grinding the ore finer and separating the phosphorous by flotation. The Phosphorus material was initially pumped to a tailing facility. Later the tailings were treated, and a production of an Apatite concentrate was done.

The Jan-Matts tailing facility is one of a few tailing facilities in the area with a high Phosphorous level, making production of an Apatite concentrate possible.

1.3 Location

The Jan-Matts tailings dam and the planned process plant lies in the town of Grängesberg, see Figure 2, located in the municipality of Ludvika, approximately 240 km west-northwest of Stockholm. The railroad passes approximately 100m east of the process plant building, the old switch yard is located in between.

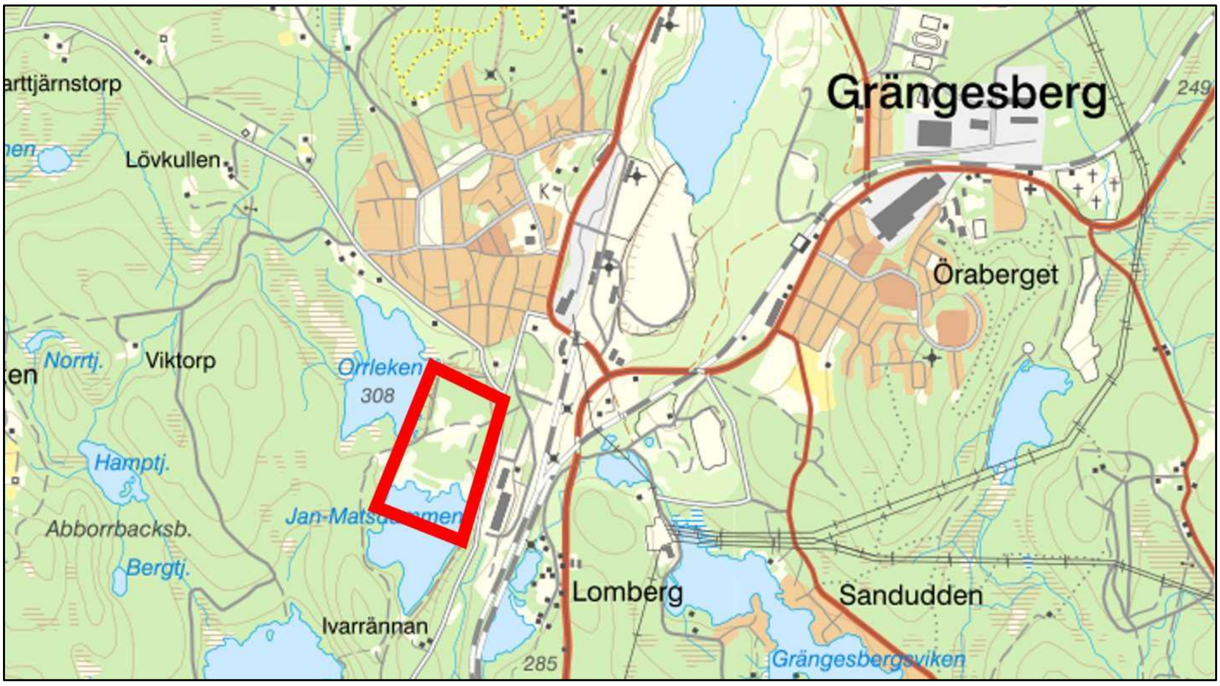

Figure 2. Location of Jan-Matts dam and the process facility.

1.4 Right to the tailings storage of the waste (Tenure)

GRANGEX has in a contract secured the full rights to recycle all the tailings in the Jan-Matts facility. The intention is to dispose of the tailings after the recovery of the Apatite and Magnetite by pumping them to the existing open pit about 1 300 m from the process plant.

1.5 Competent Persons (CPs)

The Estimated Mineral Resource presented in this Scoping Study is compliant with the principles as set out in JORC 2012.

According to JORC a competent person ("CP") must have a minimum of five years relevant experience in the style of mineralisation or type of deposit under consideration and in the activity which that person is undertaking. The CP must also be a Member or Fellow of the Australasian Institute of Mining and Metallurgy, or of the Australian Institute of Geoscientists, or of a "Recognised Professional Organisation ("RPO")".

Mr. Thomas Lindholm, GeoVista AB, who is a Fellow of the Australasian Institute of Mining and Metallurgy, is the CP responsible for the Resource Estimate for Grängesberg Exploration Holding AB. based on his training and experience in exploration, mining and mineral resource estimation of iron ore, base and precious metals. The Mineral Resources are reported following the guidelines of the JORC Code, 2012 edition. Thomas is regularly involved in Resource estimation for Scoping Studies through to full Feasibility Study ("FS"), site supervision and exploration drill programme design.

Table 1 presents a summary of the Resources of Tailings for Grängesberg Exploration Holding AB as of November 1, 2021. Further explanation and background on the geological model and subsequent resource estimation process is presented in section 6 of this report.

1.6 Project Status

This Scoping Study is the first step in the process of undertaking a thorough review of the possibility of recycling the tailings in the Jan-Matts tailing facility and to produce Apatite and Magnetite as well as possible REE.

A condition for the recycling operation to be successful is to produce an Apatite with a quality acceptable for the customers in Northern Europe. The focus for this study is to demonstrate the likelihood of the production of a sellable Apatite and Magnetite. Test work has concluded that by grinding the material fine, a high-grade Apatite concentrate as well as a high-grade Magnetite concentrate can be produced.

Based on the results of this Scoping Study the plan is to proceed to a Definitive Feasibility Study (DFS). This will be possible based on existing knowledge of the tailing facility as well as the test work executed. Key activities after the completion of the Scoping Study and partly in parallel to the execution of the DFS, will be to finalize the necessary documents for submission of the Environmental Impact Assessment ("EIA").

1.7 Feasibility Concept

A feasibility study represents a multi-disciplinary evaluation of a mining project that integrates all facets of the mining business, including technical, political, regulatory, environmental, and economic facets. Different feasibility study types reflect the level of confidence in a project. Studies progress from Scoping to Preliminary Feasibility to full Feasibility Study (Bankable or Definitive,Feasibility Study)

A Scoping Study typically has an estimation accuracy of ±30 - 40% and is generally used to provide a high-level assessment of technical characteristics (usually justified by a formalised estimation of Resources), identify fatal flaws, and present a simple operation and process design(s) and cash flow that can rely on assumptions. For the case of the recovery of Apatite and Magnetite from the Jan-Matts tailings facility the information collected, and test work executed are at a level making it possible to go direct to the DFS.

1.8 Study Participants

This Scoping Study has been complied by GeoVista AB using client-supplied data and information. As such, this report draws upon information presented in previous reports, by external parties. Information has been utilised by the project team, comprising predominantly by GRANGEX technical staff from specialist sub-contractors. The composition of the study participants and project team are outlined in Table 1 below.

Table 1. Scoping Study Participants.

Chapter	Discipline	Lead author
1	Introduction and project description	Karl-Axel Waplan
2	Environmental permitting and legal framework	Henning Holmström
3	Country and regional	Karl-Axel Waplan
4	Market conditions for Grängesberg concentrates	Bård Bergfald / Hans Nilsson
5	Geology	Thomas Lindholm
6	Mineral resource estimation	Thomas Lindholm
7	Mine design and planning	Michael Meyer
8	Hydrology and hydrogeology	Henning Holmström
9	Processing	Bo Arvidson
10	Waste management	Henning Holmström
11	Infrastructure and power supply	Alf Jeborn / Kurt Hansson
12	Transportation	Hans Nilsson
13	Environmental and social studies	Henning Holmström
14	Mine closure	Henning Holmström
15	Health and safety	Michael Meyer / Henning Holmström
16	Manpower requirements	Michael Meyer / Alf Jeborn
17	CAPEX	Alf Jeborn / Kurt Hansson
18	OPEX	Alf Jeborn / Kurt Hansson
19	Financial evaluation	Karl-Axel Waplan / Paul Johansson
20	Sustainability	Henning Holmström
21	Risks and opportunities	Karl-Axel Waplan
22	Project implementation plan	Karl-Axel Waplan
23	Conclusions and recommendations	Karl-Axel Waplan
24	References	

2 Environmental permitting and legal framework

Starting an operation in Sweden involves a large focus on environmental issues as well as well as on the implemented EU-legislation (waste and water). A Swedish EIA, Environmental Impact Assessment, is also a very technical document, and does not only include baselines studies but usually also detailed calculations on future concentrations in recipients from e.g., a tailings impoundments or landfill, noise and vibrations etc. There are seldom fixed limit values. Swedish authorities are focused on water and how recipients are affected (due to the EU Water Framework Directive). Permitting is usually an iterative process.

2.1 Background and Assumptions

The planned operation has similarities with Harsco Metals located in Norberg, Sweden. A company which is reprocessing slag followed by putting the waste in a landfill (TMF). The company is exempted from several paragraphs in the Ordinance on waste deposition (SFS 2001:512) e.g., sealing layer and geological barrier.

However, GRANGEX has been in contact with the County Administration of Dalarna ("CABD") who in turn has discussed the matter with the Swedish Environmental Protection Agency as well as the Mines Inspector. GRANGEX received an answer October 14th, 2021. The County Administration adviced the company to not explicitly follow the guidelines regarding tailings impoundments (GruvRidas), but still to keep the geotechnical aspects of the guidelines in mind. The CABD more or less also points in the direction that an environmental permit would have to be approved by the environmental court. The CABD does not object to using the former open-pit as a disposal area but refers to the Ordinance on waste from extractive industries (SFS 2013:319) and hence GRANGEX has assumed that reprocessing of tailings at Grängesberg would follow a similar path of permitting i.e. resemble a mining project.

2.2 Regulatory framework

The Swedish Environmental Code (SFS 1998:808) provides the legal environmental framework for environmental matters. The Environmental Code comprises of 33 different chapters dealing with different aspects such as provisions concerning management of land and water areas, environmental quality standards, environmental impact statements, protection of nature and species, provisions concerning environmentally hazardous activities and health protection, contaminated land, water operations, chemical products, waste and producer responsibility, consideration of cases and matters, supervisions and charges, and penalties. As part of the framework there are also a number of ordinances issued under the Environmental Code. Such ordinances mainly specify or clarify the rules or objectives stipulated in the Environmental Code.

A few of the important chapters and related ordinances are as follows.

Chapter 2: General rules of consideration.

General rules on environmental knowledge, protective measures, avoiding hazardous chemical products, materials and energy conservation and site selection. When applying for an environmental permit the applicant must show that the obligations arising out of this chapter has been complied with.

Chapter 3: Provisions concerning the management of land and water areas.

Basic provisions related to the use of land and water as well as rules regarding areas of national interest.

Chapter 5: Environmental quality standards (EQS).

Guidance on matters to be specified in EQS, compliance, action programs and measurements. The EQS for surface waters are published in a regulation issued by the Swedish Agency for Marine and Water Management (SAMWM) with the title Regulations on classification and EQS regarding surface water (HVMFS 2013:19). Corresponding EQS for groundwater are published in a regulation (SGU-FS 2013:2) issued by the Geological Survey of Sweden.

Chapter 6: Environmental impact statements and other decision guidance data.

Ordinance on environmental impact assessments (SFS 1998:905).

Rules on compulsory consultation activities prior to performing the Environmental Impact Assessment (EIA) work and rules on the content in an EIA report. The ordinance contains rules and guidance on when significant environmental impacts can be expected from certain activities.

Chapter 9: Environmentally hazardous activities and health protection.

Ordinance on environmentally hazardous activities and health protection (SFS 1988:899) and Ordinance on environmental permitting (SFS 2013:251).

Definitions and basic rules on environmentally hazardous activities and health protection. The ordinance SFS 1988:899 contains inter alia rules on environmental permitting when handling and storing certain hazardous substances, rules related to discharge of wastewater and rules on notifications that has to be performed for certain activities. For instance, clean-up activities of contaminated land have to be notified to the supervising authority prior to commencement. The ordinance SFS 2013:251 describes the kind of operations and measures that cannot be performed without an environmental permit or a notification. Two permitting levels are described in the ordinance: A-level which implies that the Environmental Court is the permitting authority, and B-level where the Permit office at the County Administrative Board (CAB) deals with the permit application. It has been assumed that reprocessing of tailings would belong to the A-level i.e. Environmental Court.

Chapter 15: Waste and producer responsibility.

Ordinance on waste (SFS 2011:927), Ordinance on waste deposition (SFS 2001:512), Ordinance on waste from extractive industries (SFS 2013:319).

This chapter includes waste definitions and responsibilities related to handling of waste. The ordinance SFS 2011:927 contains additional rules on waste including information on waste classification. The ordinance 2001:512 covers rules on landfills and requirements regarding design as well as protective measures. The ordinance 2013:319 solely focuses on waste from extractive industries (i.e. waste-rock and tailings) and should be applicable according to the statement by CABD.

Chapter 22: The procedure for application cases in the environmental courts.

In this chapter the permitting procedure is outlined together with rules regarding the contents in a permit application.

Chapter 26: Supervision.

Ordinance on operators self-monitoring (SFS 1998:901).

Rules related to supervision and environmental reporting. The ordinance includes duties for operators to document environmental responsibilities within the organisation, to implement procedures for control of equipment, to repeatedly assess risks associated with the operations and to keep records of chemical products.

2.3 Environmental permitting process

The first step in the permitting process is consultation with the County Administration Board (CAB), the Local Environmental Department (LED) and potentially affected private individuals (Chapter 6 in the Environmental Code). This consultation is most often two separate meetings, one with the CAB and LED and one with the local stakeholders. Prior to the consultation the applicant must prepare a consultation document that covers planned localizations for the activities, the extent of the planned operations, preliminary designs and the foreseen environmental impacts from all activities. If the planned activities are expected to impose significant impacts, consultation shall also be carried out with other national authorities, municipalities, environmental organizations (NGO's) and the public. The purpose of the consultation is to obtain viewpoints to consider in the Environmental Impact Assessment (EIA) report. The CAB has a key role to guide the applicant regarding the extent of the EIA.

After finalizing the EIA report and the technical description of the activities and facilities, a formal permit application (legal) is prepared. All reports, drawings and documents are thereafter submitted to the permitting authority (Environmental Court or the Permit office at the CAB). The actual EIA is just a report with several appendices, usually with the following main sections:

- Administrative information
- Introduction including purpose and any limitations
- Legislation
- Planning matters
- The nature and extent of the operations
- The no-go option
- Site and area description
- Protected areas and areas of national interest (land and water)
- Cultural and socio-economic conditions
- Effects of pending operations (impact assessment)
- Rehabilitation
- Best available technologies
- References
- Attachments and appendices

An application also includes a detailed technical description, drawings, lay-out etc.

In the next step the permitting authority sends the full application to the consultation bodies for viewpoints if supplementary information or data is required to regard the application as complete. The public gets the same opportunity to respond as the consultation bodies. Requests for additional information and/or clarification are thereafter sent to the applicant who gives the opportunity to submit additional information to the permitting authority.

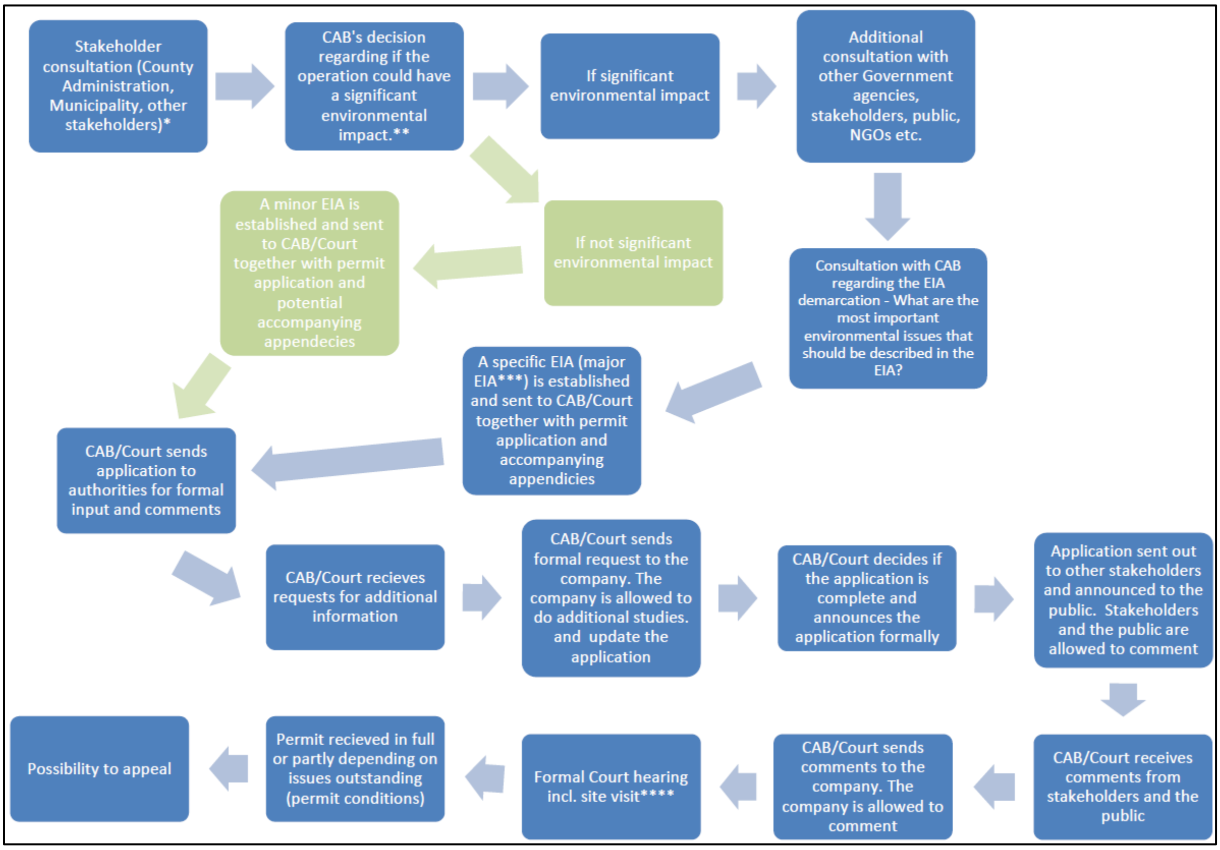

Figure 3. Swedish Permitting System.

*Should be conducted as early in the process as needed for the company to be able to take opinions/information into account when planning the operations localization, potential process design choices etc. Is the basis for CAB's decision regarding significant environmental impact.

**If considered a significant environmental impact a specific EIA should be conducted.
***A specific EIA usually require more underlying investigations of surrounding environment (for example endangered/threatened species, ecological and chemical status in water recipients etc.).
****Only for District court. Usually not conducted for applications handled by CAB.

When the permitting authority has judged the permit application to be complete, announcement of the application and the EIA report is done. After announcement consultation bodies, experts, organizations and private individuals are asked to provide their opinion on the complete application within a certain time. Opinions are sent by the permitting authority to the applicant who gets the opportunity to response to the provided opinions. If the Environmental Court is the permitting authority, the Court decides upon a date for court hearings after consultation with the applicant. The hearings normally take place in local premises in the area of the project site, making it possible for local stakeholders to attend and giving the Court a possibility to perform a site visit together with the applicant, consultation bodies, stakeholders and others. At the end of the hearings the Court informs when a decision on the application can be expected. The decision made by the Court can be appealed to the Environmental Court of Appeal and a decision made by the CAB can be appealed to the Environmental Court. The actual process is summarized in Figure 3.

2.4 Needed data – Data requirements

The first step in the permitting process is consultation and the following are required a before a consultation document can be prepared:

- Preliminary localization(s) as well as the preferred.
- General description of the planned operation, facilities, consumables as well as waste generation.
- General description and characteristics of the material and waste.

Based on any comments received during the consultation process further studies might be needed. Based on all gathered data and technical studies (At least PFS-quality is needed for the technical description) an EIA-report as well as a technical description is written. After finalizing the EIA report and the technical description covering all planned activities and facilities including logistics, a formal permit application (legal) is prepared. The following is usually required in order to be able to prepare the EIA as well as a technical description:

- Technical data covering the full operation incl. power, consumables etc. of at least PFS-quality including a design of the mine, tailings impoundment, other infrastructure, logistics, water management etc.

It should also be noted that if the project changes significantly during the permitting process, then the consultation stage need to be revisited and redone.

Other permits needed for an operation

Several other important permits would be needed in order to be able to start up an operation in Sweden. Most notably the following:

- Construction permits according to the Planning and Building act (2010:900) – Could be needed based on the view of the Municipality.
- Power Line Concession according to the Electricity Law (1997:857) – Not needed since power to the site already exist.

Once the Land and Environmental Court has granted permission to begin operations, a construction permit is required by the local municipality.

A construction permit normally takes between four and eight weeks to process and covers buildings and other facilities that need to be constructed in connection with a project.

However, granting a construction permit is only possible if the municipality's Master and Detailed Plans (land use plans) have designated the land required for the project as being suitable for such activities. A Detailed Plan is required if the planned building and activities connected to it may have a significant impact on the surroundings, such as landscape or traffic. This is normally considered to be the case for the industrial areas in Sweden but should not be needed for Grängesberg due to being a former mine site.

A power line concession is handled under the Electricity Law (1997:857). The application is usually handled by the power company itself, but usually the operator/client has to pay for most of the work either directly or indirectly by a higher fee. The process itself is time consuming and can be appealed, and hence the process should start early.

2.5 Time table

An environmental permit application requires thorough technical and environmental studies and the actual time before an environmental permit is granted can be up to 24 months after filing an application. If not more in very complex projects.

As the basis for an application a future DFS is planned. Due to the rather straight forward nature of the project, GRANGEX expects that the environmental studies needed should take no more than 6 months to finish and that these studies can be performed in conjunction with the DFS. After filing the application, the company expects that it will take no more than 12 months before the application will be approved. GRANGEX believes that the only future risk from a permitting perspective lies in using the former open pit as an underwater waste disposal facility.

2.6 Environmental Status of the surroundings

A nature inventory study was carried out in 2011 around the Grängesberg area as a part of an exploitation concession application written by the company HIFAB, see Figure 4. The concession was later granted, and the documents are public. The actual study was done by the company Pelagia

The focus of the study was primarily to study if there were areas that housed older trees, dead standing trees, lying dead trees and presence of older deciduous trees. Prescence of indicators of forest worthy of protection, so-called signal species and endangered species (red-listed species), as well as rare species in general were also investigated.

One area of “certain natural value” (Class 3) was found, a deciduous forest east of the former open pit, far away from the Jan-Matts TMF. The area consists of a fairly young forest, actually with too little dead wood to really be considered a key biotope of the type "Lövnaturskog" according to the Swedish Forest Agency's criteria’s (2011), in addition there are no signal species and red-listed species. However, the forest has to some extent a multi-layered tree structure of younger and older trees. Other areas identified had no special natural value (Class 4).

In conclusion, based on current knowledge there should be no protected areas or nature values of importance in and close to the Jan-Matts TMF. Figure 5 shows the actual TMF as it looks today.

Figure 4. Previously investigated area (2011).

Figure 5. Current photo (September 2021) showing the Jan-Matts TMF today.

2.7 Studies initiated and needed for an environmental permit

A number of studies have been initiated but not yet reported. However, the following studies are underway:

- Nature inventory study of the Jan-Matts TMF, including aquatic studies in the recipients.
- Determination of water volume and geochemical investigations of the uppermost 30 m of the open pit.
- Quarterly water sampling in the lakes and recipients (supposed to be done for a full year).
- Waste-characterization of tailings (produced during processing tests).

Further studies would be required for an environmental permit and the environmental permit application would need to include at least the following:

- Formal application incl. stakeholder consultation documentation
- Localization study
- Final waste-characterization report
- Rehabilitation plan – Conceptual
- Waste-Management Plan (formal)
- Dust and vibration study
- Geotechnical studies covering the stability of the tailings impoundment
- Geohydrological studies including installation of monitoring wells – water balance
- Aquatic studies (biology, sediments and water chemistry)
- Nature inventory and if needed compensatory study/suggestion
- Status report
- EIA and Technical Description

The need of studies and investigations could change after the stakeholder consultation based on requirements from the authorities.

Activities and estimated budget for an environmental permit is presented in Table 2.

Table 2. Estimated activities and budget for an environmental permit.

	Activity	Budget (SEK)	Remark
1	Legal Support	300 000 SEK	
2	Application	200 000 SEK	
3	Stakeholder Documentation	50 000 SEK	
4	Satkeholder Document	50 000 SEK	
5	Localization Study	50 000 SEK	
6	Nature Inventory	150 000 SEK	TMF and surroundings
7	Aquatic Studies	450 000 SEK	Recipients and open pit
8	Water Chemistry	200 000 SEK	Recipients and Outlet Open Pit
9	Dust and Vibration	200 000 SEK	
10	Geotechnical investigations	500 000 SEK	Field work and reporting
11	Hydrology, Geohydrology	700 000 SEK	E.g. Water Balance incl. Drilling
12	Waste Characterization	400 000 SEK	Tailings
13	Waste Management Plan	250 000 SEK	
14	Rehabilitation Plan	150 000 SEK	
15	SEVESO Report	150 000 SEK	Assumed
16	Status Report	150 000 SEK	Simplified
17	EIA-Main Document	350 000 SEK	
18	Technical Description	200 000 SEK	Assumed based on future PFS
19	Contingency	100 000 SEK	
	TOTAL	**4 600 000 SEK**	

3 Country and regional

The project is located in the province (County) of Dalarna in the Bergslagen region of south-central Sweden. It is found in an area dominated by arboreal forest with the local terrain consisting of gently undulating hills. The elevation of the surface of the tailings dam varies between 300 m and 315 m above sea level.

The area is serviced by the main railway line “Bergslagsbanan” and the Route 50 highway which runs past the and through the nearest town of Ludvika. The electrical power required for the milling operations will be sourced from the main power line (50 kV), operated by VB-Energi, water for the process plant can be sourced from the tailings dam itself or the old open pit.

Ludvika lies on the shore of Lake Väsman and has a population of approximately 15,000, the current largest employer is ABB, where they manufacture high-voltage power equipment such as transformers and other heavy electrical equipment.

The main Northern Swedish railway from Göteborg to Gävle, named Bergslagsbanan, runs right next to the process plant building, which has its own switch yard. The rail system passes through Ludvika and connects to ports at Lysekil (410 km) on the Swedish west coast, and Gävle (180 km) and Oxelösund (270 km).

The capital, Stockholm, is to the SE, accessed by exceptionally maintained roads 240 km from site via Route 50, Route 66 and E18. Stockholm Arlanda is the closest major internationally served airport. Dala Airport in Borlänge, 45 km north, and Västerås Airport, 110 km south are domestic airports that can be used to reach the site. Another means of access is via train from Stockholm via Västerås or Borlänge.

4 Market conditions for Grängesberg concentrates

4.1 Apatite and REE concentrates

Apatite is an igneous phosphate mineral mainly used for fertilizer application. It is mined specifically, in mines such as in the Kovdor and Apatit mines in Kola, Russia and Siillinjärvi, Finland, or processed as a by-product from Magnetite mines, such as Grängesberg.

Apatite is an attractive and premium paid feedstock for the most critical of all materials: food.

However, even if Apatite is a high grade and valuable product, it is competing in the market with low grade and low priced phosphorite minerals which for 100 years have suppressed the price.

The volume of the market is enormous, with annual shipments estimated at 200-250 million tons. As an ore, this is equivalent to bauxite, and only surpassed by iron ore in volume. Hence, for the total market, the Grängesberg volumes of 50.000 tons will be small, easy to place in the market and without any influence on neither price nor market patterns.

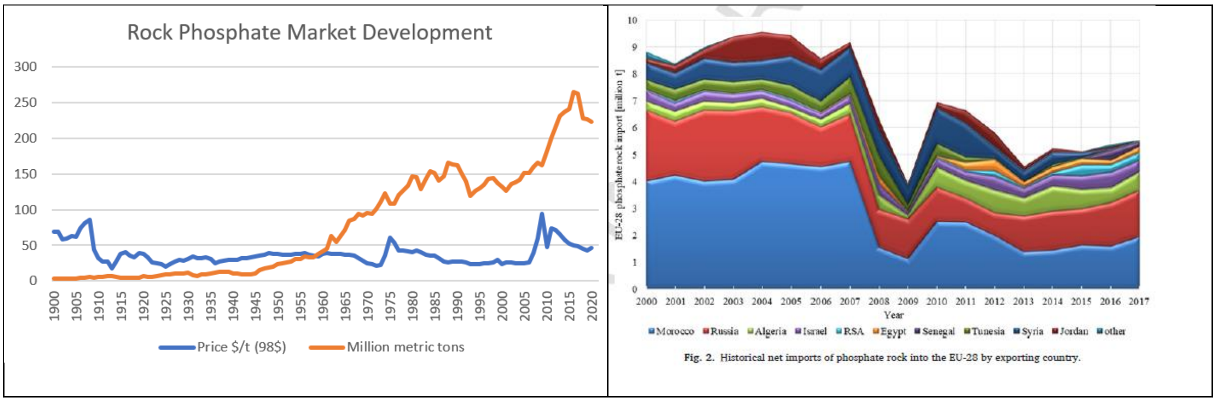

Figure 6. Left: Historical global prices and consumption of rock phosphates[1]. Right: import of rock phosphates to EU-28. Look beyond the financial crisis in 2008/2009 and see how environmental regulations have moved phosphoric acid production from EU to Morocco[2]

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The overall market is supplied mainly from three sources and processed via three routes. The dominating sources are phosphorites, which are marine sediments with the precipitated skeletons of primordial organisms as well as bird droppings. Secondly, igneous Apatites with

[1] USGS. https://pubs.usgs.gov/periodicals/mcs2021/mcs2021-phosphate.pdf.
[2] Resources Policy 2019. Uranium resources in EU phosphate rock imports.

different compositions are found and mined in a few countries, for example Russia, Finland and South Africa.

And lastly; there are several minor recycled, recovered and by-product sources, such as Grängesberg, but these secondary sources are small in comparison to phosphorites. The potential within this sector is widely underestimated in global statistics, both regarding reserves as well as availabilities in western democracies.

The main processing route for phosphate rock is the production of phosphoric acid, where the rock phosphate is dissolved in surplus of sulphuric acid, producing a liquid phosphoric acid and a precipitated calcium sulphate (gypsum) waste. Most of this acid is then neutralized with ammonia producing the main fertilizer product DiAmmoniumPhosphate (DAP).

An old and very simple technology called superphosphate is still in use in many regions of the world, where only a small amount of sulphuric acid is used. Sufficient to crack open the phosphate mineral, but not to convert into liquid acid and gypsum. This pasteous mix of crude phosphate and sulphate is then granulated and sold directly.

A third technology with roots in Norway dissolves the rock phosphate in nitric acid instead. This directly produce a NP product that can be advanced with potash to a high value NPK product. As by-product, the calcium is precipitated as calcium nitrate, a valuable fertilizer adding much needed calcium ions to the soil. This route produces no waste.

The two dominating bulk suppliers of rock phosphates are Morocco and China. USA has a declining production with little export and will be less important than Russia in the foreseeable future.

Even if phosphate is essential for the agriculture production and food security in every country, there are few tons coming from Western, liberal democracies (Figure 8).

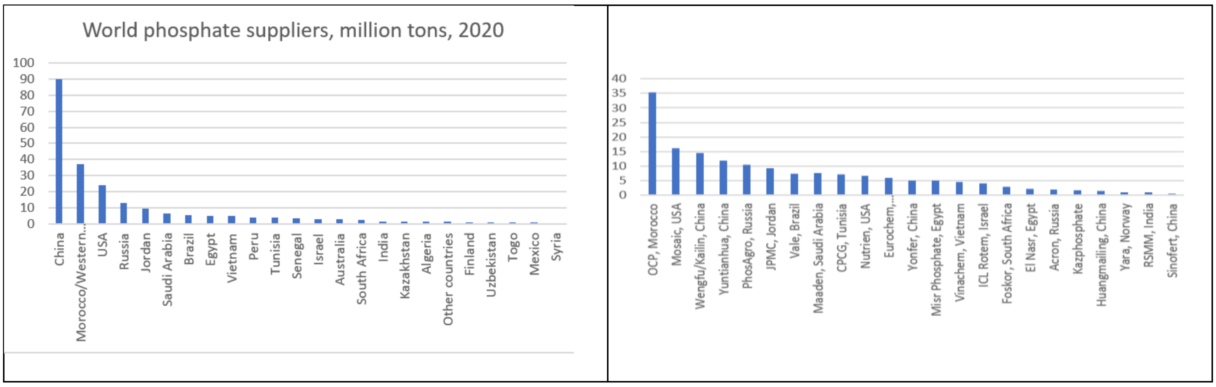

Figure 7. Left: The Country figures are gathered from USGS. The figures are not accurate, and underestimate both China and Russia significantly. Right: The Company figures are gathered from company websites and may also include inaccuracies based on inconsistent

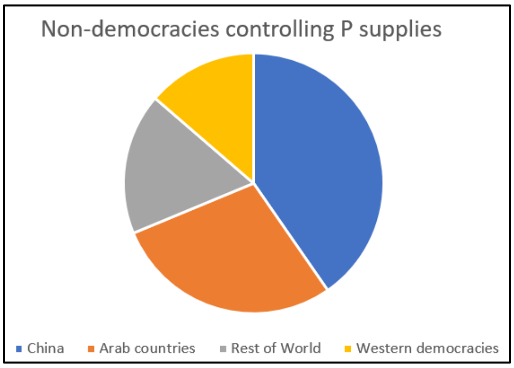

Figure 8. The limited production of phosphates in the western countries could become a political problem.

4.1.1 Phosphates have different compositions

Phosphates have a special ability to attract contaminants. That is why phosphates are popular in detergents, but it creates some issues for miners and processors. Almost all phosphate resources have issues with contaminants in larger or less degrees. Phosphorites are typically high in Uranium and Cadmium, which is useful in times with high uranium prices, but a costly environmental problem otherwise.

Apatites are typically high in thorium and rare earths, which could be a bonus if it is possible to get access to it.

The Phosphoric Acid-route have historically had the benefit of concentrating the toxic contaminants into the waste gypsum. If legal to landfill gypsum, which is still possible in most countries, it is possible for the producers to use low grade, low cost, high contaminant rock phosphates as feedstocks.

In civilized regions of the world, such as EU, contaminant levels in fertilizers are regulated, though not strict. Most focus has been on cadmium, due to grave concerns about the toxification of agricultural soil and observing health issues. The current EU cadmium regulation of 60 mg Cd pr kg P is not set based on risk assessment for soil, but for the level where most of the European producers are able to bind the cadmium in the precipitating gypsum. The EU scientific committee, as well as the EU commission has advocated a limit of 20 mg Cd pr kg P. This is a limit based on many and thorough risk assessments. The lower limit has been proposed, but not adapted due to harsh lobbying from agricultural lobbyists.

If the new and sensible regulation is implemented, high cadmium phosphates users would need to install cadmium extraction units in their plants. Or – fertilizer plants would need to find and source low-cadmium feedstocks. Both options would increase cost for farmers, which is not seen as acceptable, and hence the toxification of agricultural soil is progressing. If this policy changes – it will give huge price advantages to low cadmium phosphates.

Grängesberg has a non-cadmium bearing Apatite. This will be highly attractive if European environmental legislation will follow the recommendations from the EU Scientific Committee. Probability of EU being able to choose science over agricultural lobbyism is however regarded as low.

4.1.2 Pricing mechanisms

Pricing of rock phosphates is complicated, even for such a large commodity. Decisions made by a few stakeholders in China and Morocco as key suppliers and India as key importer, strongly influence the global pricing mechanisms and flow of material.

As Morocco is the dominant non- Chinese supplier and reserve country, most phosphates are sold with a reference to a FOB value of Moroccan phosphorite with a 32 % content of the key ingredient P_2O_5. For suppliers with higher content of P_2O_5, and less content of regulated toxic components, prices are higher. In addition, plant, or process specific issues such as iron, alumina and silica content, that can influence other downstream reactions can influence pricing. And finally, logistics is also important. Morocco is close to Europe, but if needed to import from China, Australia or even US – bulk charges may be a rather important part of the final cost for the fertilizer plant. Hence, finding the right customer for a specific phosphate raw material could add as much as 100 % to the official listed FOB Morocco price.

Even if historical prices of FOB Morocco phosphorite have been in the 50 $/ton range, several factors have increased this significantly lately. Recent decision by China to stop exporting phosphate (and nitrogen fertilizers) in 2022 (possibly also in 2023) have pushed the FOB Morocco prices to a new level 150 $/ton – and will possibly push it further to a new level closer to 200 $/t.

Grängesberg has a 38 % P_2O_5, low-toxic Apatite. Other contaminants are within acceptance levels of the customers so far contacted. The Apatite is within the European market and with comparatively easy logistics to competitors in Kola Peninsula and South Africa.

Grängesberg have identified three plants in Europe where the benefits of using its Apatites instead of phosphorites are significant. These are non-Russian plants that is mainly supplied with Russian feedstocks today. The combined consumption in these three plants is appr. 1,4 million tons of rock phosphate per year, so a supply of 50.000 tons would be non-intrusive in this market. There are several other plants that also could use Grängesberg Apatite, but these three plants are assumed to have the highest benefit and consequently the highest price acceptance level.

By including Grängesberg Apatite with low level of radioactive and toxic elements, these three plants will be more flexible in their feedstock mix.

GRANGEX have been in dialogue with all these plants since early in the project, keeping them well informed about the progress and developing dialogue. All plants are eager to get access to the material and are suggesting constructive and helpful contractual structures.

When combining all benefits of Grängesberg Apatite; the high P_2O_5-level, less logistical costs and less toxic content, we expect to achieve a premium on deliveries in the region of 30-60 $/ton.

Our expectation, unless any other market development occur, is that Grängesberg should be able to secure prices within a window of 180-250 $/ton. If the market crashes, as commodity markets might do from time to time, we expect to see short term bottom levels of 80 $/t. On the other hand, short term supply crunches, such as we see now might worsen, and bring short term peak levels above 500 $/t. As long-term partnership is preferable to spot deliveries in such a project, a floor and roof structured contract will be developed.

4.1.3 REE credits

The Grängesberg Apatite contain highly valuable Rare Earth Elements as contaminants. This is a possible added value that is currently under investigation.

Rare Earth elements are necessary for several types of clean energy and electric vehicles, as well as key components in computers, cell phones, and other electronics. Even if the tonnage needed is small, the importance of these elements cannot be underestimated. Due to dominance by China, all major countries such as USA, EU; Japan, Russia, Brazil, India, South Korea and more have programs to increase sustainability and security of supplies.

The Rare Earths (REE) content in Jan-Matts dam alone is sufficient to supply 1 million BEVs.

The Jan-Matts tailings contain REE in mainly two distinctly different minerals, Apatite and allanite.

When processing the tailings for Apatite, the REE in those mineral follows with to the product (Figure 9), resulting in appr 0,8 % REE in the Apatite concentrate. Grängesberg is now in dialogue with possible Apatite customers regarding extracting of these elements from their downstream processing. One of the possible customers, Yara, is known to participate in Rare Earth extraction through the EU-funded SECREETs program.

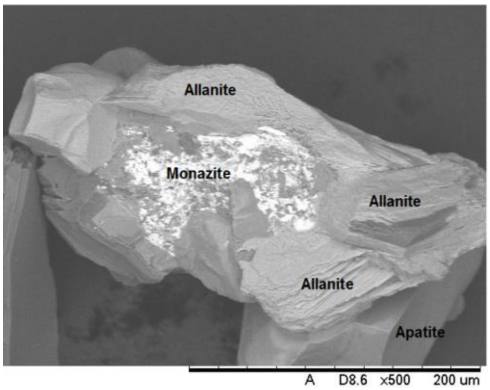

Figure 9. REE-bearing minerals, such as allanite, Apatite and monazite is only to some degree intergrown. It is expected that rather good separation and recovery is possible.

In addition, the Grängesberg mineralogy team is looking into ways of recovering the allanite and to extract the REE from the allanite. This processing is more difficult than Apatite flotation, but if successful could establish Grängesberg as the first West European primary REE supplier ever.

Grängesberg has signed a mutual NDA and is in dialogue with a Norwegian REE processor and will present progress plans to them when flowsheet is matured.

The possible revenue stream from REE concentrates will not be very high. Based on the volume of Jan-Matts deposit, the REE distribution and realistic recovery rates from allanite, an amount of ballpark 1500-2000 tons of contained REE concentrate might be produced over the entirety of the period. With present end market prices, such a concentrate would be priced at about 10 $/kg, giving an income of 15-20 M$ over a period of 7 years or ballpark 2-3 M$/year.

In addition, if the Apatite customers are able to extract the REE's from their process streams, additional credits could be expected, hopefully in similar range of 1-2 M$/year.

It should be noted that these markets are opaque and challenging to operate in, so Grängesberg will attempt to develop its processing technologies and lock up agreements such as to limit fluctuations and add into transparent Western value chains.

It should further be noted that due to the strong political interest into this sector, and the difficulty of establishing new mines in the Western Hemisphere, Grängesberg believe it to be probable that grants and other types of financial support for this part of the production will be achieved. Hence, even if the revenue stream from sale of REE concentrates will be limited, the plants will be considered strategically important for European industry and receive support and protection accordingly.

4.1.4 Additional market

The technology and mode of operating at the Jan-Matts dam is possible to copy and use also on other tailings dams in other countries. At least 1 billion ton of tailings, similar to Jan-Matts, is expected to be mapped. This possibility will not be covered in this document.

4.2 Iron ore concentrates

4.2.1 Iron ore and its market

The global steel industry is the single largest driver of the global iron ore market. The crude steel production is based on partly virgin iron units (iron ore products), partly recycled iron and steel units (scrap). There are primarily two different types of steel manufacturing, one being the BF/BOF (Blast Furnace-Basic Oxygen Furnace) route, using primarily iron ore products as raw material, the other being the EAF (Electric Arc Furnace) route, primarily based on scrap. The BF/BOF route is by far the dominant technology (about 70% of world steel production), particularly in Europe and Asia, whereas the EAF route is more common (30% of global production) in the MENA region (Middle East North Africa) and the Americas.

There are two major iron oxides being produced and traded in the world, with hematite (Fe_2O_3) being the most common, and Magnetite (Fe_3O_4) the second most common. Hematite is usually produced as a sinter feed product (70% of global iron ore production), with typical particle size of < 6 mm. Hematite mines also typically produce a small proportion of lump ore (5 to 10%) at a typical particle size of 6 to 16 mm. The large producers of hematite ore are located to Australia, Brazil, South Africa, and India, with Australia being the largest exporter of hematite ores. Magnetite has normally a lower Fe-grade in situ (concentration of Fe in the Run of Mine ("ROM")) and therefore needs to be further processed or concentrated. Large production of Magnetite ores occurs in Scandinavia, Russia and North America. Concentration of lower grade Magnetite is done by further grinding of the ROM, magnetic separation and sometimes also flotation and the end-product is then a "concentrate" with a particle size < 0.1 mm and an Fe-content of 65% or more. Predominantly Magnetite concentrates, but also hematite fines are used as pellet feed for making iron ore pellets. Most pellet plants are so called captive pellet plants, i.e., they are built and operated by the iron ore producer. There are however a few stand-alone merchant pellet plants relying on buying concentrates and fines products on the global market.

Pellets can come in two different types, one being blast furnace pellets (BF pellets), where the Fe-content normally is between 63 and 65%; and the second, as high-grade pellets called direct reduction pellets (DR pellets) with a required Fe-content of more than 66%.

Fines, lump, and BF pellets are predominantly used for BF/BOF technology while high grade DR pellets and high-grade lump ores are used with the EAF technology. Fine-sized concentrates are either used as premium feedstock for pellet plants or used in limited proportions in sinter plants. The reason for the limited proportion into sinter plants is its exceptionally fine particle size, which at higher proportions reduces productivity.

4.2.2 Supply and Demand Dynamics

The supply of iron ore products is dominated by the "big four" iron ore companies of the world. They are, in size order: (1) Vale (Brazil), (2) BHP Billiton, (3) Rio Tinto and (4) FMG (all the latter three from Australia), and account for about 75% of the global iron ore production. They are all primarily suppliers of fines for sintering except Vale, which is also the world's largest producer of both BF and DR pellets. The European and the Asian steel markets, including

China, are dominated by the BF/BOF technology, and primarily use sinter fines, BF pellets and lump ore for their iron and steel making, while the MENA region is dominated by EAF technology, which is reliant on high grade lump ore and high grade DR pellets, the latter primarily supplied from South America (Vale, Samarco and CMP), Sweden (LKAB) and a small number of merchant DR pellets producers of which Bahrain Steel is the largest. The merchant pellet plants base their production on purchasing high grade concentrate from some of the suppliers of DR pellets, e.g., Vale and CMP, but also from concentrate producers such as Kaunis Iron (Sweden) and IOC (Canada). The concentrate for DR pellets production needs to be high in Fe, preferably above 67%, and low in impurities, which is why the number of suppliers is limited.

4.2.3 The green shift

In the last few years, politicians and business leaders around the world have begun to realize the need for, and value of, reducing the carbon footprint from people's everyday life. Production processes are being developed where the use of fossil fuels is being reduced or entirely replaced. Recycling and reuse of products have gained more attention and the steel industry is no exception, quite the contrary.

The Steel industry is a major contributor to the CO_2 emissions in Europe, representing 25% of the total on an annual basis. The industry and its customers have, during the last few years, started focusing on reducing its carbon footprint throughout the entire value-chain, from the mining through to the manufacturing and use of its end products. Car manufacturers not only make cars that will run on fossil free fuel, but they also demand that the steel (and other products) they buy is also as carbon free as possible. This has resulted in a couple of very large projects in Sweden alone, i.e., Hybrit (a collaboration between LKAB, SSAB and Vattenfall) and H2 Green Steel, both projects with ambitions to become fossil free steel producers. Other steel companies in Europe e.g., Tata Steel in Ijmuiden, and around the world, are in different phases of making similar changes to their future steel production processes.

This change will result in a dramatic increase in demand for high grade raw materials. The major iron ore producers in Australia all supply relatively low-grade products of around 62% Fe, while the new production processes will require Fe-grades of more than 65%. This puts producers of high-grade ore in a very strong position when negotiating prices with their customers.

4.2.4 Iron ore price

Traditionally the pricing of iron ore was determined by annual negotiations between one of the "big three" (FMG has only become part of the "big four" group in recent years) and a dominant steel company in Asia and another dominant steel company in Europe. As the Chinese economy grew very rapidly during the first decade of this century, to a large degree based on its very rapid growth of its steel industry, the market and pricing dynamics started to change. China became, and has continued to grow into, the determining marketplace for iron ore pricing. The annual benchmark pricing system has been abandoned and replaced by spot pricing and index-based pricing. A number of different iron and steel analysis companies are, since about the last 10 years, publishing indices for standard iron ore products, based on disclosed sales on the spot market and futures market. These indices are then used by most iron ore suppliers in their negotiations with customers. Platts publish daily indices for several different standard products, e.g., sinter fines with 58%, 62% and 65% Fe, but also for BF pellets. They also publish price adjustments for any deviation from the typical specification for respective product type, e.g., Fe-adjustment per percentage point over or below 65%, penalties for excessive SiO_2, Al_2O_3 or

P. A typical price formula in a supply agreement for a 65% Fe concentrate sold to a European buyer would have the following components:

Index price for 65% Fe +/- Fe adjustment to actual Fe +/- adjustment for SiO_2, Al_2O_3 or any other deviating element – freight rate Brazil to China +/- freight cost difference between freight cost Brazil to Europe and actual load port to Europe +/- any other premium or discount. The result of the calculation would then represent the FOB (Free on Board) price the supplier could achieve.

During the last couple of years, the steel industry has somewhat slowed down in China and the overall demand has dropped to a large degree dependent on the pandemic. The prices for 62% and 65% Fe products have fallen from a level of USD 200 and USD 230y to a level of USD 100 and USD 115.respectively. The difference between 62% and 65% Fe products is currently at a level of about USD 5 per Fe-unit above 62% Fe.

4.2.5 The Grängesberg high-grade Magnetite concentrate

The Grängesberg High-Grade Magnetite has extremely valuable characteristics with very high Fe (>70% vs theoretical maximum of 72.3%) and low contents of harmful impurities. It is a fair assumption that the Grängesberg product will be extremely appreciated and work very well as feedstock to pellet plants, both BF and DR pellet plants. Given the small annual quantities it is likely to be sold only to one customer either in Western Europe or in North Africa.

It may also be possible to sell the High-Grade Magnetite to other users than the typical steel producer as its extremely high Fe, its fine particle size and its density makes it attractive to other industrial applications.

At current price level, if the product was to be sold to the traditional steel producers, the Grängesberg High Grade Magnetite would be priced CFR China at a level of USD 120 per tonne, given, current pricing dynamics and assuming no penalties and no extra premiums above current levels. However, with a fast growth of demand for high-grade ores like and very limited additional supply, the premiums are likely to increase for such high-grade ores.

The price for a High-Grade Fine-Particle Size Magnetite for other applications, e.g., for water treatment chemicals, is at a level of USD 200 per ton.

5 Geology

The mineralization consists of flotation tailings, resulting from the production of iron ore concentrate at the nearby Grängesberg mine. The minerals found in the tailings are typically silicates (potassium feldspar, quartz and amphiboles), micas (biotite), iron oxides (Magnetite and hematite), Apatite and monazite. The tailings dam is located just outside the industrial area of the former mine, see Figure 2.

The deposition of material took place between the years 1950 and 1970 according to production data.

6 Mineral resource estimation

The project is not considered to be a mineral resource project and does thus not require a formal Mineral Resource Estimation. However, the company has decided to base its assessment on tonnages and grades on the Australasian reporting code JORC-2012 edition. The resources have been estimated by M.Sc. Thomas Lindholm GeoVista AB, Sweden, who is a Fellow of AusIMM and a competent person to report on mineral resources based on his education, relevant experience and affiliation with a professional association. A detailed report on the resource estimation was published by GeoVista AB, 2021.

6.1 Drilling, sampling, analyses and quality assurance

The tailings dam has been investigated in three campaigns. The first by 13 drillholes made with a rotating hand-held shovel resulting in 44 samples, with sample depths between 1 and 4,75 m (Berg, 2011). The second by 24 holes using a track mounted drill rig, equipped with a flow through sampler, resulting in a total of 125 samples, with sample depths between 1 and 15 m (Wikström, 2021). The latter campaign drillholes always ended in the former lake bottom, to be able to determine the actual depth of deposition in each hole. The final campaign was again done with a track mounted rig and aimed at determining the in-situ density of the deposited material. A sample map is shown in Figure 11.

The first campaign samples were split and milled at the University of Gothenburg and later sent to ALS Global for assaying. The second campaign samples were sent whole to the Geological Survey of Finland’s mineral processing plant in Outokumpu, GTK Mintec, for sample preparation, assaying and metallurgical testwork. The third campaign samples were transported to the Swedish School of Mining and Metallurgy in Filipstad for determination of density and moisture content (Hellingwerf, 2021).

Assay batches have been done using the customary insertion of blank and certified reference samples by the laboratory. The results show a good level of hygiene during the sample preparation and that the behaviour of the control samples leads to the author’s opinion that the assays are of sufficient quality for the estimation of Mineral Resources.

All drill hole collars have been surveyed and recorded, using RTK-GPS, with an estimated accuracy of +/- 5-10 mm in easting and northing and +/- 10-15 mm in elevation. Of the surveyed hole positions, 9 lacks elevation coordinate due to dense forestry. The elevation coordinates for them have been generated by draping the X/Y position over the elevation model.

All surveys were done using the Swedish National grid, SWEREF99TM, which is basically the same as UTM zone 33.

6.2 Bulk density

The bulk density has been determined in a third campaign by drilling down and filling a plastic tube with material. The contents (samples) have been weighed as sampled (wet) and after drying (Hellingwerf, 2021). A clear tendency of increased density with depth can be observed. This is also expected since material located at depth should be more compressed and consolidated.

A total of 4 density stations were investigated, with samples every 1,2 m down to a maximum depth of 10,8 m. A total of 30 density samples were taken. The densities vary between 1,84 and 2,50 tonnes/m^3 as can be seen in Figure 10.

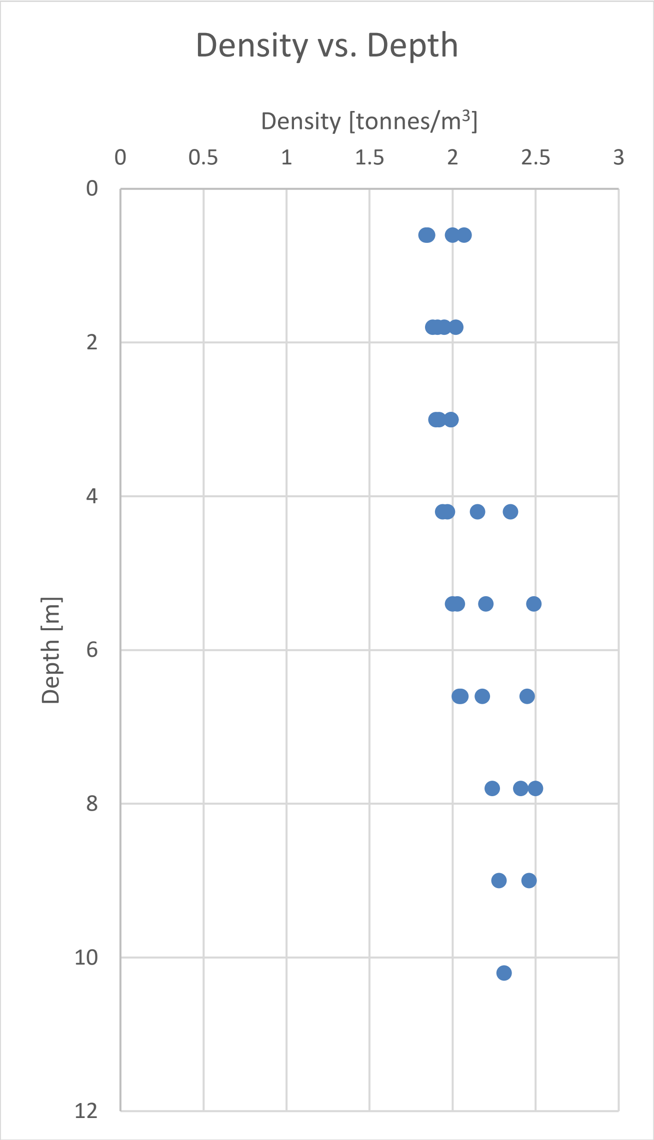

Figure 10. Results of density determinations as a function of sample depth.

The resulting function between depth and bulk density was determined to be:

Density = 1,84 + 0,07 * Depth [tonnes/m^3]

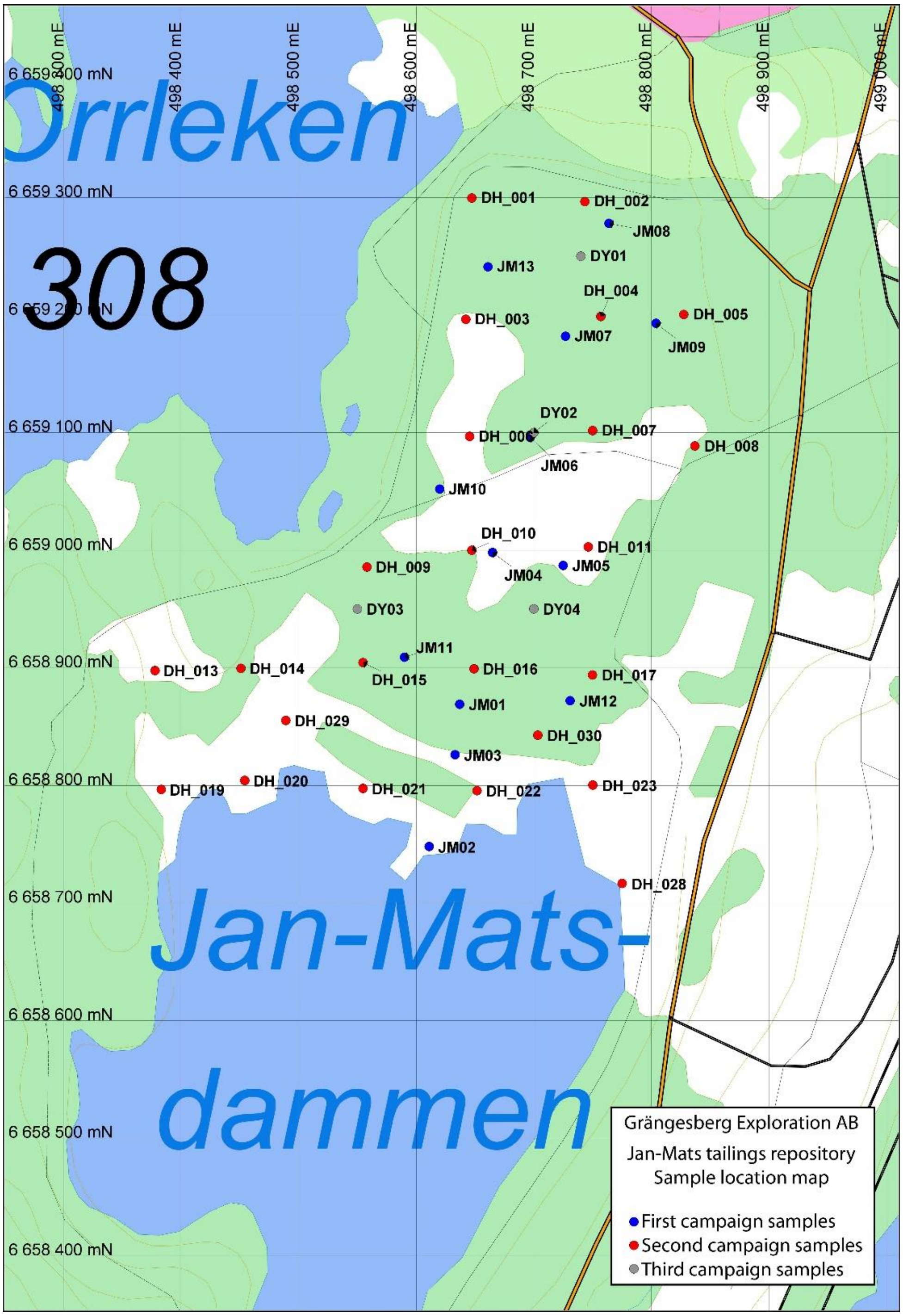

Figure 11. Sample location map.

6.3 Solids contents

The content of solids has been determined by weighing all samples from the second campaign wet (as sampled) and dry (after drying in oven). The result is that solid contents vary between 60,5 % and 99,3 %, with an average of 84,7 %.

The contents of dry solids have thus been assumed to be 84,7 % in the estimation of dry tonnage.

6.4 Modelling

The volumes of mineralized material have been determined by a combination of a high-resolution terrain model (LIDAR) and the results from the drilling. All holes from the second campaign penetrated into the sub-stratum and the volumetric model can thus be considered to give a fair representation of the deposit. The modelling principle is illustrated in a cross-section in Figure 12.

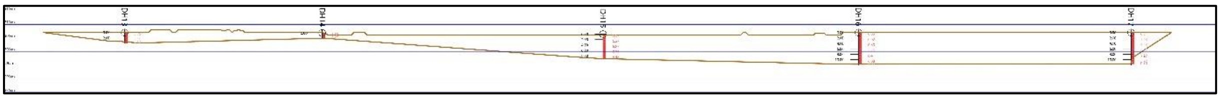

Figure 12. Cross-section showing drillholes and modelled bottom.

No drilling was carried out from the surface of the water. In the southern part of the deposit, the tailings are expected to have formed a sloping "toe". The shape of this "toe" has been done with a 45° slope, which is probably too conservative due to the nature of its' deposition. Future investigation will show the true shape.

The finished model encloses a volume of 1,48 million m3, an isometric rendering is shown in Figure 13.

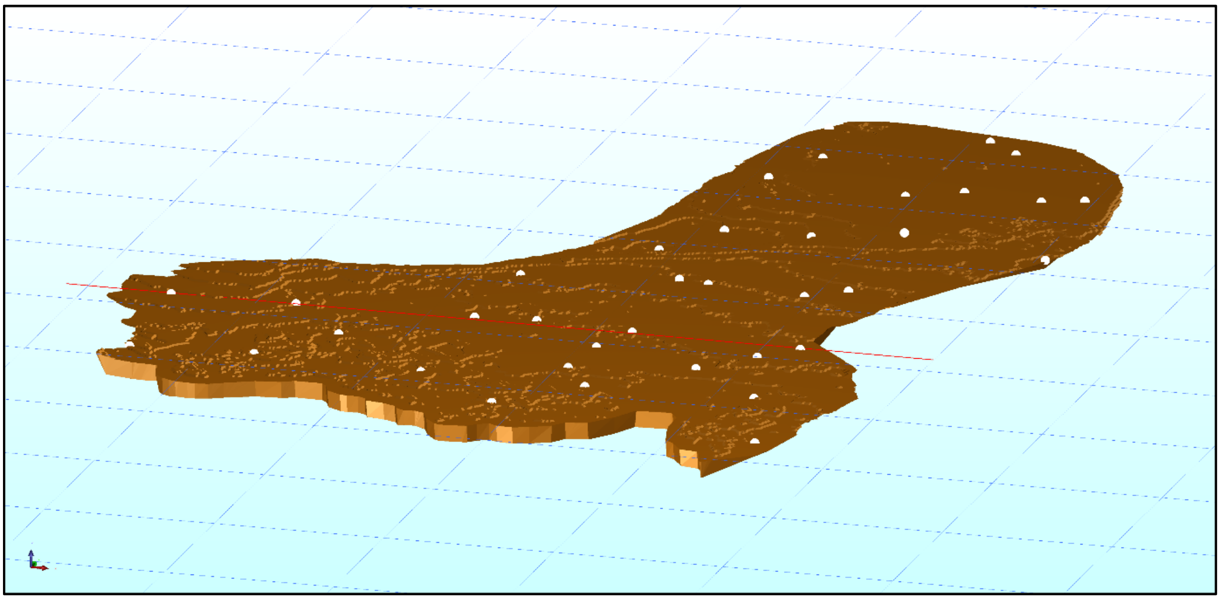

Figure 13. Isometric rendering of the Jan-Matts tailings repository, drill hole collars in white, red line marks position of section in Figure 12.

6.5 Cut-off grade

No economic cut-off grade has been defined. Most likely, the material deposited in the repository can't be extracted selectively, a cut-off is thus not meaningful unless lower grade material is found at the very bottom, which does not appear to be the case.

6.6 Composites

Compositing is the first process in the estimation of grades. The composites were calculated to 1 m nominal length, using Surpac's "best fit" function. This resulted in composites that vary in length between 0,75 m and 1,08 m, with an average length of 0,94 m.

Top-cutting of composited values was not considered appropriate, given the smooth distribution of data.

6.7 Block modelling

A basic statistical study of the composited assays indicates a distribution close to normal, fit for grade interpolation by kriging. A stacked histogram in Figure 14 illustrates this.

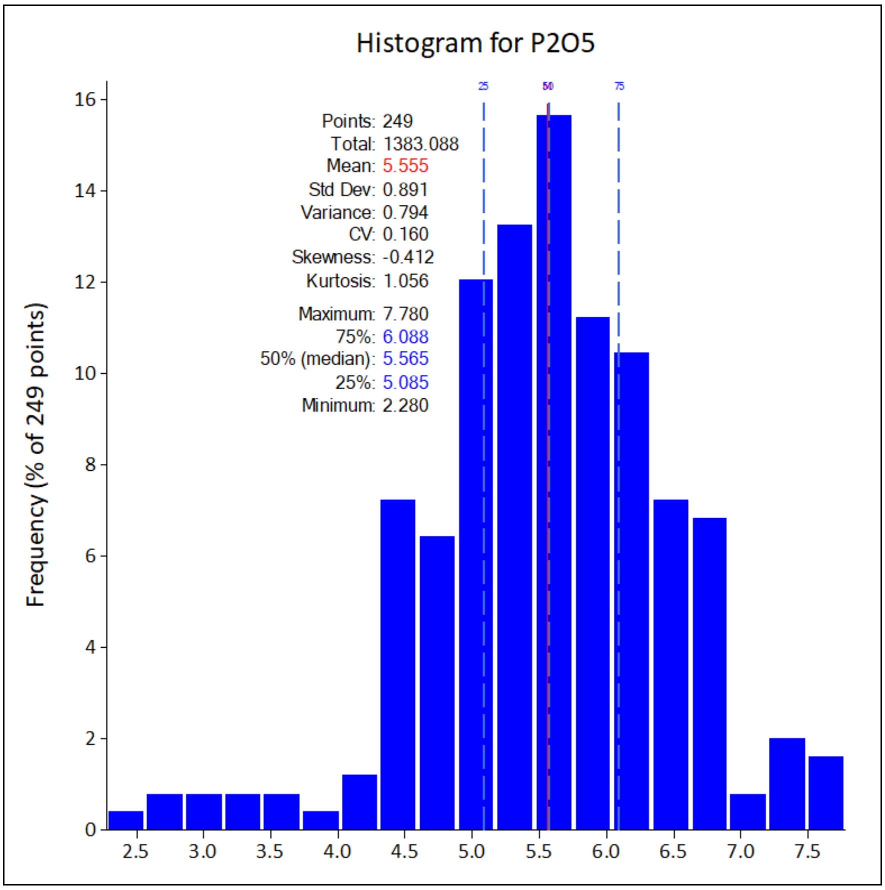

Figure 14. Histogram of Composites for P_2O_5.

The deposit has thus been modelled as one single domain.

Variography studies of the composites show good grade continuity along as well as across the deposit, with ranges of well over 100 m, as indicated in Figure 15.

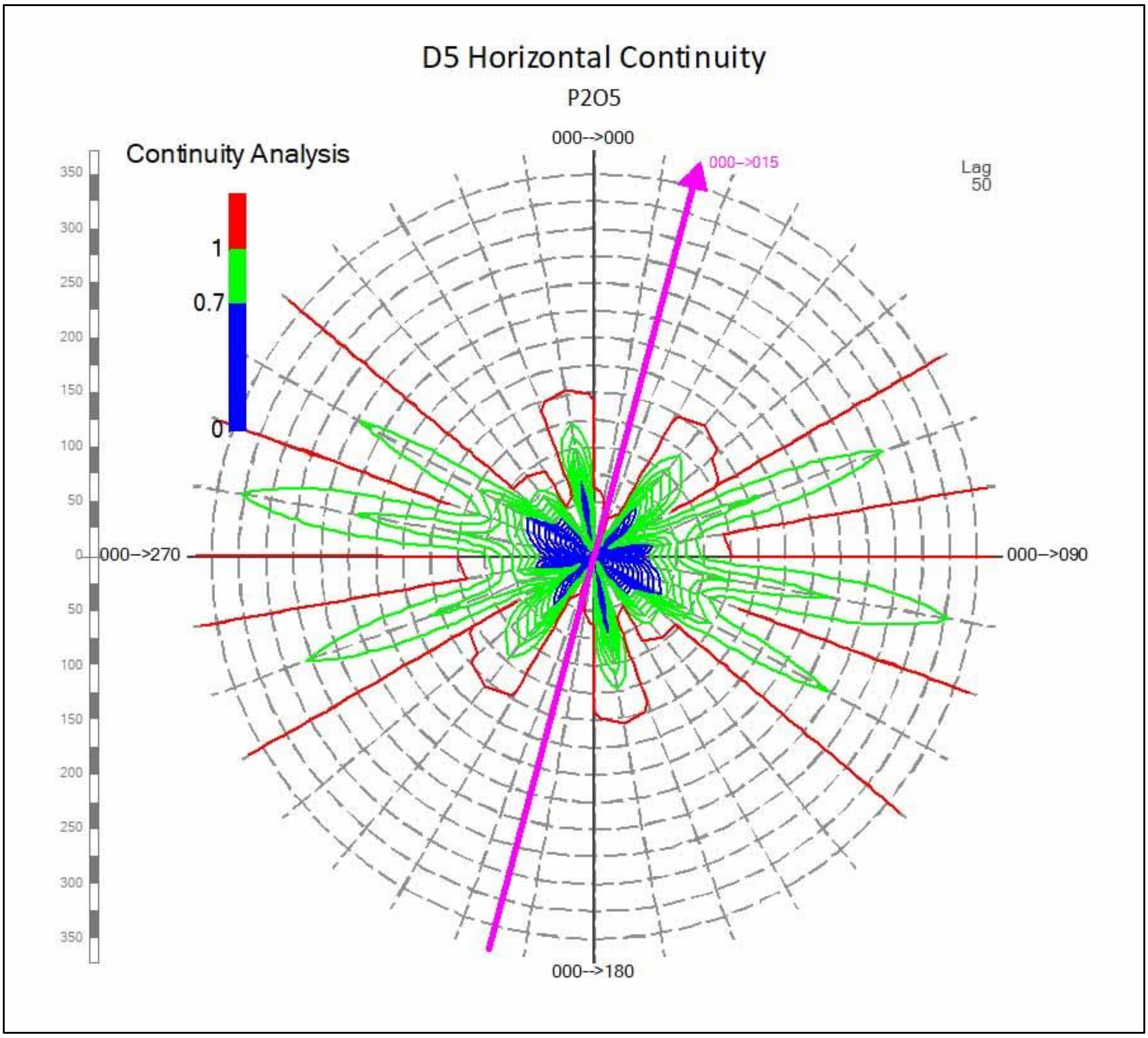

Figure 15. Horizontal continuity for P_2O_5*.*

Downhole variography as shown in Figure 16 indicates that there is virtually no nugget effect.

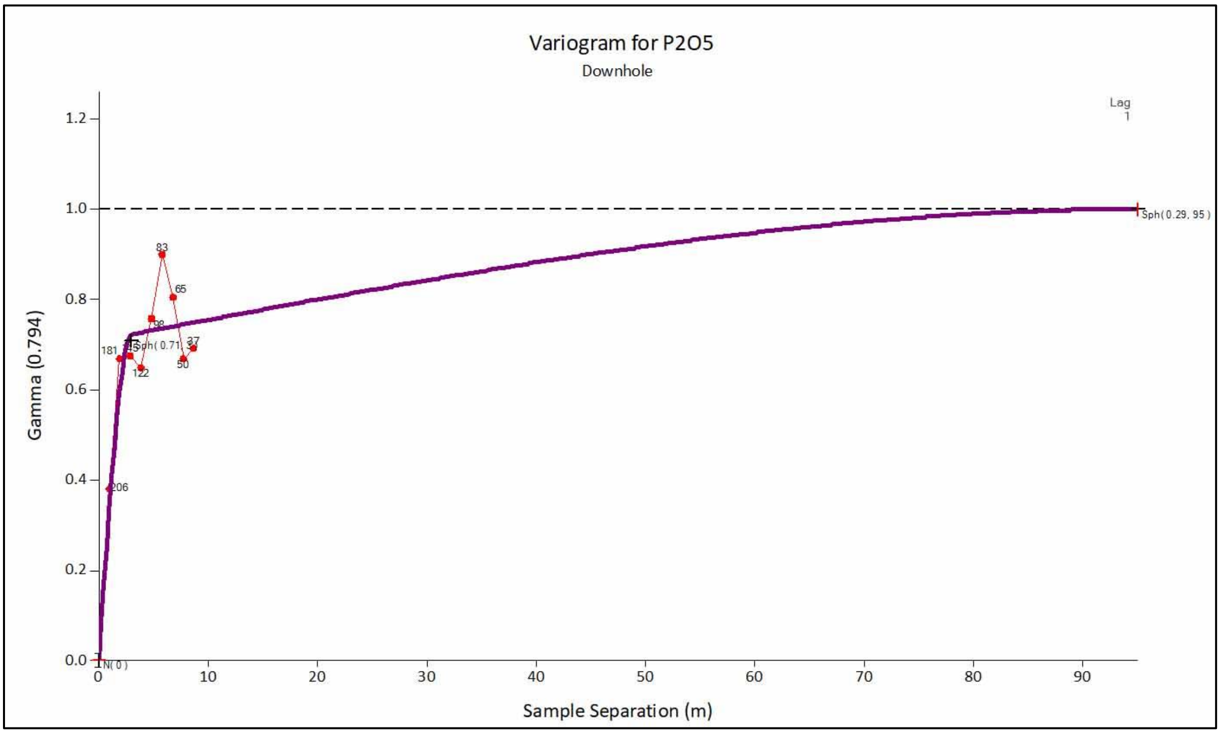

Figure 16. Downhole variogram for P_2O_5.

Grade estimation for the deposit has been populated into a block model. The block sizes are, X=25 m, Y= 25 m and Z=2 m, using a sub-blocking factor of ¼ of the side lengths, to better fit the geometry of the heaps.

The elemental grades of P_2O_5 and Fe were interpolated using Ordinary kriging whilst the density was calculated based on the depth, as discussed in section 6.2. The search ellipse was oriented with the major axis along the main strike of the deposit, as indicated by the variography and flat lying.

The search parameters for interpolation by way of Ordinary Kriging are presented in Table 3.

Table 3. Search parameters for Ordinary Kriging.

	Search radii		No. of samples		Min. no. of holes
Pass	Major/Semimajor	Minor	Minimum	Maximum	
1	75	5	4	10	2
2	150	8	4	10	2

Block models were developed for P_2O_5, Fe, and density.

The basic statistics for composited values for P_2O_5 compare well with those of the blocks, see Table 4.

Table 4. Basic statistics for composited values for P_2O_5 compared to those of the blocks.

	Comps	Blocks
Minimum value	2.28	3.18
Mean	5.55	5.43
Median	5.58	5.43
Maximum value	7.78	7.10
Variance	0.79	0.31
Standard Deviation	0.89	0.56

A plot comparing the frequency distribution of values for P_2O_5 composites to blocks is shown in shown in Figure 17. The comparison shows a slight bias, with overestimation of low-grade material and some underestimation of higher grade. This bias implies an overall underestimation of grade, but is it not considered significant.

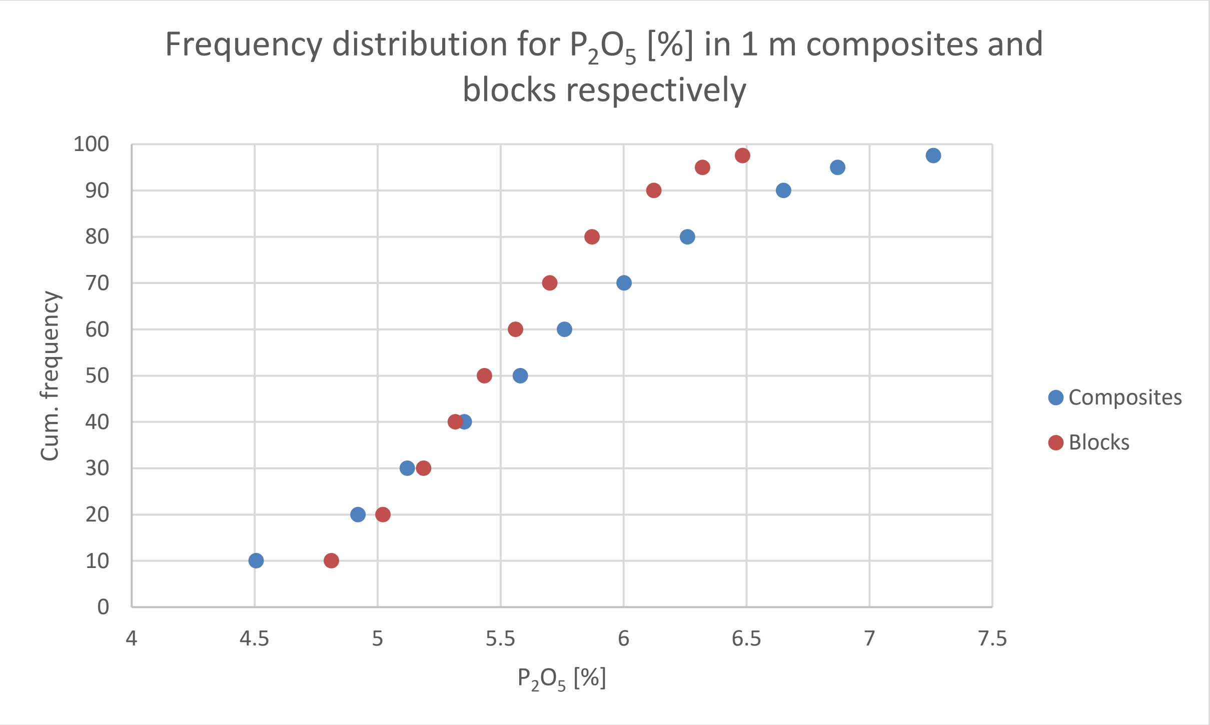

Figure 17. Frequency distribution for P_2O_5 in 1m composites and blocks respectively.

The block models have also been visually checked for accuracy by comparing the block values with those of nearby assayed samples from the drilling. The results show good correlation.

6.8 Classification

The basis for the classification of the Mineral Resources is the degree of confidence the Competent Person has for the estimation of tonnage and grades.

Mineralization may be classified as an Indicated Mineral Resource when the nature, quality, amount and distribution of data are such as to allow confident interpretation of the geological framework and to assume continuity of mineralization.

Mineralization may be classified as a Measured Mineral Resource when the nature, quality, amount and distribution of data are such as to leave no reasonable doubt, in the opinion of the

Competent Person determining the Mineral Resource, that the tonnage and grade of the mineralization can be estimated to within close limits, and that any variation from the estimate would be unlikely to significantly affect potential economic viability.

The determination of the volume and grade variations in the tailings dam is considered to be of good quality and is not likely to change significantly, should more sampling through drilling be carried out.

The determination of density shows greater variation, as does the contents of moisture, and the tonnage factor to convert block volumes to tonnage is therefore more uncertain.

Based on the above, the material in the dam is classified as Indicated Mineral Resources.

6.9 Resource statement

The dry density for the material has been calculated by removing the influence of the moisture for every block in the block model when reporting.

Dry density = Humid density * (1 – (wet weight – dry weight)/wet weight).

All tonnes reported for the Mineral Resource estimate are thus dry tonnes. The overall tonnage and grade are presented in Table 5.

Table 5. Mineral resources in the Jan-Matts tailings dam, current on November 1, 2021.

Grade range P_2O_5 [%]	Dry Tonnes	Fe [%]	P_2O_5 [%]
2.0 -> 3.0	1 775	5.52	2.94
3.0 -> 4.0	45 405	6.53	3.63
4.0 -> 5.0	483 437	8.34	4.72
5.0 -> 6.0	1 820 755	10.74	5.47
6.0 -> 7.0	436 894	9.83	6.28
7.0 -> 8.0	3 881	10.76	7.11
Grand Total	**2 792 148**	**10.11**	**5.44**

In total the Jan-Matts tailings dam contain 2,79 million tonnes with 5,44 % P_2O_5 and 10,1 % Fe, as shown in Table 5.

Assumptions:

- Thomas Lindholm, of GeoVista AB, Sweden, is a competent person for the Mineral Resource Estimate. The effective date of the estimate is November 1, 2021.
- There are reasonable prospects for eventual economic extraction under assumptions of a product price for 37 % P_2O_5 concentrate of US$ 180/tonne; employment of truck and shovel material re-handling, and conventional metallurgical processing in a purpose - built facility.
- All in processing, re-handling and general and administration costs are an estimated US$ 79/tonne of product.
- No mining cut-off has been applied as all material will be processed.
- No allowance has been made for dilution or losses.
- The Resource Classification of Indicated is based on better than 100m drilling centres and the low variation in grades within the sampled material.

7 Mine design and planning

7.1 Preparing for recovery of the tailing sand

The tailing in the tailings facility, Jan-Matts dam, is covered by trees and a thin layer of undergrowth. The depth of the tailings in the facility varies from about 4 m to 12 – 14 m. Part of the tailings is covered by water. The groundwater level in the facility appears to be at the same level as the water surface of the part of the dam containing open water. The buoyancy of the tailings, because of structure and fine ground material, is very low or rather not existing when getting close to the groundwater. The tailings above the groundwater seems to have a good buoyancy.

To prepare for the recovery of the tailing sand, the trees, which covers almost the whole area, will have to be harvested and taken and away. The roots and vegetation will also have to be cleared before recovery operation can start. It is expected that about 30 cm of the surface, mainly consisting of different plants will have to cleared.

7.2 Recovery of the tailing sand – "mining"

Recovery of material from the tailings dam will be done by excavators equipped with long stick or short stick to enable an efficient recovery. The plan is to start from the north of the facility with short stick excavators. The material will be taken by trucks from the tailing facility to the process plant, a distance of about 1 100 m. To initially feed the process plant with process water, the water in the Jan-Matts facility will be pumped to and used in the process plant. By pumping, and thereby substantially reducing the amount of water in the Jan-Matts dam it is expected that the tailing facility will dewater and thereby also making the recovery of the tailing sand less complicated. The amount of open water in the dam is estimated to cover the process plants' needs up to 9 months, however, the water from the dam, the groundwater, will probably be enough for further months of production. This needs to be calculated at next stage of study.

The plan is to start mining the tailing sand from the north of the facility and gradually move south. The plan is to use the excavator with short stick as much as possible as the cost is substantially lower than with the long stick excavator. The challenge while excavating the tailing sand is the stability of the material. The two test pits gave as result that it is probable that it will be possible to work with equipment until 1 – 2 meters above the ground water level. Below that, the sand is expected to be substantially less stable and lack buoyancy. The excavation will therefore have to be done either from the top of the tailing sand until the work gets close to the ground water and stability is reduced, making it necessary to extract with the long stick excavator. The intention is also to use the short stick excavator standing on the firm ground after the tailings have been recovered from an area and digging into the facility. The tailing sand with high moisture content will initially have to be moved a short distance to dewater before being trucked to the process plant.

The mining is planned to operate one shift five days a week. The sand will be trucked to the area of the process building where it will be loaded into the process plant 24/7.

Two test pits have been excavated in November 2021, during the study, see Figure 18 and Figure 19, this to secure material to meet customers' requirements of bulk samples of the Apatite. The sand has been transported to a test facility in Freiberg for pilot tests and to prepare bulk samples of around 500 kg to each customer. The excavation did also make it possible to better understand the sand and its properties, wet and dry. A piece of knowledge that will be important for the excavation of the sand during production.

The two test pits in did show a very homogenous material with high buoyancy when not wet, or above the ground water level. The test pits did also show that the ground water did flow very easily, which points at that there is a good possibility to reduce the ground water level by pumping from the part of the dam with open water and/or from pump sumps.

Figure 18. Excavation of test pit, November 2021, picture 1.

Figure 19. Excavation of test pit, November 2021, picture 2.

8 Hydrology and hydrogeology

8.1 Topography and water pathways

The Jan-Matts-TMF and Lake Orrleken is situated high in the area, at level +308 m as compared to the larger system of lakes downstream where Lake Södra Hörken is situated at +258 m. The height difference is 50 m which mean that water is flowing in the general direction of Lake Södra Hörken, see Figure 20 and Figure 21.

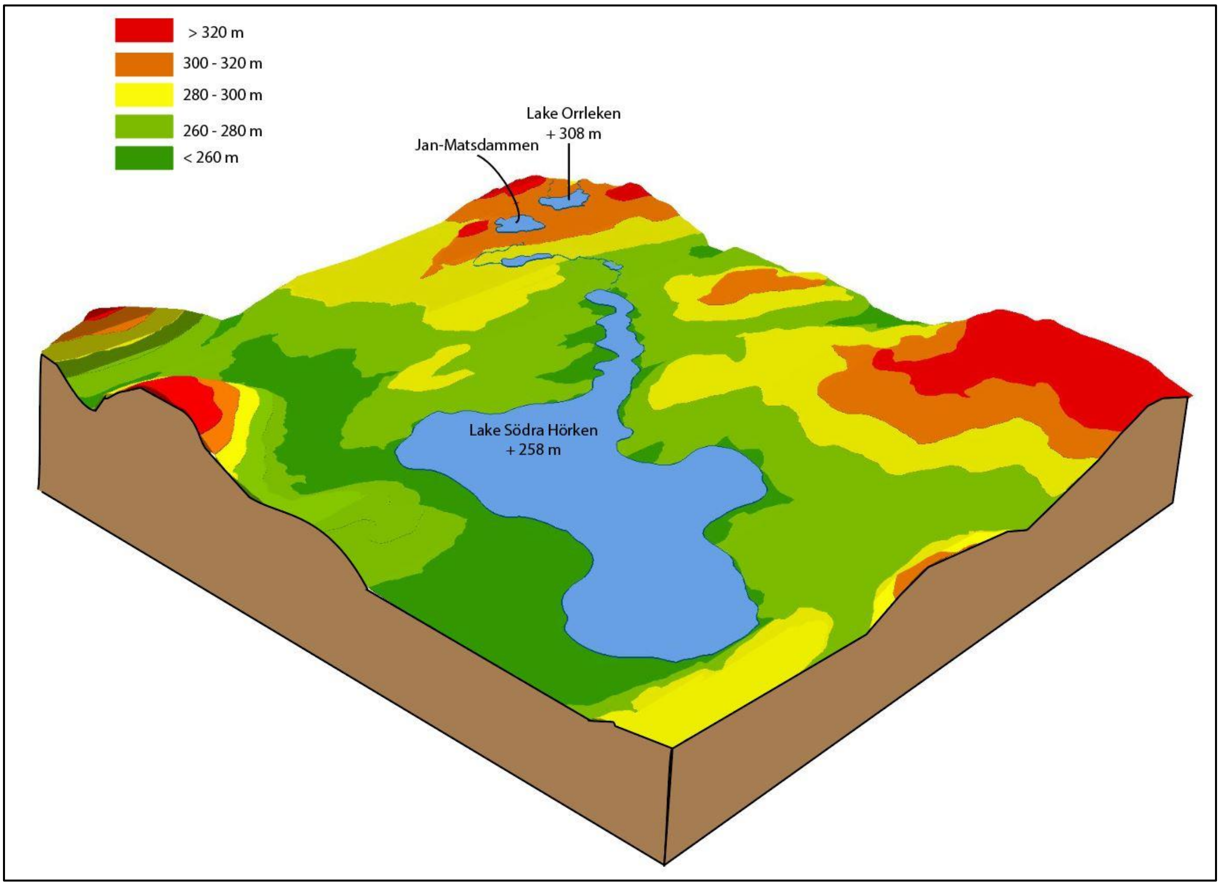

Figure 20. Topography of the surroundings.

In more detail the difference in height between the Jan-Matts TMF is c 50 m compared to Lake Hörken. The Jan-Matts TMF is most likely in itself is a water divide for surficial groundwater where water flows both in the direction of Lake Orrleken as well as Lake Södra Hörken.

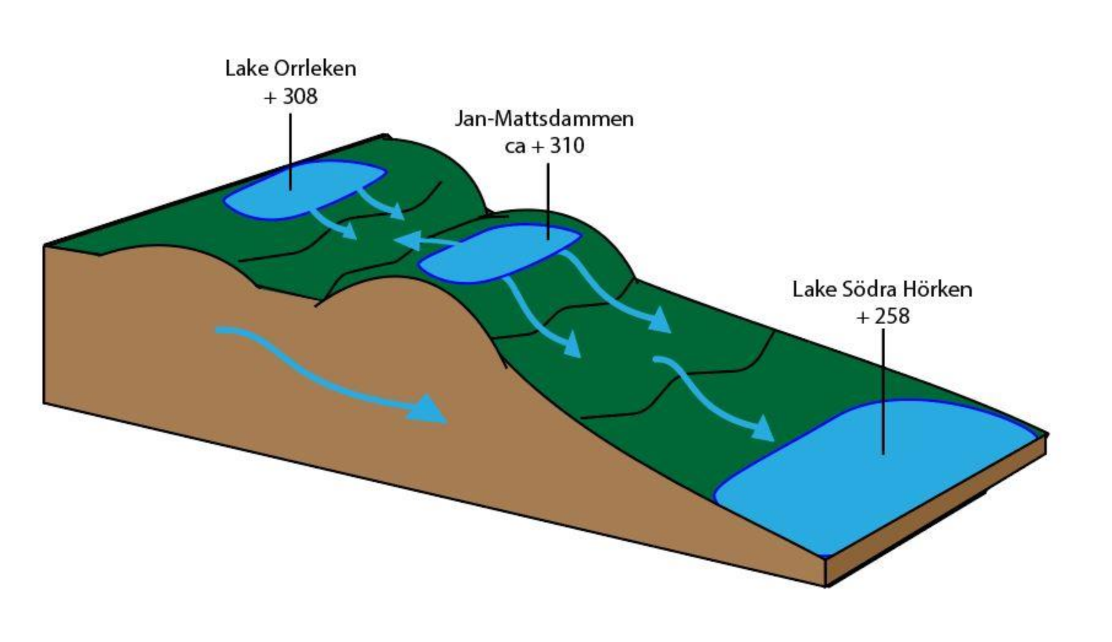

Figure 21. Overview of the water pathways.

Former Open Pit – Water volume

The former open pit at Grängesberg is being investigated and preliminary data shows that the average depth of the pit is c. 33 m. The pit is at its deepest 109 m and contains c. 9,3 Mm3 of water. A thermocline seems to be present at depths between 6-12 m. Further studies are needed in order to completely understand the geochemistry of the pit including the exact location of the thermocline.

Water Balance and waste management

Process water will be taken initially (during the initial stages) from the Jan-Matts TMF. At first from the surface body located in the TMF, and in time also from extraction wells which are needed in order to drain the TMF during the excavation. Any extra water needed will be taken from the surface water of the open pit. The plan is to, if possible, have a re-circulating process water system where no clean or make-up water would be needed from any lakes.

Tailings produced from the process will be disposed of in the open pit. Tailings will be transported via pipes to the pit bottom and deposition will occur under the thermocline. It is expected that this will reduce the amount of resuspension in the open pit thereby minimizing the environmental impact of the discharged water as well as let the open pit remain as a future water supply.

It is expected that the processing plant could be supplied with water from these sources. However future work is needed in order to set-up a water balance and understand the hydrogeology of the system.

Currently the total need for process water is c 267 m3/h. This can be fed by recirculated water from the tailings thickener before the tailings are being disposed of at the bottom of the water filled open pit. This amount has been estimated to 116 m3/h which leaves 151 m3/h of needed added external water.

Total need of annual added external water is c. 1,05 Mm3 based on the processing plant running c. 7000 h/y.

The Jan-Matts TMF has an area of c. 32,5 ha. The catchment area where the TMF lies has a specific recharge of 385,8 mm/y (http://vattenwebb.smhi.se/avrinningskartor) or c. 386 litres/m2, y which corresponds to c. 125 300 m3/y of water being collected and discharged from the TMF annually. This amount of water will have to be pumped out on an annual basis but cannot feed the processing plant alone. However, it is evident that the amount of water in the former open pit together with the annual recharge of water over the TMF would be enough to supply the plant.

The water covered area of the former open pit is around 27,2 ha which means that approximately 105 000 m3 of water (using the same specific recharge) is being filled up in the pit annually. Currently the future discharge and flow of water is unknown since the exact details of the overflow and volume of the pit above the water table is unknown, but assuming that all recharge water from the TMF and the open pit is surplus water, the flow from the overflow/outlet from the open pit including the tailings disposed of at the bottom of the pit could be in the order of 230 000 m3/year.

9 Processing

9.1 Introduction

Iron ores in the Grängesberg region were known for several 100 years to have a high phosphor content. During the operating time when a portion of the concentrate production was directed to grinding to fine particle size, but no Apatite recovery was implemented, the fine tailings were deposited in the dam called Jan-Matts. Samples from this relatively small dam showed that there was potentially recoverable Apatite.

9.2 Executive summary

The main objective for this scoping study was an investigation to develop a viable process to obtain an as high-grade Apatite concentrate as possible. Possibility to recover a Magnetite concentrate was added. Since there would potentially be some REEs in the rest product after Apatite and Magnetite recovery, indications on how to achieve further recovery of mineral(s) containing such elements were requested.

The metallurgical balance presented in the GTK report based on several tests shows that the Apatite concentrate P_2O_5 grade is projected to 37.3% at 76.7% recovery. Potential for a higher grade and substantially greater recovery was noted. Approximately 1/3 of the REEs reported to the Apatite concentrate with Yttrium nearly 60%.

A Magnetite concentrate with over 70% Fe was obtained through indicative testing.

Further REE + Y values reported in initial rougher flotation allanite concentrate (The Ce and La recoveries were the highest, about 60%. Nd recovery was 47%, and Y recovery 35.4%).

In summary, the Apatite concentrate can be obtained at a very high grade, and so can the remaining Magnetite. A potential penalty for the Apatite product high As level may be offset by the low Cd, Th + U values in an economic evaluation.

Potential for more REE + Y recovery exists, although the grades in the rest product after the preceding processing are low. Further process development would be required to assess the economic potential for such additional elements.

9.3 Sampling

A total of 24 drill holes were done and these were sampled, see details in the report by Tyren's AB (L. Wikström, 2021). The samples were shipped to GTK Mintec. A selection of 43 samples from priority holes were advised by Grängesberg Exploration AB. These were dried, screened for particle size distribution determinations, analysed by XRF and later by also by ICP and Colorimetric methods, then combined into a composite sample for metallurgical testing. A subsample was taken for a mineralogical study by Mineral Liberation Analyzer ("MLA") see the final test report (D.A. Salvador, 2021).

Sample summary data are seen below in Table 6 and found in the GTK Mintec test report (D.A. Salvador, 2021). The moisture content, particle size in the form of d_{80} (80% passing size), elemental assays by XRF, ICP and Colorimetric methods for all elements of interest are recorded. The REEs are shown as Total Rare Earths ("TRE"). The average moisture content is 15.3 %. The variations are very large, see Table 6.

As can been seen, the arsenic value is at a level of concern, while the Cd, Th and U data are very low.

With regards to iron ore mineral content, the various assay methods gave conflicting results. However, with Satmagan, which is based on magnetic susceptibility response, the Magnetite content is 7.5-8%, i.e., more Magnetite than hematite.

It should be noted that data reported as FeO in the GTK report are not true indication of Fe^{2+}; it is only a common way of reporting elements by the XRF method

9.4 Mineralogy study report

The composite grade analysed by ICP was 5.9% P_2O_5, 8.6% Fe, and 0.81% total REE. Mineralogical analysis showed 14.2 wt.% Apatite grade, and 14.2 % Fe oxides (Magnetite and hematite). The main REE-bearing mineral is Ce-Allanite, and the mineral grade is 0.61%. Details are in the GTK report, Appendix II – Mineralogical Report (D.A. Salvador, 2021).

The most notable mineral discovery is allanite, a silicate mineral. There are other rare high-grade REE deposits with allanite in the world. A process is proposed to be developed by an Allanite Expert Group.

9.5 Processing concepts investigated

The composite sample had particles up to about 5 mm. To prepare for assaying and further grinding to suitable liberation size, the dry material was crushed in a roll crusher to < 1mm and then split into small size batches. Wet rod mill grinding to P_{80} 82 microns (30 minutes) was used in most tests.

One of the flotation reagents used at another Swedish beneficiation plant (Atrac 1563) was applied initially in the GTK testing. Another chemical, Flotinor FS 2, was suggested and it provided improved recovery, enhancing the overall Apatite results. An additional flotation agent was tried with inferior result.

Table 6. Priority sample data.

Identification		Dry Solids %	P_2O_5 (%)			Fe (%)	TRE (ppm)	As (ppm)	U (ppm)	Th (ppm)	Cd (ppm)	Sieve Analysis
DH	M		XRF	ICP	Colori-metric	XRF	ICP					d80 (µm)
002	0-1m	90.9	5.8	5.0	5.4	8.5	1928	69	5.3	17.7	0.07	726
	2-3m	93.9	5.3	4.7	4.8	9.8	1851	67	6.2	17.4	0.05	1532
	4-5m	91.7	5.5	4.8	5.0	8.9	1740	63	5.7	14.0	0.06	1482
	6-7m	91.5	4.7	4.1	4.2	7.9	1587	56	6.4	15.3	0.06	1682
	8-9m	80.1	7.8	6.9	7.2	8.5	2637	93	9.5	21.2	0.07	194
	9-9,6m	80.6	7.6	6.6	7.1	15.5	2625	84	10.4	21.3	0.06	155
004	0-1m	77.1	4.8	4.3	4.5	7.0	1707	53	5.1	15.8	0.05	1616
	2-3m	93.9	6.6	5.8	6.1	10.6	2048	75	6.6	16.6	0.06	1159
	4-5m	95.3	6.1	5.2	5.5	10.4	1912	67	5.9	18.9	0.06	1334
	6-7m	92.5	6.2	5.4	5.7	8.4	1853	64	5.4	14.6	0.05	1161
	8-9m	84.9	6.1	5.4	5.8	13.6	1829	75	5.5	14.7	0.05	534
	10-10,8m	86.0	6.5	5.8	6.2	13.6	1910	75	7.2	14.9	0.05	455
006	0-1m	94.2	4.9	4.4	4.8	9.7	1672	60	4.6	17.4	0.05	1319
	2-3m	88.5	5.4	4.7	4.9	7.3	1799	57	4.5	17.0	0.06	1452
	4-5m	90.2	4.8	4.1	4.3	6.2	1600	55	5.2	15.7	0.05	1411
	6-7m	86.5	5.5	4.8	5.1	8.2	1800	65	6.3	17.3	0.05	1474
	8-9m	84.4	6.1	5.4	5.7	11.7	1859	78	6.0	14.0	0.05	606
	10-11m	83.6	6.6	5.9	6.0	12.3	2050	83	6.2	16.6	0.05	392
	12-13m	81.4	5.8	5.2	5.5	13.8	2209	64	8.4	18.1	0.07	166
	13-13,5m	83.9	6.0	5.3	5.6	13.8	2056	68	7.9	17.4	0.06	226
007	0-1m	94.3	4.3	3.9	4.1	8.9	1661	51	4.9	16.5	0.06	1320
	2-3m	94.3	5.8	5.1	5.3	9.5	1939	76	5.1	17.8	0.05	1450
	4-5m	95.7	5.1	4.6	4.8	10.1	1731	58	5.5	15.5	0.06	1494
	6-7m	95.4	5.2	4.7	5.0	22.5	1648	68	5.5	13.6	0.05	697
	8-9m	88.1	5.2	4.7	5.1	26.1	1742	60	5.5	14.9	0.05	681
	10-11m	86.7	6.1	5.5	5.8	25.0	1841	64	6.6	14.4	0.16	470
	12-13m	86.8	5.9	5.2	5.6	19.0	1872	67	6.4	16.1	0.04	386
	13-13,8m	81.6	5.7	5.1	5.3	16.8	1953	63	7.4	16.6	0.07	212
010	0-1m	94.5	6.4	5.5	5.8	11.4	1870	75	4.2	16.2	0.05	701
	2-3m	94.5	4.3	3.7	4.0	7.4	1395	43	5.2	14.8	0.05	1762
	4-5m	85.8	5.0	4.4	4.5	7.0	1739	59	6.0	16.9	0.06	1153
	6-7m	87.4	4.6	4.0	4.2	6.5	1469	51	6.0	13.6	0.05	1873
	8-9m	83.4	6.2	5.5	5.8	11.8	2102	73	6.7	16.2	0.05	498
	10-11m	82.3	6.9	6.0	6.5	17.1	2202	71	6.6	16.6	0.05	233
	12-12,7m	76.7	4.9	4.4	4.8	13.1	2299	61	12.1	20.9	0.07	154
015	0-1m	73.1	5.7	5.1	5.4	8.8	2496	73	12.6	22.4	0.07	120
	2-3m	77.0	6.3	5.5	5.9	7.7	2160	73	7.4	17.4	0.06	317
	4-5m	79.5	6.9	6.0	6.4	7.5	2189	80	7.2	17.8	0.06	248
	6-7m	79.7	7.8	6.8	7.3	13.8	2425	90	6.6	17.9	0.06	212
	8-8,9m	81.1	6.5	5.8	6.1	13.5	2258	75	7.1	20.5	0.09	194
016	0-1m	89.2	6.7	5.9	6.1	9.9	2289	83	5.4	18.6	0.06	330
	2-3m	84.2	6.0	5.3	5.4	7.1	2017	67	5.3	16.7	0.08	456
	4-5m	81.4	6.8	6.1	6.3	7.6	2236	81	7.8	18.5	0.06	320
	6-7m	86.3	4.5	4.0	4.1	6.0	1500	49	6.0	13.4	0.04	1803
	8-9m	81.0	6.4	5.7	6.0	13.4	2117	83	6.3	17.0	0.06	277
	10-11m	79.9	6.1	5.3	5.7	14.8	2216	70	8.0	19.8	0.06	168
	11-11,7m	74.6	4.9	4.4	4.5	10.6	2391	65	13.1	23.1	0.08	121

It is a common practice to apply desliming prior to flotation to reduce the amount of flotation reagent and enhance the process selectivity. The Apatite liberation at the P_{80} 82 micron level appeared to be sufficient for very high grade concentrate.

Since iron ore minerals may negatively affect Apatite flotation, Magnetite removal by LIMS (Low-Intensity Magnetic Separation) preceded the desliming stage in all tests except one. A comparison test with iron mineral removal after Apatite flotation reduced the P_2O_5 recovery. An attempt to remove hematite by applying stronger magnetic forces after LIMS resulted in unacceptable loss of Apatite.as well. The magnetic field strength in the medium-intensity magnetic stage was 0.5 Tesla.

The discovery of the mineral allanite and its association with significant REE values, added a stage in the test program to attempt recovery of this mineral after the Apatite flotation. Flotation is employed for allanite processing and an extensive search for suitable flotation agents resulted in recommendations for several. Indicative tests with a few of them showed that high REE recoveries are possible.

9.6 Apatite batch flotation tests and results

Small scale trial and error testing was conducted by GTK with three flotation agents that are known to be used for Apatite recovery, modifying agents (e.g., depressant targeting iron minerals). LIMS and MIMS (low-intensity and medium-intensity magnetic separation respectively) stages were used. Table 7 summarizes a few of the resulting data. Testing protocols and flowsheets are in the GTK report, Appendix III (D.A. Salvador, 2021).

Table 7. Summary of a few Apatite batch flotation testing conditions.

Unit	**Grinding**	**Desliming**	**WLIMS**	**Apatite Flotation**		**Notes**
Tests	*Time (min)*		*T*	*Depressant (g/t)*	*Collector (g/t)*	
Test 1	30	Settling and siphoning	0.07	-	Atrac 1563 (200 g/t)	
Test 5	30	Settling and siphoning	0.07	Starch (300 g/t)	Flotinor FS 2 (200 g/t)	As Test 4, but with Starch
Test 11	30	Settling and siphoning	0.3	-	Flotinor FS 2 (200 g/t)	pH 9 in Apt. Flot.
Test 14	30	Settling and siphoning	0.07	-	Flotinor FS 2 (200 g/t)	Scavenger for cleaner tails

A typical test flowsheet is shown in Figure 22, based on test No. 5.

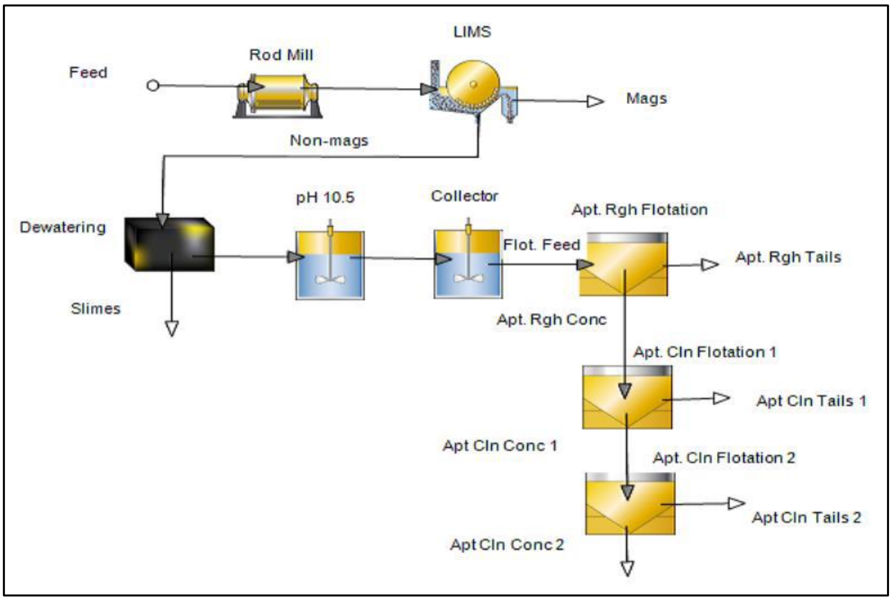

Figure 22. Flowsheet for test No. 5.

A few of the results are summarized in Table 8. Note that the reported FeO values do not represent Fe^{2+} assays, but rather the XRF element Fe_{tot}. Multiply with the factor 0.7773 to obtain the actual Fe_{tot} value. The test run on which subsequent locked cycle test is based is highlighted in yellow. Only four of the elements of interest besides P and Fe are shown in the table. Additional REEs are seen in the GTK report, Appendix IV (D.A. Salvador, 2021), where all the ICP and Colorimetric data are included.

Table 8. A few Apatite batch flotation results.

Results summary			P205		FeO		Ce		La		Nd		Y	
		wt. %	%	Rec. %	%	Rec. %	%	Rec. %	%	Rec. %	%	Rec. %	%	Rec. %
Test 1	Mags	8.2	2.0	3.0	67.3	33.8	0.03	3.5	0.02	3.9	0.01	3.0	0.01	2.7
	Slimes	7.6	4.3	6.0	9.2	4.3	0.07	7.9	0.04	8.0	0.03	8.3	0.03	8.3
	Apt Cln Conc 1	**7.4**	**40.0**	**55.0**	**0.5**	**0.2**	**0.14**	**16.1**	**0.06**	**13.3**	**0.09**	**24.5**	**0.13**	**39.7**
Test 5	Mags	7.9	1.8	2.7	68.7	34.9	0.02	3.1	0.01	3.1	0.01	2.7	0.01	2.6
	Slimes	1.1	2.7	0.6	11.1	0.8	0.08	1.4	0.04	1.4	0.03	1.1	0.02	1.1
	Apt Cln Conc 2	**11.9**	**36.8**	**82.1**	**0.7**	**0.5**	**0.15**	**27.8**	**0.06**	**21**	**0.09**	**35.7**	**0.12**	**59.3**
Test 11	Mags	10.3	2.6	5.1	67.6	43.3	0.04	5.9	0.02	6.6	0.02	7.1	0.01	5.4
	Slimes	1.3	2.4	0.6	10.6	0.9	0.08	1.6	0.04	1.6	0.03	1.4	0.02	1.2
	Apt Cln Conc 3	**9.8**	**39.9**	**73.0**	**0.3**	**0.2**	**0.15**	**23.9**	**0.07**	**19.8**	**0.09**	**30.3**	**0.13**	**51.7**
Test 14	Mags	7.8	1.7	2.5	71.2	34.4	0.02	2.9	0.02	3.6	0.01	2.7	0.01	2.2
	Slimes	0.9	2.1	0.4	11.2	0.6	0.08	1.1	0.04	1.2	0.03	1	0.02	0.8
	Apt Cln Conc 3	**8.5**	**40.3**	**64.3**	**0.3**	**0.2**	**0.15**	**19.7**	**0.06**	**15.6**	**0.09**	**27**	**0.13**	**44.4**
	Cln Conc 3 + Scv.	**10.3**	**39.0**	**75.6**	**0.5**	**0.4**	**0.16**	**24.9**	**0.06**	**19.9**	**0.09**	**33.4**	**0.13**	**53**

9.7 Locked cycle Apatite flotation testing and results

As it was concluded that adequate high-grade Apatite concentrate at favorable recovery could be generated with a simple flotation process, it was determined to add a simulation of a production flowsheet that would involve typical scavenging stages to enhance the recovery further in a locked cycle processing. A second objective was to produce enough LIMS rougher concentrate to enable tests to further upgrade the Fe grade by additional separation stages. A third objective was to obtain suitable flotation tailings for a rougher allanite flotation trial with a few selected flotation reagents.

The flowsheet applied is shown in Figure 23 below, showing not only the locked cycle testing, but also the subsequent Magnetite test and the allanite batch rougher flotation testing.

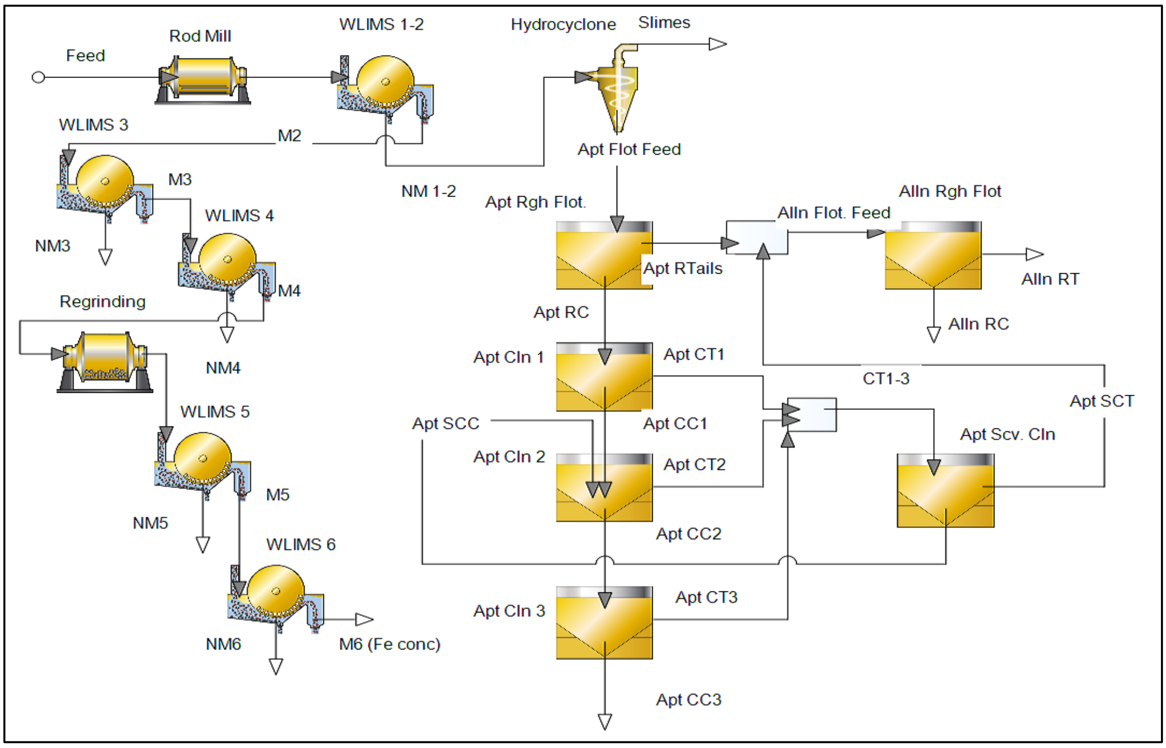

Figure 23. Overall flowsheet for locked cycle Apatite flotation testing, Magnetite test and allanite batch flotation testing.

The graph in Figure 24 shows the results in the form of final P_2O_5 grade and recovery. Test cycle 4 is considered to be representative for what a full-scale industrial production may look like. ICP assay data of main interest are as follows: As 428 ppm, Cd, 0.10 ppm, U 4.6 ppm and Th 15.1 ppm. Of major concern is the arsenic, which to a large extent follows the Apatite upgrading, while the other most important elements are practically unchanged compared to the analyzed plant feed.

9.8 Magnetite beneficiation test and results

The rougher LIMS concentrate from the initial two stages before Apatite flotation was cleaned twice by LIMS. Just in case more liberation may be required, grinding to P(80) about 63 microns was conducted, followed by additional LIMS stages. The GTK/Labtium assay was over 70%. The main contaminant is P_2O_5 at 0.12%.

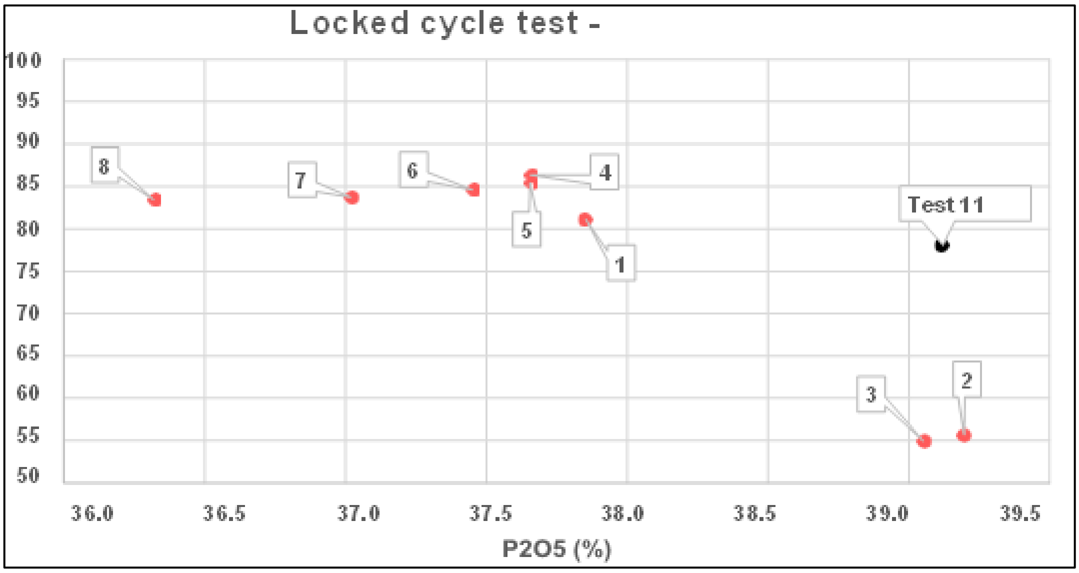

Figure 24. Locked cycle rounds results.

9.9 Allanite batch flotation testing and results

Two different flotation reagents were applied in the indicative rougher flotation tests. High recoveries of the remaining REEs + Y in the Apatite tailings material were achieved in rougher flotation stages, but a cleaning stage could reduce the recovery level according to one test. With one of the recommended reagents, recoveries around 80% were superior compared to the initial tests. The mass recovery was very high, and the grades were consequently low. Starting at the low REE levels present in the rest product, this is considered promising.

9.10 Projected global mass and metallurgical balance

The GTK calculated overall mass & met balance is shown in Table 9. If the REE and Y values are added up from the Apatite concentrate and allanite rougher concentrate, around 80% may potentially be recovered if a final allanite process can maintain good recoveries. For Yttrium, the added sum is very high at about 95%. Apatite concentrate mass yield is 10.9 %. The bonus Magnetite concentrate mass recovery is 5.8%.

Table 9. GTK projected overall mass and metallurgical balance (Al values removed).

Stream	Total solids Rec %	P2O5 % Bal.	P2O5 Rec %	FeO % Bal.	FeO Rec %	SiO2 % Bal.	SiO2 Rec %	As % Bal.	As Rec %	Ce % Bal.	Ce Rec %	La % Bal.	La Rec %	Nd % Bal.	Nd Rec %	Y % Bal.	Y Rec %
Feed	100	5.3	100	15.9	100	43.0	100	0.00	100	0.07	100	0.03	100	0.03	100	0.02	100
M2	6.8	1.4	1.7	80.9	34.7	5.9	0.9	0.00	2.1	0.02	2.2	0.01	2.5	0.01	2.4	0.01	1.8
NM 1-2	93.2	5.6	98.3	11.1	65.3	45.7	99.1	0.01	97.9	0.07	97.8	0.04	97.5	0.03	97.6	0.03	98.2
M3	6.5	1.1	1.4	84.0	34.3	4.3	0.6	0.00	1.9	0.02	1.8	0.01	2.2	0.01	2.0	0.01	1.4
NM3	0.3	6.3	0.4	17.5	0.3	39.4	0.3	0.00	0.2	0.08	0.4	0.04	0.4	0.04	0.4	0.03	0.4
M4	6.4	1.0	1.2	85.1	34.2	3.8	0.6	0.00	1.8	0.02	1.6	0.01	2.0	0.01	1.7	0.00	1.2
NM4	0.1	8.9	0.2	21.3	0.1	33.3	0.1	0.01	0.1	0.12	0.2	0.06	0.2	0.06	0.2	0.04	0.2
M5	5.8	0.2	0.2	91.0	33.6	1.0	0.1	0.00	0.8	0.01	0.5	0.00	0.6	0.00	0.3	0.00	0.1
NM5	0.5	10.2	1.0	18.9	0.6	34.8	0.4	0.01	1.0	0.14	1.1	0.09	1.3	0.08	1.4	0.05	1.1
M6 (Fe conc)	**5.8**	**0.1**	**0.1**	**91.4**	**33.5**	**0.8**	**0.1**	**0.00**	**0.8**	**0.00**	**0.4**	**0.00**	**0.6**	**0.00**	**0.3**	**0.00**	**0.0**
NM6	0.0	6.2	0.0	34.8	0.1	27.6	0.0	0.00	0.0	0.13	0.1	0.07	0.1	0.06	0.1	0.04	0.1
Slimes	1.5	4.0	1.1	9.6	0.9	47.5	1.7	0.00	0.6	0.08	1.7	0.04	1.8	0.03	1.5	0.03	1.6
Apt Flot Feed	91.7	5.6	97.1	11.1	64.4	45.7	97.4	0.01	97.3	0.07	96.0	0.04	95.6	0.03	96.1	0.03	96.6
Apt RC	22.6	19.0	81.1	6.6	9.4	24.1	12.7	0.02	94.3	0.12	40.3	0.05	35.2	0.06	46.8	0.08	69.9
Apt RTails	69.1	1.2	16.0	12.6	55.0	52.7	84.7	0.00	2.9	0.05	55.8	0.03	60.5	0.02	49.3	0.01	26.8
Apt CC3	**10.9**	**37.3**	**76.7**	**1.0**	**0.7**	**2.1**	**0.5**	**0.04**	**89.5**	**0.16**	**26.6**	**0.07**	**21.2**	**0.09**	**34.2**	**0.13**	**59.3**
Apt SCT	11.7	2.0	4.4	11.8	8.7	44.6	12.1	0.00	4.8	0.08	13.7	0.04	14.0	0.03	12.6	0.02	10.5
Alln Flot. Feed	80.8	1.3	20.4	12.5	63.7	51.5	96.9	0.00	7.7	0.06	69.5	0.03	74.5	0.02	61.9	0.01	37.3
Alln RC	**35.8**	**2.9**	**19.5**	**21.4**	**48.2**	**43.7**	**36.4**	**0.00**	**3.9**	**0.11**	**62.5**	**0.06**	**61.5**	**0.04**	**47.0**	**0.02**	**35.4**
Alln RT	45.0	0.1	0.9	5.5	15.5	57.8	60.5	0.00	3.8	0.01	6.9	0.01	12.9	0.01	14.9	0.00	1.9

9.11 Conceptual flowsheet for potential production

Based on the test data and experience in Magnetite processing, a conceptual flowsheet was developed as shown in Figure 25. Approximate mass and metallurgical balance as well as rough budgetary costing are generated related to this flowsheet. Several unknown stages are indicated in text boxes.

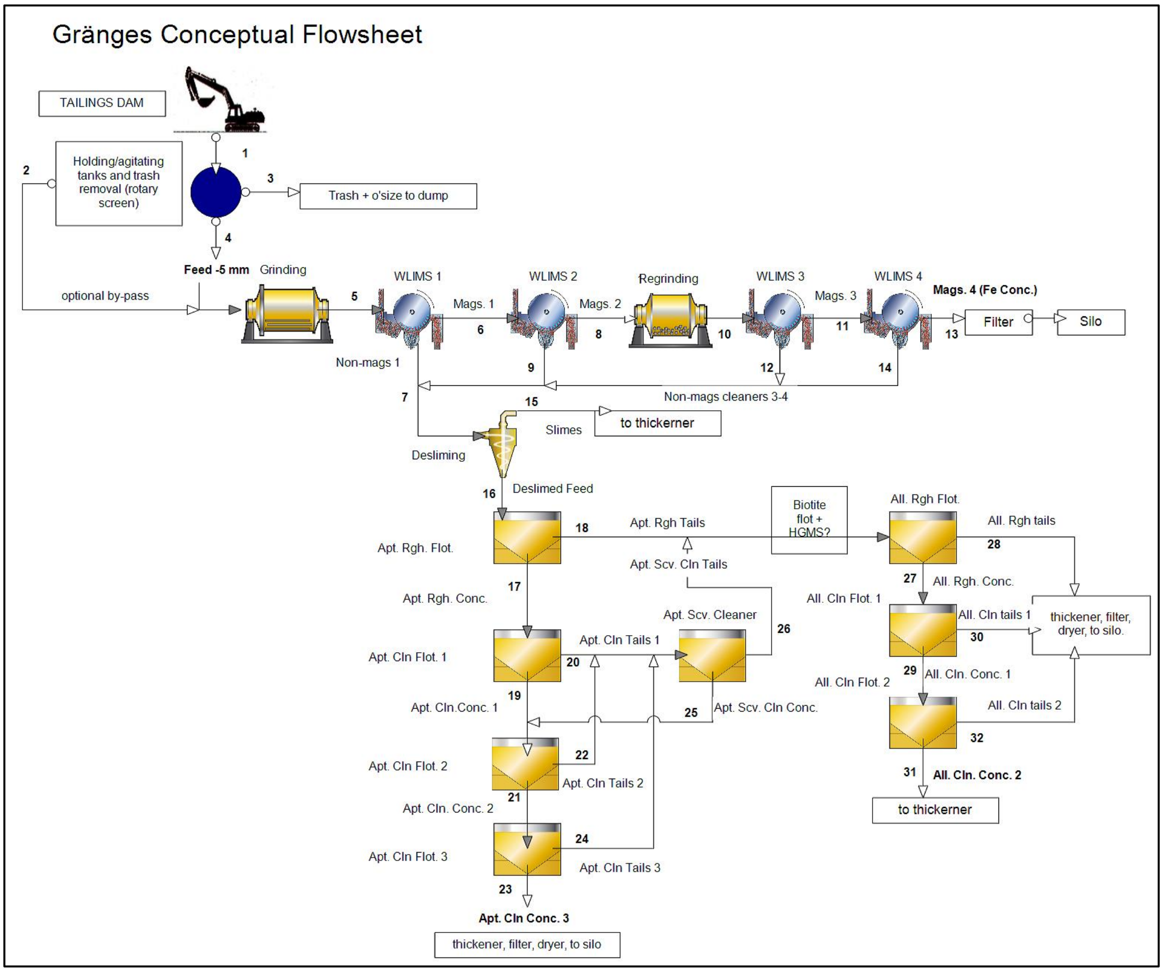

Figure 25. Conceptual flowsheet.

10 Waste management

A testing programme consisting of both static (metal assays, acid-base accounting) and kinetic testing (humidity cells test) has been started up (June 2021) using material from processing tests. The programme is supposed to comply with the standard CEN/TR 16365. The programme is supposed to continue for the rest of 2021.

Results from the metal assays are presented in Table 10 and acid-base accounting in Table 11.

Table 10. Metal concentration in tailings from processing tests.

ASSAY TYPE	SAMPLE	UNIT	Tailings - Concentration
ME-ICP06	SiO2	%	51,3
ME-ICP06	Al2O3	%	9,85
ME-ICP06	Fe2O3	%	15,85
ME-ICP06	CaO	%	4,18
ME-ICP06	MgO	%	9,29
ME-ICP06	Na2O	%	2,28
ME-ICP06	K2O	%	3,45
ME-ICP06	Cr2O3	%	0,006
ME-ICP06	TiO2	%	0,47
ME-ICP06	MnO	%	0,11
ME-ICP06	P2O5	%	0,86
ME-ICP06	SrO	%	<0.01
ME-ICP06	BaO	%	0,02
OA-GRA05	LOI	%	1,41
TOT-ICP06	Total	%	99,08
C-IR07	C	%	0,12
S-IR08	S	%	0,01
ME-MS81	Ba	ppm	231
ME-MS81	Ce	ppm	600
ME-MS81	Cr	ppm	50
ME-MS81	Cs	ppm	16,5
ME-MS81	Dy	ppm	19,4
ME-MS81	Er	ppm	10,7
ME-MS81	Eu	ppm	4,6
ME-MS81	Ga	ppm	21,5
ME-MS81	Gd	ppm	24,4
ME-MS81	Ge	ppm	<5
ME-MS81	Hf	ppm	3,2
ME-MS81	Ho	ppm	3,55
ME-MS81	La	ppm	323
ME-MS81	Lu	ppm	1,63
ME-MS81	Nb	ppm	16,9
ME-MS81	Nd	ppm	223

ASSAY TYPE	SAMPLE	UNIT	Tailings - Concentration
ME-MS81	Pr	ppm	64,4
ME-MS81	Rb	ppm	485
ME-MS81	Sm	ppm	32,8
ME-MS81	Sn	ppm	111
ME-MS81	Sr	ppm	46,9
ME-MS81	Ta	ppm	5,4
ME-MS81	Tb	ppm	3,25
ME-MS81	Th	ppm	14,55
ME-MS81	Tm	ppm	1,64
ME-MS81	U	ppm	5,88
ME-MS81	V	ppm	253
ME-MS81	W	ppm	11
ME-MS81	Y	ppm	112
ME-MS81	Yb	ppm	11
ME-MS81	Zr	ppm	106
ME-MS42	As	ppm	10,1
ME-MS42	Bi	ppm	0,27
ME-MS42	Hg	ppm	<0.005
ME-MS42	In	ppm	0,105
ME-MS42	Re	ppm	0,001
ME-MS42	Sb	ppm	0,9
ME-MS42	Se	ppm	<0.2
ME-MS42	Te	ppm	0,01
ME-MS42	Tl	ppm	1,43
ME-4ACD81	Ag	ppm	<0.5
ME-4ACD81	Cd	ppm	<0.5
ME-4ACD81	Co	ppm	12
ME-4ACD81	Cu	ppm	8
ME-4ACD81	Li	ppm	110
ME-4ACD81	Mo	ppm	1
ME-4ACD81	Ni	ppm	27
ME-4ACD81	Pb	ppm	10
ME-4ACD81	Sc	ppm	13
ME-4ACD81	Zn	ppm	76

The concentrations of metals are rather low. The sulphur content is 0,01 % whereas the arsenic concentration is around 10 mg/kgTS, copper 8 mg/kg TS, zinc 76 mg/kg TS respectively. The uranium content is around 6 mg/kg TS whereas the thorium content is around 14,5 mg/kg TS which roughly corresponds to the background concentrations in the area (Geokemisk Atlas över Sverige, Sveriges Geologiska Undersökning, 2014, ISBN 978-91-7403-258-1).

Table 11. Acid-Base Accounting – Tailings produced from processing tests.

Sample	S-IR08	S-ICP19	S-CAL19	C-IR07	C-IR06	C-CAL04	NP	AP	NPR	NNP
	%	%	%	%	%	%	kg CaCO3/t	kg CaCO3/t		kg CaCO3/t
Taillings	0,01	<0.01	0,01	0,13	0,03	0,1	21	<0.3	136,32	21

The results from the acid-base accounting test show that the tailings are net neutralizing. No potential for producing any future acid exist due to the almost complete lack of sulphides in combination with a good buffer capacity.

11 Infrastructure and power supply

11.1 Water management

Initially the water in the Jan-Matts facility will be used as process water. When the water in the Jan-Matts facility is consumed the process water will be pumped from the open pit. The open pit is also being used for the waste from the process and is today containing more than 9 million m3 of water. The tailings from the process will be disposed of in the open pit. This will result in an overflow of water from the open pit calculated to about 250 – 300 000 m3 per year. This water will have to be pumped to Skråssabäcken from the open pit.

11.2 Power supply

The existing building, planned for the process plant has an existing power supply connected to main network. The capacity of the connection is above the calculated capacity needed for the planned process plant. The foreseen power consumption should be available but needs to be negotiated.

11.3 Construction

The complete process plant will be placed in the existing building without any need for further construction. Some of the equipment will need extra foundation, this all calculated in the CAPEX chapter 17.

12 Transportation

12.1 Train loading and Transports

Loading of trains will be carried out at the site in Grängesberg. Both the Apatite and the Magnetite will be loaded into 10 ft XM containers placed three-by-three on 30 ft rail cars. Each container will carry 21 tons of payload (90 gross tons on 22.5 tons axle load).

The train transport will be arranged in one block train once or twice a week, carrying about 1,800 tons of product (about 2,500 gross tons) of which about 1,200 tons of Apatite and 600 tons of Magnetite. The rail line between Grängesberg and Kristinehamn is about 170 km in total length. It runs straight south from Grängesberg to Örebro (about 100 km) and then turns west to the city and port of Kristinehamn (about 70 km) on Lake Vänern, see Figure 26.

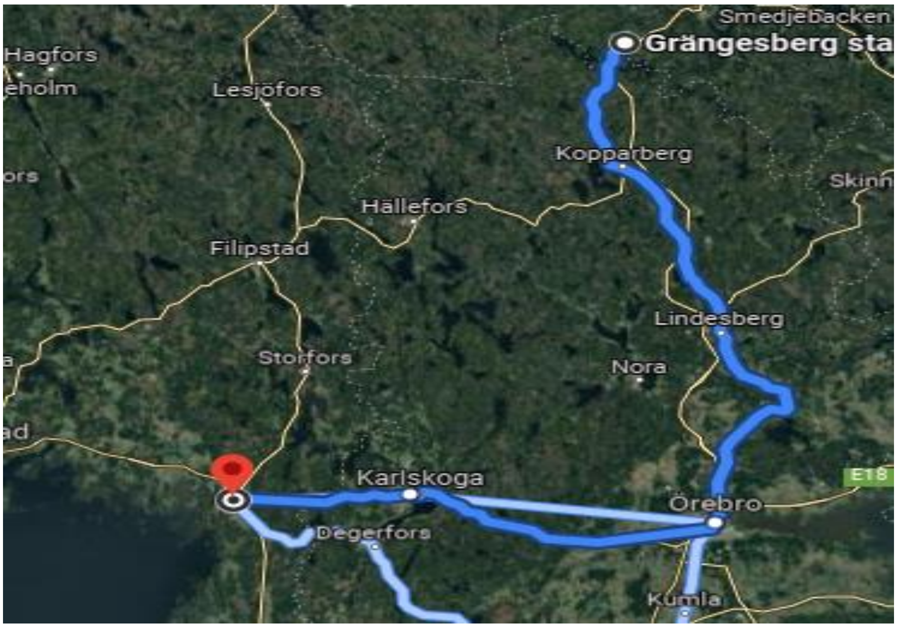

Figure 26. Transport route to port in Kristinehamn.

The rail transports will be carried out by hybrid locomotives which can run on renewable fuel for the first and last mile, i.e. for the loading at site and unloading in the port, where there are no overhead power lines for the locomotives. The company will lease 15 rail cars and 90 XM containers and provide them to a rail operator for the actual transport service, including the maintenance of the rail cars.

12.2 Port of Kristinehamn

The Port of Krisitinehamn (see Figure 27) is located on the northeast shores of Lake Vänern, the largest Swedish lake. Lake Vänern is connected with the open sea via Trollhätte Kanal (The Trollhätte Canal) and Göta Älv (the Göta River) which allows ships of about 5,000 tdw to call on ports in the lake. The port is operated by Vänerhamn AB, which in addition to the Port of Kristinehamn also operates the ports of Karlstad, Otterbäcken, Lidköping and Vänersborg. The Port of Kristinehamn currently handles many different kinds of commodities, e.g. scrap metal, grain and various mineral concentrates, both in big bags and in bulk.

Figure 27. Port of Kristinehamn.

12.3 Port handling

When the incoming train arrives the XM containers will be lifted off from the rail car by a forklift or front-end loader equipped with a rotator. The container will be transported into a storage shed with a storage capacity of about 10,000 tons, equally divided between Apatite and Magnetite. The respective containers will be turned 180^{o} upside down and the product would be stacked onto separate stockpiles, well separated from each other.

12.4 Ship loading

The route through Trollhätte Canal and the Göta river allows vessels of about 5,000 tdw to be loaded. Apatite vessels can be loaded either by using pneumatic loading equipment or traditional crane with grab, while Magnetite loading will be carried out only by conventional crane and grab. Loading of a full vessel will require about one shift to be completed and loading to take place on SSHEX terms, i.e. loading Monday – Friday on two shifts with a possibility for overtime on shipper’s account.

13 Environmental and social studies

GRANGEX will in parallel to finalising the SS and starting the DFS prepare documents for the public consultation and with the objective to finalize the EIA and to file the permit application early Q2 2022.

The Project is expected to cause no significant impacts to human health and is expected to have a positive social impact, and even more important the project will have a favour.

GRANGEX will engage in communications with the local stakeholders, including public meetings. The reception to the Project in initial contacts with locals is positive. The impact of the Project on the surrounding area will also be limited.

14 Mine closure

Closure and rehabilitation of the operation will be done as follows:

- Buildings will be kept intact. Equipment will be dismantled and sold.
- Pipelines e.g. tailings pipes to the open pit will be dismantled and/or plugged.
- Any hazardous material on site will be collected, transported to a landfill with permits in place.
- Any contaminations on site e.g. oil spills will be dug out and contaminated soil will be transported to a landfill with permits in place. Currently no such areas are known.

It has been assumed that due to revenues received when selling equipment these costs are outbalanced.

The old TMF will more or less be restored to pristine conditions i.e. resemble the area before disposal of tailings started (wet land). Dam walls will be contoured i.e. pushed into the TMF to create a "beach" i.e. a smooth transition to the ground inside the former TMF. A water body, small lake or pond will, most likely, in time be created due to the continuous precipitation and the water from Lake Orrleken. An outlet to the southeast will be created i.e., a small stream which is to lead any surplus water further downstream. Dry areas will be revegetated with seeding of grass and trees.

A final rehabilitation plan will be sent in to the authorities for approval in good time before the operation closes and this plan will also be supported by any needed investigations and studies.

It has been assumed that a financial assurance/environmental bond would be required for the operation covering the rehabilitation costs. Such an assurance provides a level of certainty to regulatory authorities and communities that the financial resources exist when needed (i.e., in case of a bankruptcy). The estimated rehabilitation costs (CAPEX) which are presented in Table 12 rely on several assumptions as well as local experience, and local contractor unit estimates.

Table 12. Rehabilitation costs Grängesberg – CAPEX.

Infrastructure	**Cost (SEK)**	**Remark**
Excavation, transport of contaminated surface soil (E.g. oil spill)	128 000	Assumed an area of 1000 m^2 with a depth of 0,3 m
Landfilling cost	81 000	Nontoxic waste, assumed 300 m^3
Rehabilitation of surfaces	N.A.	Roads and open surfaces kept intact
Vegetation/Hydroseeding	N.A.	Roads and open surfaces kept intact
De-installation of equipment (processing plant)	N.A.	Balanced by sales of equipment
De-installation of equipment (tailings pipes, other)	N.A.	Balanced by sales of equipment
Demolishing of buildings	N.A.	Buildings kept intact. Other use
Removal of roads	N.A.	Roads are kept
TMF		
Constructions of beaches - Push back of dam walls	1 282 600	Northern and southern dam walls, 1100 m, assumed average 5 m wide, 8 m high.
Construction of permanent outlet	1 000 000	Assumed concrete channel
Planting of trees/seeding	13 500	3000 small plants/trees
Permitting and Approval of Rehabilitation Plan		
Final Mine Closure Plan - Detailed Design	150 000	
Project and Contruction Management		
Project and Contruction Management	300 000	100 000 SEK/month. Assumed 3 months
Contingency		
Contingency	701 275	25%
TOTAL CLOSURE COST	**3 656 375**	

The estimated OPEX costs for the next 30 y are presented in Table 13.

Table 13. Rehabilitation Costs – OPEX.

Year 1 after closure	Cost (SEK)	Remark
Monitoring Programme - Set-up	28 800 kr	24 h, 1200 SEK/h
Approval of Monitoring Programme	28 800 kr	24 h, 1200 SEK/h. Formal notification/application to CAB
Installation of monitoring equipment (pipes, weirs etc.)	200 000 kr	Outlet, 2 gw-pipes
Sampling/Field Work	48 000 kr	One week, Once a year
Assays	6 000 kr	2 groundwater wells + 1 surface water stations. Metals+ Anions
Annual Reporting	48 000 kr	40 h, 1200 SEK/h
Contingency 25%	89 900 kr	
TOTAL	**449 500 kr**	
Year 2-30 after closure		
Sampling/Field Work	28 800 kr	One week, Once a year
Assays	6 000 kr	2 groundwater wells + 1 surface water stations. Metals+ Anions
Annual Reporting	48 000 kr	40 h, 1200 SEK/h
Maintainence of Equipment	50 000 kr	Fixed.
Contingency 25%	33 200 kr	
TOTAL	**166 000 kr**	

15 Health and safety

Operational health and safety for employees, the community, and the environment will be of paramount importance throughout the project life and managed by safety management systems which will be developed in accordance with company policies. These policies cover the development of effective management structures, rigorous requirements, and arrangements with planned and systematic implementation.

Work Environment Act (No. 1,160 of 1977), is the principal health and safety law which covers employees' safety in the workplace. The Work Environment Act is a framework act and detailed regulations are found in the provisions issued by the Swedish Work Environment Authority, which is the principal regulatory body concerning health and safety in the workplace in Sweden.

The Work Environment Act states the obligations of the employer regarding prevention of ill health and accidents. The provisions of the Swedish Work Environment Authority on rock and mining work and general recommendations on implementation of the provision's (AFS 2010a) are the main provisions concerning mining. They regulate, among other things, the investigations and risk assessments that are required before mine operations can begin, the working methods and equipment that should be selected, the level of expertise required by mine employees, and the personal protective equipment the workers shall use and required inspections.

Health and safety performance will be measured against agreed international standards and best practices in the industry with a transparent auditing and review process being implemented.

The company will ensure the availability of all necessary resources needed to conduct all health and safety, environmental and social management, monitoring and mitigation activities at the project throughout the construction, operation, and closure phases.

Selection of contractors or sub-contractors will carefully consider individual companies health and safety standards and track record.

16 Manpower requirements

16.1 Introduction

The Apatite operation is preliminary planned to commence production early 2025. GRANGEX plan to employ an owner-operated labour strategy with contractors utilised during construction and initial development as well as qualified maintenance during production. It is also anticipated that for contractors specialised in earthmoving will contracted to do the excavation of the tailing sand from the facility and truck it to the process plant.

The workforce is anticipated to comprise of local skilled and unskilled labour living in in the surrounding areas.

At full production approximately 20 staff will be directly or through contractor employed by the project.

16.2 Training

Recruitment and training of the workforce will need to commence prior to commissioning of the operation. Costs have been allocated for training and included in the Capital Cost Estimate (Chapter 18.0 - Capital Costs) training.

Recruitment of personnel will begin six months before commencement of production with the intent to have employees available on site at least two months. The ramp up will be short and therefore whole staff will be hired before start up.

16.3 Workforce Structure and Organisation

The number of staff in the process plant will be same during the whole lifetime of the project and the staff will be directly employed. The staff for the recovery of the sand from Jan-Matts as well as the trucking to the process plant is planned to be executed by contractors.

16.4 Maintenance

The daily and weekly maintenance should be executed by the process staff. For more specialised work contractors will be used.

16.5 Health and Safety

Operational health and safety for employees, the community, and the environment will be of major importance throughout the project life and managed by the site manager. Safety management systems will be developed in accordance with GRANGEX policies.

16.6 Quality Assurance and Risk Management

The project will develop a comprehensive and effective system of quality assurance and risk management. The quality assurance system shall include an element of quality control where periodic audits take place of suppliers and contractors engaged with the mine development. Each procedure at the mine will undergo a comprehensive risk analysis where the likelihood and consequences of each risk are measured. Possible adverse deviations in current technology are to be studied and mitigation measures designed. A series of 'user' friendly risk matrices will be developed for ease of updating.

17 CAPEX

Budget quotes, rates supplied by the client and escalated tender rates were used to compile the CAPEX estimate. The estimates contained within this report and associated accuracies are fixed as per November 2021.

Table 14. Estimated capital expenditure, CAPEX.

Capital expenditure, CAPEX	kw	KKR
Admin		10 000
Logging and Clearing the dam*		2 900
MAGNETITE		
Feed to Ball Mill	78	5 700
Ball mill 1 incl. Grinding balls, Cyklons	400	13 000
Separator Ball mill 2 incl. Grinding balls	65	12 300
Drummfilter incl. vacuumstation	78	3 400
APATITE		
Flotation, pumps, blowers	495	15 250
Drummfilter incl. vacuumstation	113	5 500
Rotary dryer incl EL-heater	600	3 700
PRODUCTS		
Conveyor magnetite L 250 m	15	5 000
Pneumatoic transmitter apatite	30	400
Pneumatic trp Pipe DN200, 250 m		300
Product bins		3 400
WATER, TAILING		
Water pipes		500
Watersupply fron open pit		1 250
Tailing pipe to open pit		1 250
Water tank		1 500
Flykt pump, on raft first 6 mån	54	400
Flyktpump in open pit	90	650
Slurry pipes		1 000
Power and control		9 000
Civil foundations, plints, platforms		7 000
Dust, Vent		3 000
Laboratory equipment		3 300
Subtotal		**109700**
Contingency 10 %		10970
Total energy (kW)	**2018**	
Total CAPEX (kSEK)		**120 670**
* 5 800 SEK Sustained CAPEX		

18 OPEX

The expenditure includes excavation and haulage of tailings material, processing, site general and administrative (G&A) costs and freight costs including port logistics.

Table 15. Estimated operating costs, OPEX.

Exchange rate USD <=> SEK		**8.50**
Apatite concentrate price @ 37 % P_2O_5 USD/t		**180.00**
Magnetite concentrate price @ 70 % Fe USD/t		**125.00**
Transport costs to port SEK/t		**81.00**
Handling cost in port Kristinehamn SEK/t		**42.00**
Loading on railcar SEK/t		**0.80**
Loading and transport to process plant, Type A, *excavator short stick* and truck SEK/ton		**17.40**
Loading and transport to process plant, Type B, *excavator long stick* and truck SEK/ton		**30.73**
Energy cost SEK/kWh		**0.50**
Flotation reagents SEK/ton produkt		**64.25**
Royalty (payment to landowner) SEK/ton		**0.75**
Tonnes Apatite/year		**62 000**
Tonnes Magnetite/year		**33 000**
Estimated OPEX costs for Years 1 to 5		
Item	**Quantity**	**SEK**
Loading and transport to process plant, 65 % of 568 807 x 1,15 t, Type A	425 183	7 398 188
Loading and transport to process plant, *35* % of 568 807 x 1,15 t, Type B	228 945	7 035 474
Loading into process plant		2 000 000
Staffing process plant 1 + 13(SEK 1 000 000 & 700 000)		10 100 000
Grinding balls		570 000
Chemicals		6 103 750
Energy		4 949 750
Maintenance(70 % of Energy cost)		3 464 825
Handlingcost on site	96 980	77 584
Transportation to port (36 300 t Fe and 62 000 t Apatite concentrates with moisture)	96 980	7 855 380
Handlingcost at port	96 980	4 073 160
Rent process building(SEK 200 000/month)		2 400 000
Royalty		483 000
Sub total		**56 511 112**
Site Management 1 + 1		2 000 000
10% Contingency		5 651 111
Total		**64 162 223**
Operation Costs per t Apatite concentrate SEK		**675.39**
Operation Costs per t Sand SEK		**114.58**

19 Financial evaluation

The project to produce Apatite and Magnetite concentrates from the tailing sand at the Jan-Matts TMF has a quick pay back, see further below.

The limitation of the project is the short life, about six years, based on the amount of tailing sand estimated, close to 3 million tonnes.

The result of the SS points at a very quick pay back of investment, about 21 months. This based on a CAPEX calculated to SEK 120 million, an annual Revenue of SEK 130 million, and an OPEX of SEK 64 million as shown in Table 16.

Table 16. Financial evaluation.

	Tonnes per year	USD/ton	Annual kSEK	Annual kUSD
Apatit 17%	62 000	180	94 860	11 160
Magnetit Fe 70%	33 600	125	35 700	4 200
Total revenue			**130 560**	**15 360**
OPEX	**95 600**	**79**	**64 162**	**7 548**
EBITDA			**66 398**	**7 812**
Depreciation			21 940	2 581
EBIT			**44 458**	**5 230**
CAPEX			**120 670**	**14 196**
Payback time in years			1 4/5	1 4/5

The net present value has been estimated to 170MSEK, at 8 % discount rate, and the internal rate of return to approximately 80 %.

It should be noted that the calculation of the CAPEX has been based on new equipment. A substantial part of the equipment is standard equipment, possible to buy on the second-hand market at price levels at least 25 % less.

The establishment of a recycling facility in Grängesberg, initially based on the Jan-Matts TMF, opens up further possibilities to recycle material of different kinds with phosphorus, iron content or REE or a combination of those in tailings dams from many years of production of Fe-ore in the Grängesberg region.

20 Sustainability

GRANGEX is in all its activities focusing on an environmental approach with the production to be fossil free. The production of a high-quality Apatite concentrates by recycling the tailing sand in the Jan-Matts tailings facility is a further step in the efforts to develop the company to be in the forefront of the development to create a sustainable industry.

The intention is that GRANGEX shall be the first fossil free producer of high-quality Apatite concentrates.

This objective is to be achieved by utilising electrical equipment when available, and otherwise to use HVO as fuel when electrical equipment is not available. The objective is also to have the suppliers to deliver equipment and services based on same objective, fossil free or carbon neutral.

21 Risks and opportunities

21.1 Risks

Item	Action	Risk
Substantially lower contents of Phosphorous and Magnetite than expected	A large number of samples have been taken from many places in the facility and at all possible levels.	Low
Not homogenous material	The analysis of samples and test pits have confirmed homogenous material	Low
Not the volume of tailings calculated	The number of test holes done, covering the whole, not water covered part of the facility. The amount of tailings under the water has most probably been under estimated since a conservative way of calculating the resource have been applied	Low
Mining – stability of the tailings – problem to excavate because of low buoyancy	Digging two test pits to understand the material better and preparing to pump the whole facility to reduce the ground water level	Average
Variations in Arsenic levels in the tailings giving variations in the Apatite produced and by that reducing the possible market	Careful study of mineralogy during next stage of study	Average
Stability of dam while recovering the tailings	Careful geotechnical studies during the next stage of study and preparations to raze the dam walls after all tailings are excavated	Average
Unexpected flows of water from surrounding areas	Hydrological study during coming stage of study	Low
Regulatory delays and/or obstacles	Thorough studies, close communication with all stake holders and authorities careful planning	Average
Process doesn’t give the recoveries expected and achieved during laboratory tests and bench testing	Pilot testing in Freiberg, Apatite, and GTK, Magnetite, during next stage of study	Low
Disposal of the waste from the process into the open pit	Thorough planning and careful disposal	Low
Flooding of the open pit or the down-stream area	Thorough calculation of water balances to make sure the system to pump the water after the open pit is correctly designed and installed	Average

21.2 Opportunities

Item	Action	Opportunity
Developing a recycling operation based on tailings in old tailing facilities in the general Grängesberg region, i.e. increasing volume and/or life	A number of tailing facilities in the area are known to contain material possible to recover	Good
Achieving an even better price than expected because of the high-grade Apatite and Magnetite concentrates produced	Further process improvements and competitive advantages achieved	Average
Possibility to develop allanite production with REE	Further studies	Average

22 Project implementation plan

The information collected to finalise the Scoping Study and the financials based on this work makes it possible to move direct into a Definitive Feasibility Study, DFS. In addition to this the Pilot plant test work has already been initiated and will be available at an early stage of the DFS.

With this information and the digging of a test pit already done, as well as the planned pilot-test runs at URV-FIA in Freiberg, Germany, it should be possible to finalise the DFS within 6 to 7 months.

In parallel to the DFS work the studies to collect all necessary information for the EIA and finalise the Environmental application should be finalised and presented to the Environmental court.

The decision from the court can take up to 18 months. During this period detailed engineering should be done and the project organisation to execute the project should be put in place.

23 Conclusions and recommendations

The work before and during the SS has identified good opportunities to develop a profitable recycling project in Grängesberg, with tailings sand in the Jan-Matts dam as raw material. Even with the short project life, because of the limited tonnage of high phosphate tailings, the SS has shown a highly profitable project.

Test work done during the SS has shown the possibilities to produce high grade Apatite and Magnetite concentrates.

With this knowledge at hand, and test pits excavated and material for pilot test on its way to Freiberg for production of about 800 kilos of Apatite concentrate, and thus the knowledge at a substantially higher level than normally expected for a SS it is recommended to go directly to a Definitive Feasibility Study, DFS. This in combination with all focus on finalising all investigation and work for the EIA and the filing of the Environmental Permit Application.

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