Boliden Summary Report

Mineral Resources and Mineral Reserves | 2022

Garpenberg

Prepared by
Morvan Derrien

Table of Contents

1 SUMMARY

In 2022 the total Mineral Reserves in Garpenberg increased by 15.6 Mt (million metric tonnes) to 109.3 Mt. Measured and Indicated Resources in Garpenberg decreased by 9.0 Mt to 21.6 Mt. Inferred Resources increased by 19.0 Mt to 67.4 Mt.

Table 1-1. Mineral Resources and Mineral Reserves in Garpenberg 2022-12-31.

	2022						2021					
	kton	**Au**	**Ag**	**Cu**	**Zn**	**Pb**	kton	Au	Ag	Cu	Zn	Pb
Classification		**(g/t)**	**(g/t)**	**(%)**	**(%)**	**(%)**		(g/t)	(g/t)	(%)	(%)	(%)
Mineral Reserves												
Proved	**18 700**	**0.24**	**97**	**0.04**	**3.1**	**1.3**	7 700	0.18	135	0.03	3.3	1.2
Probable	**90 600**	**0.30**	**85**	**0.04**	**2.5**	**1.1**	86 000	0.32	90	0.05	2.8	1.3
Total	***109 300***	**0.29**	**87**	**0.04**	**2.6**	**1.2**	*93 700*	0.31	93	0.04	2.8	1.3
Mineral Resources												
Measured	**100**	**0.24**	**108**	**0.03**	**2.8**	**1.0**	100	0.24	108	0.03	2.8	1.0
Indicated	**21 600**	**0.41**	**70**	**0.06**	**2.7**	**1.3**	30 500	0.40	83	0.06	2.6	1.3
Total M&I	***21 600***	**0.41**	**70**	**0.06**	**2.7**	**1.3**	*30 600*	0.40	83	0.06	2.6	1.3
Inferred	**67 400**	**0.34**	**57**	**0.05**	**2.3**	**1.1**	48 400	0.35	50	0.06	2.3	1.1

Notes on Mineral Resource and Mineral Reserve statement.

- Mineral Resources are reported exclusive of Mineral Reserves.
- Mineral Resources and Mineral Reserves are a summary of Resource estimations and studies made over time adjusted to mining situation of December 31.
- Mineral Resources are reported without dilution.
- All resources produced since 2020 have undergone a Reasonable Prospect of Eventual Economic Extraction (RPEEE) evaluation using Deswik Stope Optimizer.
- The Mineral Reserves are representative of the current Life of Mine Plan (LOMP).
- Cut-offs used to define Mineral Reserves are based on operational costs, as are the cut-offs used to define Mineral Resources even if they are simplified. Costs and cut-offs are presented in chapter 3.11-3.13.
- Tonnes and grades are rounded which may result in apparent summation differences between tonnes, grade and contained metal content.

1.1 Competence

Multiple participants have been involved and contributed to this summary report. Roles and responsibilities are listed in Table 1-2.

Table 1-2. Contributors and responsible competent persons for this report.

Description	Contributors	Responsible CP
Compilation of this report	Morvan Derrien	Sofia Höglund
Geology	Morvan Derrien	Sofia Höglund
Mineral Resources	Sofia Höglund	Sofia Höglund
Mining and Mineral Reserves	Markus Malmberg	Sofia Höglund
Mineral Processing	Ewa Maultasch	Anders Sand
Environmental and legal permits	Lotta Tanse	Nils Eriksson

The report has been verified and approved by Sofia Höglund who is employed by Boliden as a Senior Resource Geologist and is a member of FAMMP[1]. Sofia Höglund has 15 years of experience in the Exploration and Mining Industry.

Nils Eriksson works for Boliden as Head of Department for Permitting and Environmental support. Nils Eriksson is a member of FAMMP and has more than 25 years of experience from the Mining Industry.

Anders Sand works as Research Manager of Boliden Mines, with expertise particularly in mineral processing. He has been responsible for the R&D programme in Process Technology since 2018. Anders Sand is a member of FAMMP and has more than 15 years of experience in the mining industry. He also holds appointments as docent and associate professor in mineral processing at Luleå University of Technology since 2017.

[1] Fennoscandian Association for Metals and Minerals Professionals

2 GENERAL INTRODUCTION

This report is issued annually to inform the public (shareholders and potential investors) of the mineral assets in Garpenberg held by Boliden. The report is a summary of internal / Competent Persons' Reports for Garpenberg. Boliden method of reporting Mineral Resources and Mineral Reserves intends to comply with the Pan-European Reserves and Resources Reporting Committee (PERC) "PERC Reporting Standard 2021".

The PERC Reporting Standard is an international reporting standard that has been adopted by the mining associations in Sweden (SveMin), Finland (FinnMin) and Norway (Norsk Bergindustri), to be used for exploration and mining companies within the Nordic countries.

Boliden is reporting Mineral Resources exclusive of Mineral Reserves.

2.1 Pan-European Standard for Reporting of Exploration Results, Mineral Resources and Mineral Reserves – The PERC Reporting Standard

PERC is the organisation responsible for setting standards for public reporting of Exploration Results, Mineral Resources and Mineral Reserves by companies listed on markets in Europe. PERC is a member of CRIRSCO, the Committee for Mineral Reserves International Reporting Standards, and the PERC Reporting Standard is fully aligned with the CRIRSCO Reporting Template.

The PERC standard sets out minimum standards, recommendations and guidelines for Public Reporting of Exploration Results, Mineral Resources and Mineral Reserves in Europe.

2.2 Definitions

Public Reports on Exploration Results, Mineral Resources and/or Mineral Reserves must only use terms set out in the PERC standard.

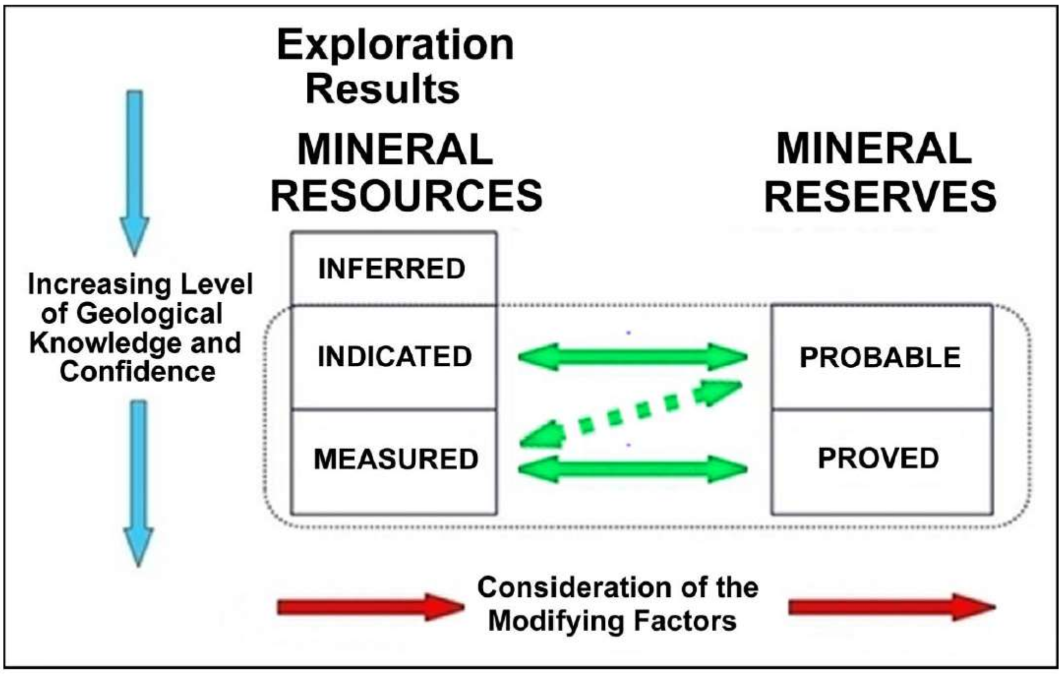

Figure 2-1. General relationship between Exploration Results, Mineral Resources and Mineral Reserves (PERC 2021).

2.2.1 Mineral Resource

A Mineral Resource is a concentration or occurrence of solid material of economic interest in or on the Earth's crust in such form, grade or quality and quantity that there are reasonable prospects for eventual economic extraction. The location, quantity, grade or quality, continuity and other geological characteristics of a Mineral Resource are known, estimated or interpreted from specific geological evidence and knowledge, including sampling.

2.2.2 Mineral Reserve

A Mineral Reserve is the economically mineable part of a Measured and/or Indicated Mineral Resource. It includes diluting materials and allowances for losses, which may occur when the material is mined or extracted and is defined by studies at Pre-Feasibility or Feasibility level as appropriate that include application of Modifying Factors. Such studies demonstrate that, at the time of reporting, extraction could reasonably be justified.

3 GARPENBERG

3.1 Project Outline

Garpenberg is a Zn-Pb-Ag-(Cu-Au) underground mine where the ore is mined from between 450 metres to more than 1 400 metres below surface. The mine encompasses several polymetallic ore bodies. See Figure 3-4 and Figure 3-5.

The mined out ore tonnage in 2022 totaled 3041 Kton. Almost 75% of the mined tonnage derived from the largest ore body, Lappberget.

Zinc and silver are the most valuable commodities in Garpenberg. Zinc accounted for about 48% of the revenue, followed by silver at 32%, lead at 13% and copper-gold at 7%.

3.2 Major changes 2022

In 2022 the total Mineral Reserves in Garpenberg increased by 15.6 Mt (million metric tonnes) to 109.3 Mt. Where Mineral Reserves grew, Measured and Indicated Resources in Garpenberg decreased by 9.0 Mt to 21.6 Mt. Inferred Resources increased by 19.0 Mt to 67.4 Mt.

3.2.1 Technical studies

In 2022, a technical study was conducted to consider the technical and economic feasibility of mining Huvudmalmen Etage 1100 (Derrien, 2022a).

Another technical report was completed regarding the upgrade of Dammsjön Etage 1300 from mineral resource to mineral reserve (Derrien, 2022b).

3.3 Location

Garpenberg is located in the Hedemora municipality in central Sweden 180 km NW of Stockholm at coordinates (WGS84) latitude 60° 19’ 27”N, longitude 16° 13’ 38”. Figure 3-1 and Figure 3-2 show the geographic location and the mining concessions of Garpenberg.

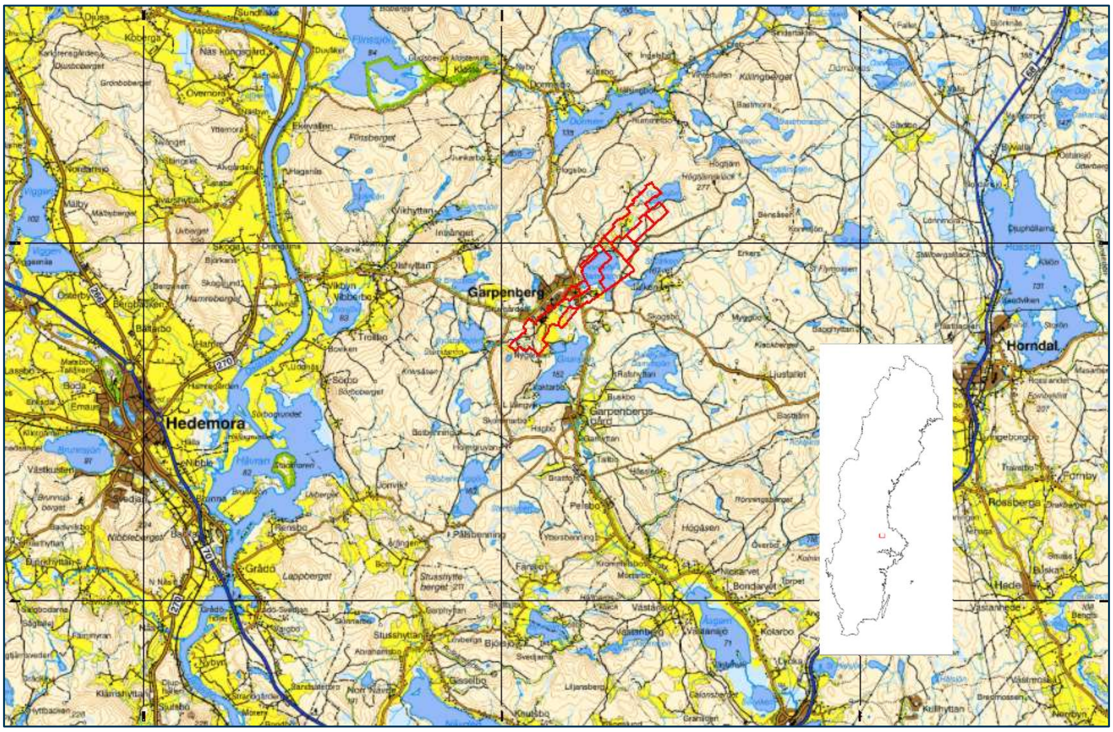

Figure 3-1. Regional map showing Garpenberg mining concession licenses in red colour. Coordinate system in the map is RT90 2.5 gon W.

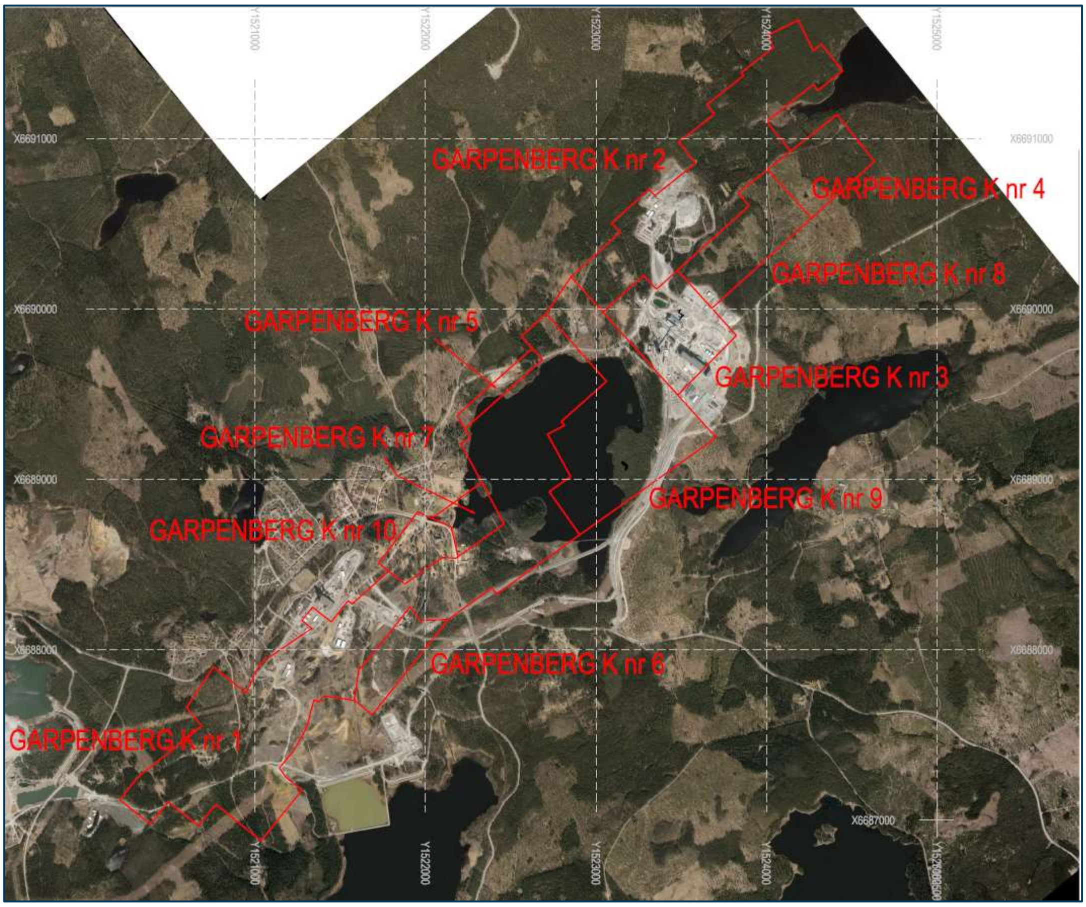

Figure 3-2. Detailed map of Garpenberg mining concessions.

3.4 History

Historical documents show that systematic mining has been conducted in Garpenberg since the 13th century. A recent study from lake sediments published in 2017 however push back the evidence for early ore mining in Garpenberg even further, from the Middle Ages to the pre-Roman Iron Age around 400 BC (Bindler et al., 2017).

In 1957 Boliden acquired the Garpenberg mine from AB Zinkgruvor. A total of 63.4 Mt of ore has been processed since Boliden took over the operations (Table 3-1).

A chronological list of historically significant events is presented in appendix 1.

Table 3-1. Annual production numbers 1957-2022. Between 1957 and 1995 the processed ore tonnes and grades are presented with 5-year intervals, while figures for mined ore are missing. From 2005 to 2014, ore from the Lovisagruvan mine was also processed in Garpenberg. A total of 63.4 Mt of ore has been processed since Boliden acquired the mine from AB Zinkgruvor in 1957.

Year	Mined Ore	Processed Ore	Grades				Lovisa
	Kton	Kton	Au g/t	Ag g/t	Zn %	Pb %	Kton
1957		260	1.2	69	2.84	2.34	
1960		306	0.7	81	4.3	3.0	
1965		297	0.9	116	4.9	3.3	
1970		307	0.9	110	4.2	2.7	
1975		349	0.6	114	3.2	1.9	
1980		427	0.5	112	3.0	1.8	
1985		534	0.4	138	3.0	1.9	
1990		747	0.5	135	3.6	2.0	
1995		750	0.4	133	4.3	2.2	
2000	1003	976	0.5	141	3.9	1.9	
2001	1018	984	0.4	136	3.9	1.8	
2002	997	1058	0.4	153	4.0	1.8	
2003	1067	1062	0.4	151	4.6	1.9	
2004	1087	1074	0.3	124	5.6	2.2	
2005	1115	1102	0.3	117	5.8	2.3	13.3
2006	1167	1182	0.4	123	5.7	2.2	17.1
2007	1218	1255	0.3	126	6.3	2.5	17.1
2008	1341	1365	0.3	130	6.9	2.6	27.7
2009	1425	1394	0.3	139	7.3	2.8	31.7

2010	1369	1443	0.3	133	6.6	2.5	28.9
2011	1441	1456	0.3	134	6.1	2.4	37.5
2012	1602	1484	0.27	130	5.6	2.1	39.0
2013	1600	1495	0.3	153	5.2	2.1	39.8
2014	1891	2224	0.31	136	5.1	2.1	38.7
2015	2304	2367	0.32	156	5.0	2.1	
2016	2610	2622	0.31	150	4.4	1.8	
2017	2630	2634	0.30	134	4.3	1.8	
2018	2625	2622	0.29	135	4.1	1.6	
2019	2865	2861	0.26	118	4.1	1.5	
2020	3000	3000	0.31	109	3.8	1.5	
2021	3052	3056	0.30	119	3.8	1.5	
2022	3041	2989	0.26	117	3.6	1.4	

Mineral Resources for new ore bodies are defined by the exploration department by drilling the mineralized rock body in a 50 x 50 m grid, aiming to produce an Inferred or Indicated Resource. This is typically followed up by denser drilling carried out by the mine department resulting in a Measured Resource and eventually a Mineral Reserve. More on Mineral Resources and Mineral Reserves in chapters 3.12 and 3.13, respectively.

The Mineral Reserve estimates are constantly being revised against the metal grades of the actual mined tonnage through the reconciliation process, see chapter 3.15.

3.5 Ownership

Boliden Mineral AB owns 100 % of the Garpenberg mine.

3.6 Environmental, Social and Governance (ESG)

3.6.1 Existing permits

Boliden is the owner of all land where the mining operations are currently developed. Boliden has 10 mining concessions covering the mine area. The concessions are presented in Table 3-2, Figure 3-1 and Figure 3-2.

Table 3-2. Mining concessions in Garpenberg.

Name	Active from	Expires	Minerals
Garpenberg K nr 1	2000-01-01	2025-01-01	Zinc, lead, silver, copper, gold
Garpenberg K nr 2	2000-01-01	2025-01-01	Zinc, lead, silver, copper, gold
Garpenberg K nr 3	2001-06-18	2026-06-18	Zinc, lead, silver, copper, gold
Garpenberg K nr 4	2001-06-18	2026-06-18	Zinc, lead, silver, copper, gold
Garpenberg K nr 5	2002-12-13	2027-12-13	Zinc, lead, silver, copper, gold
Garpenberg K nr 6	2002-12-13	2027-12-13	Zinc, lead, silver, copper, gold
Garpenberg K nr 7	2002-12-13	2027-12-13	Zinc, lead, silver, copper, gold
Garpenberg K nr 8	2003-01-07	2028-01-07	Zinc, lead, silver, copper, gold
Garpenberg K nr 9	2003-04-17	2028-04-17	Zinc, lead, silver, copper, gold
Garpenberg K nr 10	2004-03-19	2029-03-19	Zinc, lead, silver, copper, gold

Boliden has the necessary environmental permits in place to operate the mine. The main permit, in accordance with the Swedish Environmental Act, was issued by the Swedish Environmental Court in 2012 (M461-11 2012-01-31) and the final discharge limits to water were set in 2016 (M461-11 2016-04-15). In 2018, Boliden applied for some changes in the permit which were approved in December 2018 (M467-18, 2018-12-20). These changes in the permit allow Boliden to deposit waste-rock according to life-of-mine plan and tailings for 10 years (the longest building period allowed for activities under chapter 11 in the Swedish Environmental Act).

In 2021, Boliden got a new extension permit (M7041-20, 21-06-15) for extracting and processing up to 3.5 Mtpa of ore in Garpenberg, without changing anything else in the conditions of the environmental permit. The only supplement in the permit is a discharge limit for uranium to water.

The permit allows Boliden to operate the mine as described in the application and in particular to (chapter 9 Environmental Act):

- extract and process up to 3.5 Mtpa of ore in Garpenberg,
- deposit tailings in the Ryllshyttan tailings management facility (TMF) and backfill the mine.

In addition, the permit allows Boliden to (chapter 11 Environmental Act):

- raise the dams at Ryllshyttan TMF to the level of +256m with the maximum water level of +254 m and to construct a new outlet,
- extend the waste-rock dumps,
- set the financial guarantee for closure to 490 MSek,
- raise the water level in the clarification pond to the level of +227.9 m,
- extract mine water, and
- extract up to 1.9 Mm3/yr fresh water from the lakes Gruvsjön and Finnhytte-Dammsjön, of which a maximum of 0.95 Mm3 from Finnhytte-Dammsjön.

The permit is associated with a series of conditions and limit values regarding e.g., discharge water quality and noise levels in neighboring houses.

3.6.2 Necessary permits

Boliden has initiated the process of permitting a change in the dam construction method at Ryllshyttemagasinet TMF. The change implies building centerline dams instead of as currently upstream dams. The application has been submitted to the Environmental court during year 2022. This change will result in even safer dams, allow for future raises above currently permitted heights and increase the capacity of the TMF within already permitted dam heights.

The existing permit limits the construction period of the dams surrounding the TMF to 2028 and also sets a maximum height for the dams. This implies that Boliden need a new permit in place by 2028 in order to be able to continue raising the TMF or depositing the tailings elsewhere.

3.6.3 Environmental, Social and Governance considerations

3.6.3.1 ESG Commitments

Our business model set our ESG priorities, and take into consideration the risks and opportunities identified by business intelligence and risk mapping, as well as applicable requirements and expectations such as:

- Stakeholder expectations
- Current and potential legislative trends
- ISO 9001, 45001, 14001 and 50001 standards and Forest Stewardship Council (FSC® COC-000122)
- OECD Due Diligence Guidance for Responsible Supply Chains of Minerals from Conflict-affected and High-risk Areas
- GRI Standards (Global Reporting Initiative)
- UN Sustainable Development Goals (SDGs)
- UN Global Compact
- ICMM Mining principles

We regularly consult prioritized stakeholder groups on our sustainability performance from a broader perspective. These stakeholders are asked to comment on Boliden's performance to drive further improvement.

Boliden is a member of ICMM and the national mining associations in the countries where Boliden Mines operates. These commitments imply implementing relevant international and national Environmental Management System (EMS) standards and guidelines, such as e.g., the Global Industry Standard on Tailings Management on an international level and Mining RIDAS on a national level. In addition to this, Boliden Mines is certified according to a series of standards, such as:

- ISO 14001:2015 - Environmental management systems.
- ISO 45001:2018 - Occupational health and safety management systems.
- ISO 50001:2018 - Energy management systems.

Boliden has implemented an integrated management system (Boliden Management System, BMS) which sets a common base for all activities developed within the company.

Boliden strive to run a responsible business and expect its business partners to do the same. Good business ethics is essential for sustainable and successful business. Boliden has an ethics and compliance department to boost its compliance work. The department is responsible for the strategic development and coordination of Boliden's work regarding anti-money laundering, anti-corruption, competition law, sanctions, human rights, data protection, whistleblowing and Boliden's employees and management work together to create a compliance culture in which everyone knows what is expected of them - Boliden's codes of conduct. Regular risk assessments, trainings, audits and effective controls are important parts of Boliden's compliance efforts. The Group's whistleblower channel enables all employees and external stakeholders to report suspected and actual misconduct confidentially and anonymously. If misconduct is proven, disciplinary actions must be taken. Reprisals against anyone reporting misconduct in good faith will not be tolerated. Group management and the Board of Directors receive regular reports on risks, non-compliance and the status of initiatives in progress.

Boliden's Code of Conduct provides a framework for corporate responsibility based on the company's values and ethical principles. All employees and members of the Board are subject to the Code, which is based on international standards and relevant legislation. As a complement to the Code, there are internal policies that all employees are expected to comply with. Boliden strives for a sustainable value chain and therefore applies an overarching business ethics and risk management strategy when selecting business partners. The Business Partner Code of Conduct reflects the requirements placed on Boliden's own organization and sets the lowest standard of ethical conduct required of all parties in the value chain, whether Boliden is the buyer or seller. As with the internal Code of Conduct, this code is based on international standards such as the UN's Global Compact, the ILO's standard core conventions and guidance from the OECD. Compliance and sustainability risks are assessed when selecting business partners. If there is a risk of non-compliance by a business partner, a more detailed review is made. Depending on the outcome, an action plan may be developed and agreed upon, or the business relation may be terminated or rejected.

Boliden is a member of the United Nations Global Compact and works constantly to implement its ten principles, including preventing and limiting negative impact in the own operations and those of its external business partners. Boliden runs operations in countries where the risk of human rights violations is considered low. No operations are conducted anywhere in UNESCO's World Heritage List. Boliden supports the right of indigenous peoples to consultations under Svemin's interpretation of Free, Prior and Informed Consent (FPIC). Other important aspects are fair working conditions, and the position Boliden has adopted against any form of harassment, discrimination and other behavior that may be considered as victimization by colleagues or related parties. In addition to this, aspects such as child and forced labor as well as the freedom to form and join trade unions are taken into account when evaluating business partners.

Anti-corruption forms a central part of the ethics and compliance work, and Boliden has a zero-tolerance policy regarding all types of bribery and corruption. Boliden has an anti-money laundering policy for identifying and managing risks in various parts of the business and to strengthen its anti-money laundering efforts.

3.6.3.2 Socio-economic impact

Mining and metal processing has been the driving force in the local and regional economy and development in Bergsslagen for centuries if not millenniums. This means that the region lives in symbiosis with mining activities in Garpenberg and develops together with the mine. The large investments and developments that have taken place in Garpenberg over recent years has been a boost in the local economy and competence level which has created a lot of optimism regarding the future in the region. The Garpenberg mine is an important actor on the local and regional scale with 430 direct employees and creating a large number of indirect jobs. In total, it has been assessed that the Garpenberg mine generates 2300 direct and indirect jobs. More than 85 % of the workforce lives withing the municipalities of Hedemora, Avesta and Säter. The importance and engagement of Garpenberg is also reflected in the support to local organizations, cultural events and social projects.

3.6.3.3 Communities and land-owners

Boliden Garpenberg is located in the small village of Garpenberg. Many of the employees live in the vicinity of the mine, and more than 20 % of the inhabitants in Garpenberg work at the mine. The dominating land use around the mine is forestry performed by private landowners and forestry companies. In addition, there is an active outdoor culture in the area where hunting is much appreciated.

Boliden holds regular information meetings with the local community and landowners. Relations with the local community and landowners are generally good. A new grievance mechanism will be set up in 2023 through which anyone can file any complaints or improvement suggestions. During year 2022, local inhabitants raised vibrations and trucks passing by in high speed on the road to Gävle as priority areas to address. Previously, dusting from the TMF has been an important issue but implemented dust control measures have resulted in zero complaints regarding dusting during 2022.

3.6.3.4 Historical Legacy

The long history of mining in Garpenberg has resulted in a complex environmental situation with numerous historical objects on and around Boliden's land holdings in Garpenberg. Due to the age of these objects, Boliden is assessed to have very limited liability for any future remedial works to limit the environmental impact of these objects; however, Boliden has the responsibility as landowner to conduct investigations in order to determine the impact of these historical objects. These investigations are ongoing, as well as a dialogue with the County Administrative Board about the extent of the liability for any future remedial actions on these objects. A process has been initiated by the Water Authority to assess if it necessary to modify the environmental quality standards (EQS) for Gruvsjön and downstream lying water bodies as it has been shown that it is not a realistic admission to meet current EQS, even in a long-term perspective.

3.7 Geology

3.7.1 Regional and Local Geology

The Garpenberg mine is situated in the mineralized Palaeoproterozoic igneous province of Bergslagen, south central Sweden, which is host to a variety of ore deposits, and especially Fe-oxide and polymetallic sulphide deposits. Garpenberg, which is the largest sulphide deposit in the region, consists of several individual ore bodies distributed over a distance of 4 km within the Garpenberg supracrustal inlier, see Figure 3-3. The main host rock to the ore is calcitic marble (limestone) altered to dolomite and Mg +/- Mn-rich skarns. The footwall consists of rhyolitic pumiceous, graded mass-flow breccia and rhyolitic ash-siltstone and sandstone affected by strong phlogopite-biotite-cordierite-sericite-quartz alteration. The hanging wall includes polymict conglomerates and rhyolitic pumiceous breccias. The stratigraphic succession is attributed to the volcanic cycle of a felsic caldera complex. The pumiceous breccias in the hanging-wall record a climactic eruption that formed a caldera over 500 m deep and over 9 km in diameter in the Garpenberg area. The limestone horizon is interpreted as a stromatolitic carbonate platform, formed in a shallow, marine environment during a hiatus in volcanism.

The Garpenberg inlier has been interpreted as a NE-SW trending, tight to isoclinal complex syncline with a sub-vertical axial plane (Allen et al., 2003). The structure is compressed at the southern end and opens to the north. The ore-host limestone shows a complex geometry due to large scale folding, shearing and faulting. These structural features have resulted in complex synforms and antiforms, and have a major influence on the position, geometry and metal grades of the ore bodies. The largest ore bodies are linked to antiforms, such as Lappberget and Huvudmalmen.

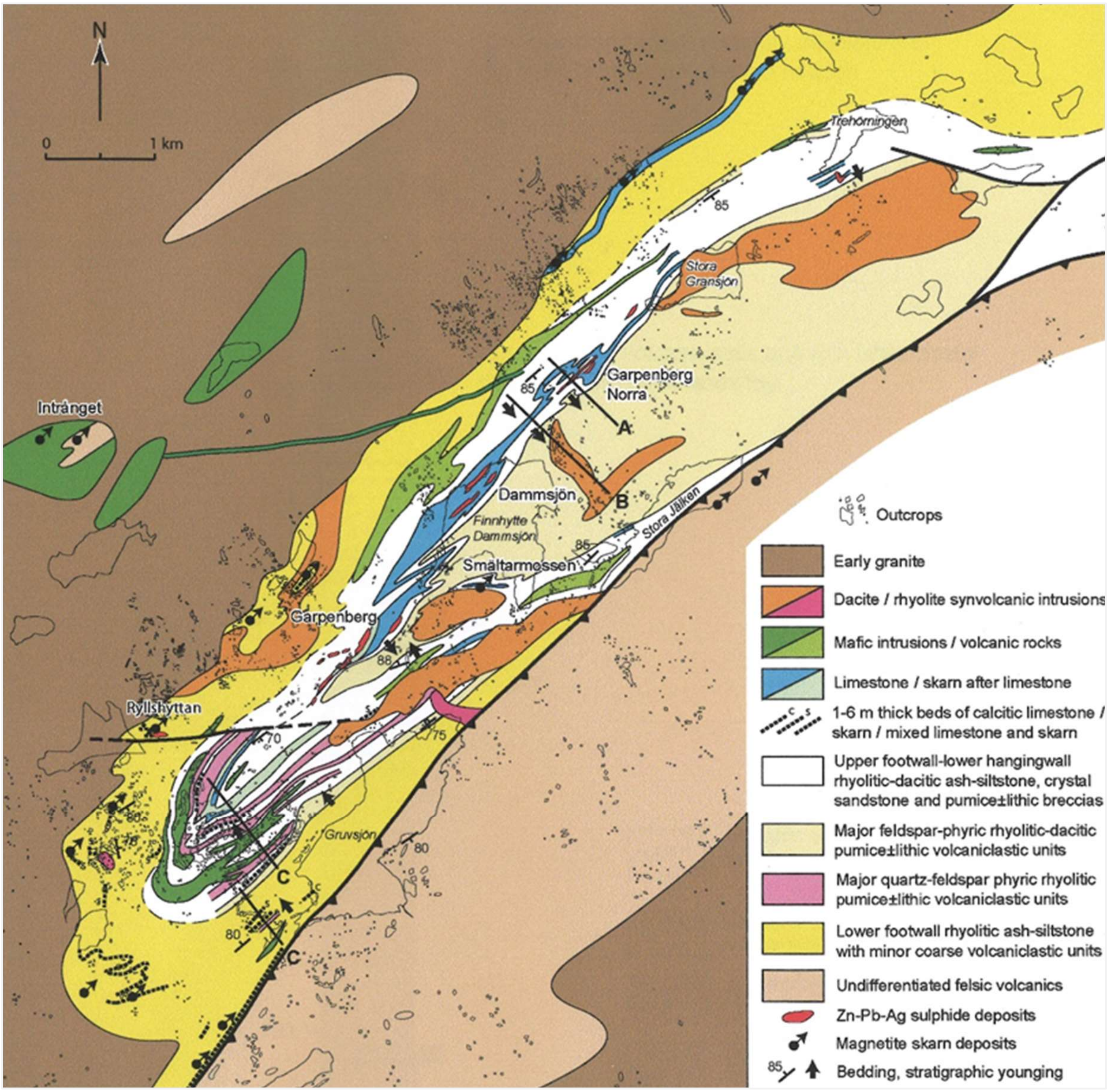

Figure 3-3. Geological map of Garpenberg. From Allen et al., 2003.

3.7.2 Mineralization

Mineralization in Garpenberg mainly consists of pyrite, sphalerite, galena and silver-bearing minerals. The ore bodies occur at the heavily skarn- and dolomite-altered contact zone between the limestone and underlying metavolcanic rocks, forming massive to semi-massive sulphides ore lenses. There is also significant mineralization in the footwall metavolcanic rocks (mica quartzites) that are stratigraphically underlying the marble horizon. The footwall mineralization is tectonically controlled and forms remobilized semi-compact thin veins that are often associated to mica-rich shear zones. Mineralization is mainly of replacement style and is likely to have taken place where metal-bearing fluids penetrated up along synvolcanic, extensional faults and came in contact with reactive limestone to form large, massive sulphide bodies. The initial main stage of mineralization and alteration at all the known Garpenberg ore bodies is interpreted to be essentially syn-volcanic in timing and to pre-date regional metamorphism and deformation (Jansson & Allen, 2011).

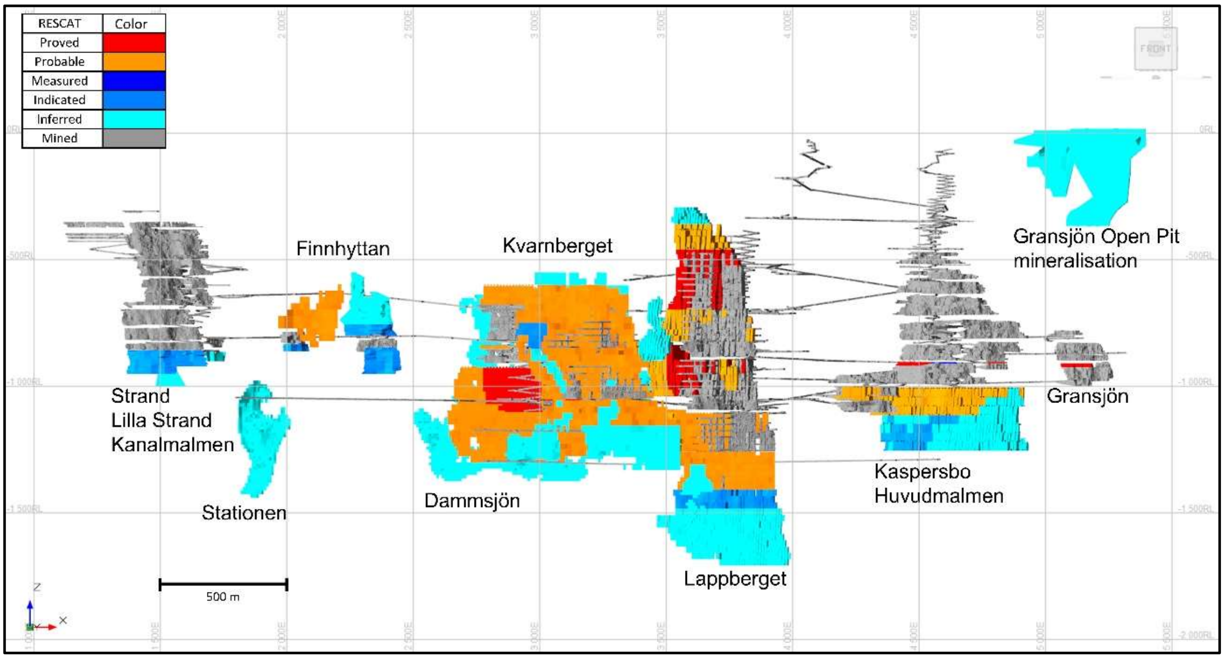

Figure 3-4. Front view of the Garpenberg ore bodies looking north in the local coordinate system. Colors according to resource category.

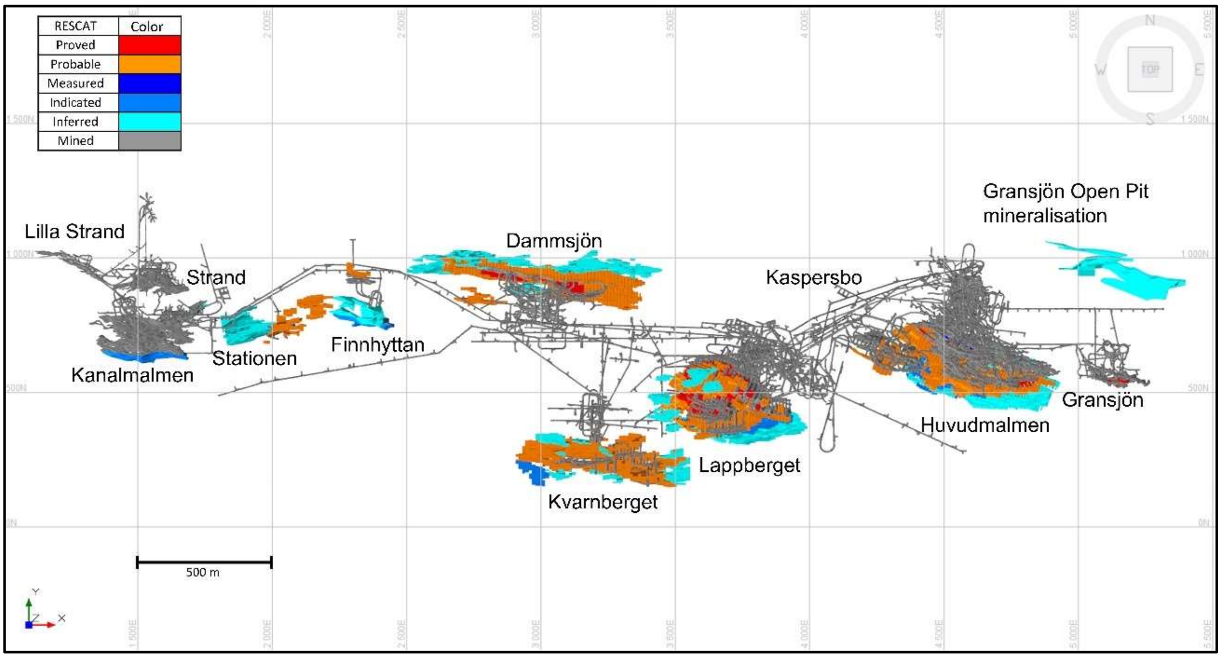

Figure 3-5. Top view of the Garpenberg ore bodies. Colors according to resource category.

3.8 Drilling procedures and data

3.8.1 Drilling techniques and downhole surveying

Diamond drilling assay data is used for mineral resource estimation. Diamond drilling is performed by drilling contractor Drillcon and supervised by Boliden personnel. By default, drilling dimension in Garpenberg is B-size with a core diameter of 39 mm. The current practice is to measure all drillholes longer than 100 m for deviation with Reflex Maxibor2 or Inertial Sensing Gyro. Drill cores longer than 400m are always surveyed with IS Gyro.

3.8.2 Logging

The drill core is logged by Boliden geologists and sampled by Boliden technical personnel. Different levels of logging details are applied depending on whether drill holes are exploration or infill drillholes. However, features that are always logged are: lithological units, fractures, level of schistosity and content of talc. Core losses over 20 cm are registered in the log.

3.8.3 Sampling

Sampling intervals are selected taking into account the degree of mineralization of primarily Zn, Pb, Ag and Cu. Moreover, sampling is done to have full coverage over the block models, even in the weakly mineralized areas. The length of the sample sections is 1-2.5 m. Samples do not cross lithological boundaries and are selected to represent consistent degree of mineralization when possible. Core loss intervals are not sampled and therefore do not get assigned any assay values.

For infill drillholes, the whole core is usually sampled, leaving no core left in the core boxes. Exploration drill holes are sawed in half along the drill core axis and one half is sent for analysis while the other half is stored in Boliden's core archive.

3.8.4 Density

Density data has been collected from bulk samples from each ore lens. This data has been used to produce individual density formulas for each ore lens based on metal content and host rock to the ore. Since 2022, density measurements on pulps are routinely conducted by ALS Laboratories on all the samples that are sent for analysis.

For example, there are two different density formulas used for Lappberget. There is one formula for the ore lenses where the main host rocks are mica quartzites, and another one for ore hosted in dolomite and skarn.

- Mica quartzites: 2.7+0.004*Cu+0.004*Zn+0.02*Pb+0.0365*S
- Dolomite and skarn: 2.9+0.004*Cu+0.004*Zn+0.02*Pb+0.0365*S

The exhaustive list of the density formulas used in Garpenberg can be found in Boliden's internal document "BlUpdOnSiteG9" (Höglund, 2022). Average bulk densities for the different ore bodies vary between 2.71 (Garpenberg south) and 3.15 (Gransjön).

3.8.5 Analysis and QAQC

Drill core analyses are carried out by ALS laboratories. Sample preparation is done in Piteå, Sweden and assays are carried out in ALS's hub-lab in Loughrea, Ireland. ALS laboratories are accredited according to ISO/IEC 17025. Umpire lab check assays are done by MS Analytical. An overview of the different analytical methods is presented in table Table 3-3.

Preparation of the samples, coded PREP-31BY, comprises crushing the rock to 70% less than 2 mm, rotary splitting off 1 kg and pulverizing the split to better than 85% passing 75 microns.

Table 3-3. Overview of ALS's designation of analytical methods. Over-range method applies to samples where assay result reached upper detection limit of primary method.

	Method	**Over-range method**
Preparation	PREP-31BY	
Assay Au	Au-ICP21	Au-AA25/Au-GRA21
Assay Ag, Cu, Pb, Zn	ME-OG46	Ag - GRA21 Pb - AAORE Zn - ME-ICPORE
Assay S	IR08	
Assay other (48 elements)	ME-MS61	
Specific gravity (core)	OA-GRA08	
Specific gravity (pulp)	OA-GRA08b	

Au-ICP21 is a package of fire assay with an ICP-AES analysis. In ME-OG46, Aqua Regia is used to dissolve base metals and silver while assay is done with ICP-AES. IR08 is used for total sulphur analysis using a Leco Sulphur analyzer. ME-MS61 is a package of a 4-acid digestion process with an ICP-MS analysis. Specific gravity is measured either directly on drill core (OA-GRA08), or on pulps using a pycnometer (OA-GRA08b).

All samples are prepared and analyzed with Au-ICP21, ME-OG46 and IR08 while selected drillholes are analyzed with ME-MS61. Since 2022, all samples are analyzed for Specific Gravity on pulps (OA-GRA08b) as well. Table 3-4 shows which elements are analyzed with lab codes ME-OG46 and ME-MS61.

Table 3-4. Elements analyzed with ME-OG46 and ME-MS61.

H																	He
Li	Be											B	C	N	O	F	Ne
Na	Mg											Al	Si	P	S	Cl	Ar
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	**Cu**	**Zn**	Ga	Ge	As	Se	Br	Kr
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	**Ag**	Cd	In	Sn	Sb	Te	I	Xe
Cs	Ba	La*	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	**Pb**	Bi	Po	At	Rn
Fr	Ra	Ac¨	Ku	Ha													
	*	La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	
	¨	Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr	

ME-OG46 ME-MS61

Quality assessment and quality control is continuously monitored using QAQC samples such as in-house standards, blanks and umpire lab checks (pulp duplicates). It is required that each sample batch is submitted with at least one blank sample and one standard sample. Batches with more than 16 samples also require a pulp duplicate sample. As the number of samples in a batch increases, so does the required QAQC samples; for example a batch with 100 samples requires two blank samples, three standard samples and one pulp duplicate sample.

A review of all yearly QAQC samples utilized shows that the results fall within the predetermined acceptable limits. The results have been summarized in Boliden's internal QAQC report (Derrien, 2022c).

3.9 Exploration activities and infill drilling

In 2022, near mine exploration focused on three key objectives (Figure 3-6). Firstly, drilling was continued at Stationen mineralization to an extent that enabled a Mineral Resource estimate later during the year. The second resource objective targeted in 2022 was the area under Kaspersbo, drilled from the 1300 exploration drift. Thirdly, exploration of areas classified as having potential for depth continuation below existing resources was conducted (Figure 3-6). The focus areas in 2022 were below Dammsjön and, towards the end of the year, Huvudmalmen. In total, 19005 m were drilled underground by near mine exploration in 2022.

In addition to underground drilling, near mine exploration has also pursued exploration objectives from surface by further drilling the northern depth extent of the Gransjön deposit. Only two holes were completed in 2022 due to restricted access to drilling resources, these holes delivered prospective intercepts.

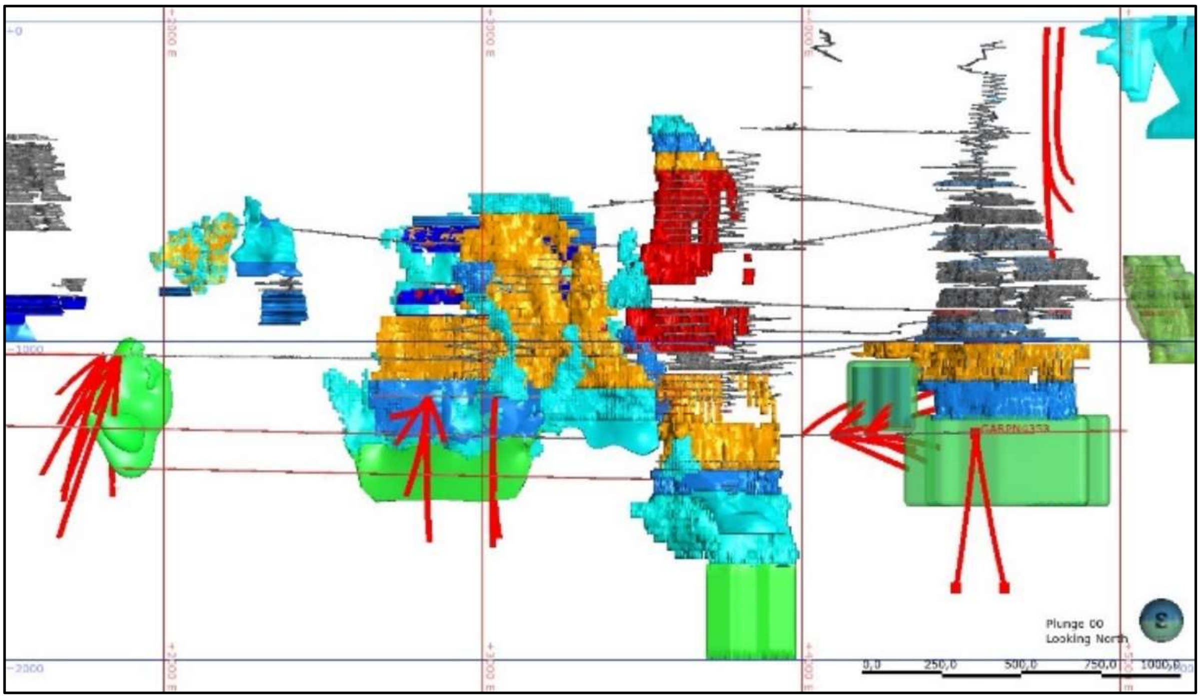

Figure 3-6. Distribution of 2022 near mine exploration resource drilling (red traces) against reserves and resources 2021 with areas of potential.

Drifting objectives focused primarily on the 1300 and 1314 exploration drifts facilitating drill access to the Huvudmalmen and Dammsjön deposits respectively. The 1314 drift is also key to the further exploration of Stationen deposit and will be extended further south beyond Dammsjön. Significant progress was made in 2022 on these drifting objectives with a total of 830 metres of drifting completed.

Infill drilling conducted by the mine department in 2022 focused on Lappberget, Finnhyttan and Huvudmalmen:

- In Lappberget, two separate areas were targeted. A large drilling program from the 1432 exploration drift, initiated in 2021, is under way. The aim of this program is to target the area between 1400-1650z. 3850m were drilled in 2022 and drilling will continue in 2023. Moreover, another drilling program towards the low-grade area, on the western limb of the ore body between 650-900z, was initiated in 2022 (ca. 4280m drilled). This drilling is to be completed in early 2023.
- In Finnhyttan, ca. 6400m were drilled from 640z, aimed mostly to better define Tyskgården and Kyrkan ore lenses.
- In Huvudmalmen, a large amount of infill drilling is necessary both in Etage 1100 and Etage 1250 in order to get sufficient coverage. In 2022, 4470m were drilled focusing mostly on the eastern side of the ore body between 1000-1150z.

In addition to drilling, the mine department, in cooperation with near-mine exploration , conducted a resampling campaign of historical drill cores, focusing on drillholes from Huvudmalmen and Gransjön. The reason for the resampling is that historically, sampling often focused only on the high grade areas, leaving large sections unsampled, even in moderately mineralized areas that could be considered economic nowadays. In total, 55 drillholes were resampled in 2022.

3.10 Mining methods, mineral processing and infrastructure

3.10.1 Mining methods

Over 95% of the mined ore in Garpenberg is extracted by sublevel stoping (also called longhole stoping), where the ore is mined in layers between two drifts vertically 25-35 metres apart. Most areas are mined with transversal longhole stoping, where the development and stope axis are perpendicular to the strike of the ore body. In some more narrow areas, longitudinal longhole stoping is used. The orientation of this method is along or parallel to the strike of the ore body. The ore body is split into primary and secondary stopes, which are mined in a predefined order and pyramid shape sequence. The standard stope dimensions are 22-35 m high, 10 m wide for primary stopes and 15 m wide for secondary stopes, with some local variation in dimensions.

The ore bodies are divided into mining blocks with 3 to 8 levels of stopes in each block. The top level of each mining block is the sill pillar, which separates the different mining blocks. The level above sill pillar is filled with cemented paste fill, which allows mining the ore left in the sill pillar. Below old, mined out areas backfilled with waste rock, a sill pillar with thickness of 10-15 m will be left. This division to different mining blocks allows the mine to have several production areas being scheduled and mined at the same time.

Another consideration concerning the mine design of Lappberget is the division into a main and a second pass sequence (2pass). The main sequence contains more of the high-grade areas and is scheduled prior to the second pass sequence, which in general contains lower grade ore (Figure 3-7).

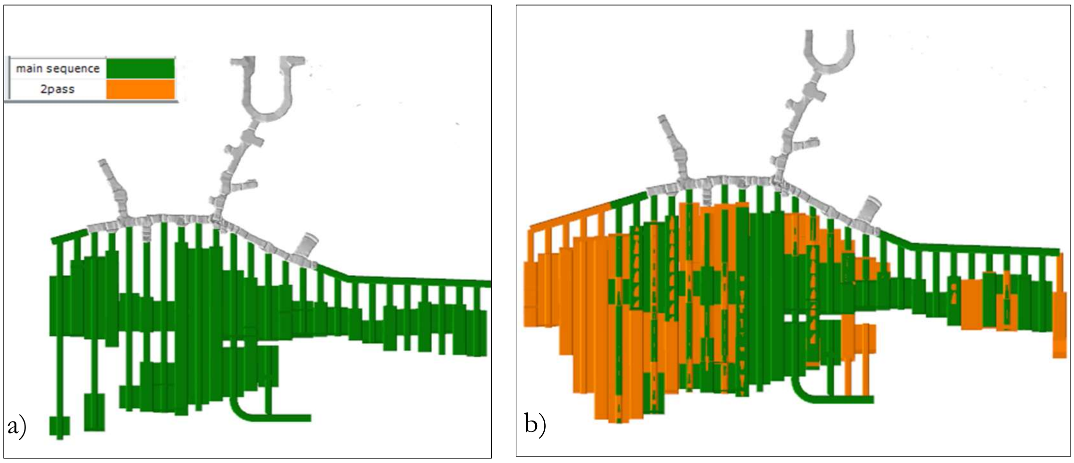

Figure 3-7. Example of mine design in Lappberget
a) High grades layout – main sequence; b) Main sequence (high grades) and 2pass (low grades).

Other rarely used mining methods include cut and fill and avoca (rill) (Table 3-5). With the cut and fill method, mining is carried out in slices along the steeply dipping, narrow ore body. The bottom slice is mined first. The excavated area is then backfilled, so mining can continue with the slice above. The rill method used in Garpenberg is in fact similar to longitudinal stoping, but the stopes are split in 20 m long slices. After being blasted and mucked, the stopes are backfilled before the next slice is blasted. This process repeats until the full size of the stope is done.

Table 3-5. Mining method for Garpenberg ore bodies.

Mining method	Ore body	Width (m)
Primary	Lapp, Kvarn, Kasp, Damm, Huvud	10-15
Secondary	Lapp, Kvarn, Kasp, Damm, Huvud	15-20
Longitudinal	Lapp, Kvarn, Kasp, Damm, Huvud	4-7
Cut and fill	Damm	5-7
Avoca (rill)	Damm	4-7

Mine reconciliation is the comparison of the planned stopes against the actual outcome.

Table 3-6 shows the reconciliation for the large-scale mining methods in 2020 and 2021.

Table 3-6. Reconciliation for sublevel stoping 2020 and 2021. Average overbreak includes overbreak ore.

Year	Stopes	Plan compliance	Average Overbreak
2020	Primary	93 %	12 %
	Secondary	94 %	11 %
	Total	94 %	12 %
2021	Primary	94 %	11 %
	Secondary	95 %	10 %
	Total	94 %	10 %

Ore mucked from a stope is tipped into an ore pass or loaded directly on truck. Transport to the crushers is done by trucks from the active mining areas. There are two underground crushing plants at 700z and 1087z. The crushed ore is hoisted to surface in a shaft, unloaded into a bin in the headframe and then transported by conveyor belts to an intermediate ore storage, which can hold approximately a week of production.

3.10.2 Mineral processing

Processing tests are systematically conducted on ore from new mineral resources to confirm the technical and economic feasibility for extraction and processing. Valid processing tests are required for classifying mineralization to Indicated or Measured Resources. For each new area, drill core samples, representative of the different ore types, are selected for metallurgical testing. Test works are conducted internally at the Boliden pilot plant. The goal of the metallurgical tests is to control the recoverability of the different ore types with a similar process to the one currently used at the Garpenberg concentrator. In 2022, tests were carried out on ore from Lappberget 1530-1650z. The tests included grindability investigations on common rock types intersected at depth, flotation tests and gravimetric concentration testing.

In the concentrator, the ore is ground in two stages with autogenous grinding in the primary stage and pebble mill grinding in the second. After grinding, the ore is screened, with the coarse fraction being returned to the primary mill. The fine fraction undergoes gravimetric separation (Knelson) to separate out coarse gold at an early stage. The gravimetric concentrate is collected in big bags. After gravity separation, the pulp stream is classified using hydrocyclones. The overflow constitutes the main flotation feed, while the underflow undergoes flash flotation in the grinding circuit, from which the concentrate is sent directly to CuPb separation in the flotation plant and the tailings back to the mills for further grinding.

Flotation is carried out in a three-stage flotation circuit: CuPb flotation, CuPb separation and Zn flotation. Regrind mills are installed both in the CuPb and Zn circuits. The flotation concentrates are dewatered using thickeners and pressure filters. Three mineral concentrates are produced in flotation: zinc, lead and copper concentrates. The precious metals report primarily to the copper and lead products.

The zinc and lead concentrates are transported by truck to Gävle port and from there by ship to Boliden's smelters in Finland, Sweden and Norway. The copper and gravimetric concentrates are trucked, the copper concentrate later being reloaded to rail, for onward transport to the Boliden Rönnskär smelter in Skelleftehamn.

3.11 Prices, terms and costs

Mineral Resources and Mineral Reserves are the basis for the company's long-term planning and will be mined for many years to come. Long-term planning prices, which are an expression of the anticipated future average prices for metals and currencies, are therefore primarily utilized in the estimations. The planning prices are used to calculate the NSR (Net Smelter Return), expressed in SEK/t, in the block models. Boliden currently uses the prices shown in Table 3-7 below.

Table 3-7.Long term planning prices currently used in Boliden.

Commodity / Currency	Planning prices 2022	Assumed Recovery (%)
Copper	USD 7 200/tonne	56.0
Zinc	USD 2 600/tonne	93.2
Lead	USD 2 000/tonne	82.2
Gold	USD 1 400/tr.oz	69.6
Silver	USD 20/tr.oz	75.8
USD/SEK	8.00	
EUR/SEK	9.35	
EUR/USD	1.17	

Based on the long-term prices and recovery from Table 3-7, the following formula is used to calculate the long-term NSR for Garpenberg:

NSR_LTP (SEK/ton)= 220*Au(ppm)+3.38*Ag(ppm)+293*Cu(%)+133*Zn(%)+116*Pb(%)

Zn and Ag are the commodities that contribute the most to the value of Garpenberg, they account for respectively 42% and 33% of the total value. The other commodities have relatively lower contribution, with 17% for Pb, 7% for Au and 1% for Cu.

The direct costs for mining and processing a tonne of ore are defined as the variable costs. Variable costs include for example consumables, transportation costs and mine sustaining investments. The variable costs are summarized to around 270 SEK/t. This cut-off is used in the stope creation process to decide, whether to include material in a stope or not. Additionally, a minimum operational cut-off of 400 SEK/t is used for the whole stope.

The site operational costs include not only the variable costs, as defined above, but also fixed costs, such as personnel costs and facility maintenance, and costs for future strategic mine development. Depreciations and capital investments are not included in the site operational costs. The site operational costs are around 530 SEK/t.

A table of the costs distributions and the cut-offs are summarized in Table 3-8.

Table 3-8.The different cut-offs considered for Garpenberg.

Costs distribution	Total											**Cost value (SEK/t)**
	Operational											
	Mine - fixed costs	**Mine - variable costs**	Mill - fixed costs	**Mill - variable costs**	Services - fixed	**Services - variable**	Reclamation fund	**Investment (sustaining)**	Investment (capital)	Capitalized costs	Depreciation	
Variable costs (Low grade stopes / Drifts)		**X**		**X**		**X**		**X**				**270 SEK/t**
Site operational	**X**	**X**	**X**	**X**	**X**	**X**	**X**					**400 SEK/t**
Site operational (with sustaining CAPEX)	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**		**X**		**530 SEK/t**

3.12 Mineral Resources

The process from modelled mineralization to reported resource described in this chapter is shown in Figure 3-8 in step 1-4. In Garpenberg, mineralization is interpreted in Leapfrog Geo guided by grades, NSR values and geological assumptions. The interpretation process results in 3D mineralization wireframes which are used as domains in resource estimation.

Two different resource estimation methods are used in block models. Ordinary Kriging (OK) is usually used in areas where there is sufficient drillhole data and Inverse Distance (ID) is usually used in areas with less available data. Resource estimation is conducted in Datamine or Leapfrog Edge. Though, there are still some older mineralization models and block models in use that were created in Propack (add-on to the CAD program MicroStation), however those models contain only a fraction of reported volumes. Table 3-9 shows block models with estimation methods and software used as well as block sizes for each of the ore bodies in Garpenberg. The block sizes are selected from spacing in supporting data, in combination with complexity in ore geometry and scale of mining.

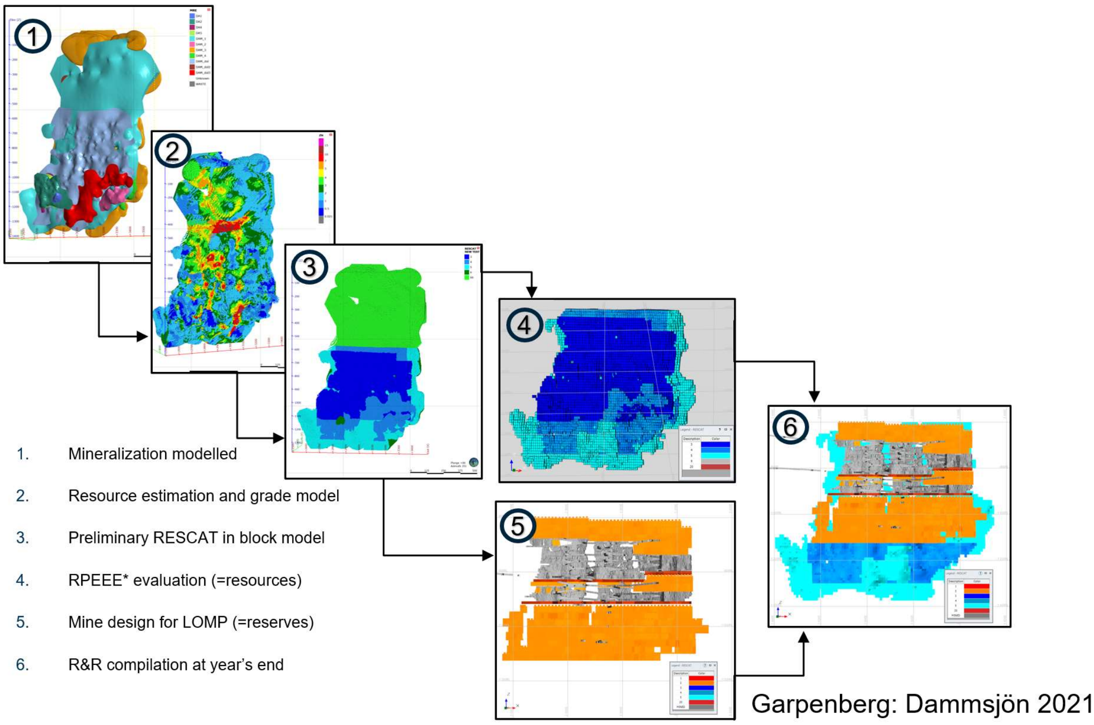

Figure 3-8. Garpenberg modelling workflow.

Table 3-9. Garpenberg block models and estimation methods.

Block model	Major lenses	Ore body	Method	Software	Blocksize X*Y*Z
BLGAR		Garpenberg south *	ID	Datamine	10*3*5
BLTYS	FI1-6, TY1-3, KY1-2	Finnhyttan, Kyrkan,Tyskgården	ID	Datamine	6*4*6
BLDAM	DAM1-DAM3, DAM_dol1-3	Dammsjön	OK	Leapfrog Edge	6*4*6
BLKVB	KVA, KVB, KVC, KVD, KVG	Kvarnberget	OK	Datamine	6*4*12.5
BLLBP	LA, LB, LC, LD, LE	Lappberget	OK	Datamine/ Leapfrog Edge	10*6*6
BLNOR	HU1-HU6	Huvudmalmen	OK	Leapfrog Edge	10*5*6

BLNOR	KA1, KA2	Kaspersbo	OK	Leapfrog Edge	10*5*6
BLNOR	F	Gransjön	ID	Propack	20*10*6
BLGRN	AAA, BBB, CCC, DDD	Gransjön Open Pit	ID	Propack	10*5*10
BLSTAT	ST2, ST3	Stationen	ID	Leapfrog Edge	10*5*6

* Including Kanal, Strand and older parts of Finnhyttan and Kyrkan-Tyskgården

In the end of the resource estimation process, Mineral Resource classification takes place using several criteria. Quality of informing data is first validated where new data generally is deemed of a higher quality than historical data. Considering Garpenberg geology, grade continuity and statistical analyses, a drill pattern of 100 x 100 m is used as a guideline for inferred, 50 x 50 m for indicated and 25 x 25 m for measured resource. However, Tyskgården-Finnhyttan is an exception since complex geological conditions demand a denser drilling grid. The final classification depends on drill pattern in combination with below listed criteria, and the process is conducted for every estimation where characteristics of the individual mineralized lenses are taken into consideration.

- Geological complexity
- Quality and quantity of informing data
    - Confidence in analytical results
    - Confidence in borehole surveying
    - Analytical data
    - Results of geostatistical analysis, variography, and QKNA
- Metallurgical factors or assumptions
- Confidence in the block estimates

Traditionally the Mineral Resources were calculated directly from mineralization wireframes. However, in resource estimations finished in 2020 or later, an evaluation of Reasonable Prospect of Eventual Economic Extraction (RPEEE) has been conducted in Deswik Stope Optimizer, applying a cut-off and mining parameters on existing block model (more information on the Deswik Stope Optimizer in chapter 3.13). The latter case stands for more realistic mineable tonnage and grades, which signify less adjustments when eventually converting Mineral Resources into Mineral Reserves. For Lappberget, Kvarnberget and Dammsjön a resource cut-off of 300 SEK/t was used and for Huvudmalmen, Kaspersbo and Stationen a cut-off of 400 SEK/t was used. For the smaller ore bodies in the south, higher cut-off values have been used. All reserve and resource tonnes and grades are interrogated from the seven active block models in Garpenberg listed in Table 3-9 and reported according to the PERC standard (See Figure 2-1).

3.13 Mineral Reserves

When converting Mineral Resources to Mineral Reserves, a number of parameters have to be considered, the most important ones being economic feasibility and rock mechanics. The rock mechanic conditions determine the amount and size of pillars and sill pillars as well as the length and width of mined stopes. Weak or unstable rock volumes might be discarded completely from the mineral reserves. The volume and geometry of the mineralization will likely determine which mining method to apply. The choice of mining method should also optimize the NPV (Net Present Value) of the ore volume.

With the sublevel stoping method, the Mineral Reserves are defined by designed stopes whereas the corresponding Mineral Resources are defined either by designed stopes or by the mineralized envelope above cut-off. Since designed rooms mostly are formed as cubes with 90 degree corners and the mineralized envelopes are irregular, some of the ore at the edge of the mineralization might get left out when converting resources to reserves. Likewise, some waste rock might be included at the edges of the mineralization.

Boliden Garpenberg utilizes the mine planning tool Deswik Stope Optimizer (SO) for designing of stopes. SO automates the design process and allows for a number of stope properties including general shape and orientation, cut-off grade, dilution and pillar size. Table 3-10 summarizes the criteria used by SO in different areas in Garpenberg.

Table 3-10. Design properties used by SO to generate stopes in different ore bodies in Garpenberg.

SO criteria	Allow up	min	max
Waste material	20%		
Dilution	25%		
Stope length Lappberget/ Huvudmalmen/Dammsjön	-	4 m	80 m
Stope length Kvarnberget/ Södra malm	-	4 m	40 m
Stope height	-	20 m	35 m

The cut-off grade used is based on the cost distribution presented in chapter 3.11. Variable costs will define what material can be included in a stope, and a full stope needs to cover site operational costs without sustaining investments. Additionally, the average NSR for each time period needs to be higher than the full site operational costs. Moreover, the cut-off is adjusted for each ore body and mining method.

For Lappberget, the separation into a main and a second pass sequence, as mentioned in chapter 3.10, is done based on different cut-offs for different mining etages. The cut-off is chosen in such a way that both mining sequences are mineable and a favorable NPV is achieved. The different cut-offs used for design with SO are presented in Table 3-11.

Regarding the classification to Proved Mineral Reserves, several criteria must be met. First, the reported position must comply to the conditions for a Measured Resource. Secondly, all required permits must be in place. Today the tailings management facility (TMF) has enough capacity to mine until 2031-32 according to the current permit. In that regard, it was decided that at least 60% of a position needed to be in the mine plan before 2032 in order to be classified as Proved Reserve.

Table 3-11. Different cut-off values used for design of the stopes with SO in the different areas in Garpenberg.

Orebody	Mining block	Cut-off (SEK/t)	Cut-off for main sequence (SEK/t)
Lappberget	E1100	300	-
	E530/E700/880/1250/1400/1600	270	730
Kvarnberget	all	270	-
Kaspersbo	all	300	-
Dammsjön	E700/852	520	-
	E1100/E1300	270	-
Huvudmalmen	all	270	-
Finnhyttan	all	270	-

Table 3-12 shows the Mineral Resources and Mineral Reserves for Garpenberg as per 2022-12-31.

Table 3-12. Mineral Resources and Mineral Reserves in Garpenberg 2022-12-31

	2022						2021					
	kton	**Au**	**Ag**	**Cu**	**Zn**	**Pb**	kton	Au	Ag	Cu	Zn	Pb
Classification		**(g/t)**	**(g/t)**	**(%)**	**(%)**	**(%)**		(g/t)	(g/t)	(%)	(%)	(%)
Mineral Reserves												
Proved	**18 700**	**0.24**	**97**	**0.04**	**3.1**	**1.3**	7 700	0.18	135	0.03	3.3	1.2
Probable	**90 600**	**0.30**	**85**	**0.04**	**2.5**	**1.1**	86 000	0.32	90	0.05	2.8	1.3
Total	*109 300*	0.29	87	0.04	2.6	1.2	*93 700*	0.31	93	0.04	2.8	1.3
Mineral Resources												
Measured	**100**	**0.24**	**108**	**0.03**	**2.8**	**1.0**	100	0.24	108	0.03	2.8	1.0
Indicated	**21 600**	**0.41**	**70**	**0.06**	**2.7**	**1.3**	30 500	0.40	83	0.06	2.6	1.3
Total M&I	*21 600*	0.41	70	0.06	2.7	1.3	*30 600*	0.40	83	0.06	2.6	1.3
Inferred	**67 400**	**0.34**	**57**	**0.05**	**2.3**	**1.1**	48 400	0.35	50	0.06	2.3	1.1

3.14 Comparison with previous year/estimation

In 2022 Mineral Reserves increased by 15.6 Mt to 109.3 Mt. Measured and Indicated Resources decreased by 9.0 Mt to 21.6 Mt mostly because of an upgrade from resources to reserves. Inferred Resources increased by 19.0 Mt to 67.4 Mt. Table 3-13 shows the changes in detail, including changes in metal grades.

Figure 3-9 and Figure 3-10 show the changes in Mineral Reserves and Mineral Resources respectively between 2021-12-31 and 2022-12-31, with the explanation of what caused these changes.

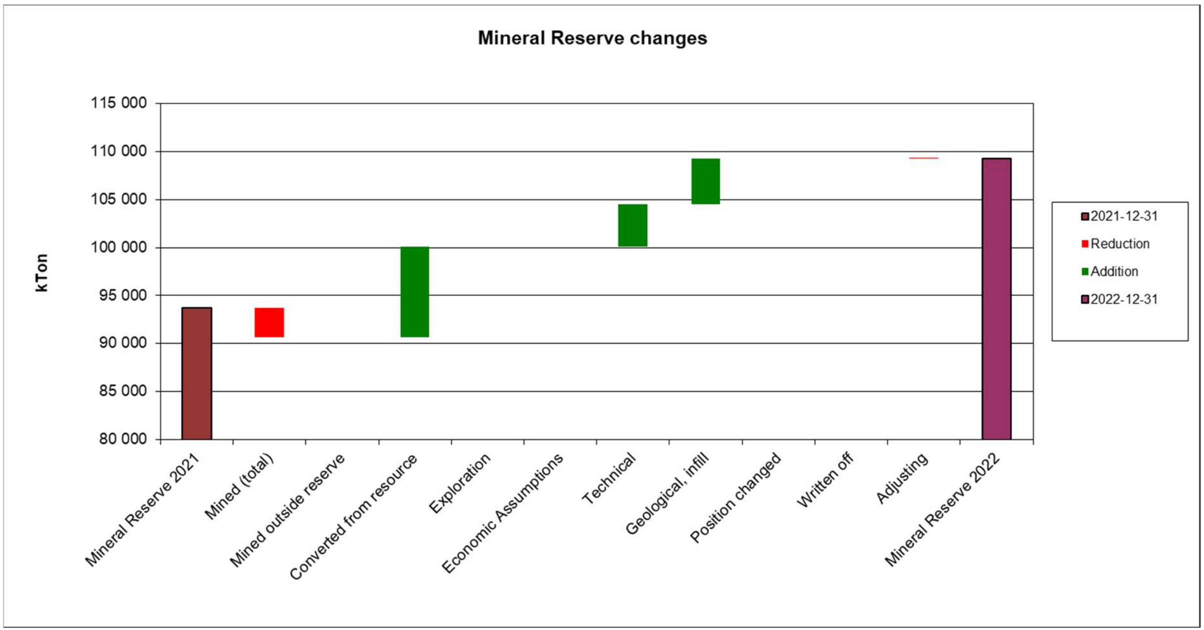

Figure 3-9. Changes to Mineral Reserves between 2021-12-31 (leftmost column) and 2022-12-31 (rightmost column). The other columns show the causes for reduction (in red) and addition (in green) of tonnage. Note that the scale of the y-axis has been adjusted and starts at 80 000 kton.

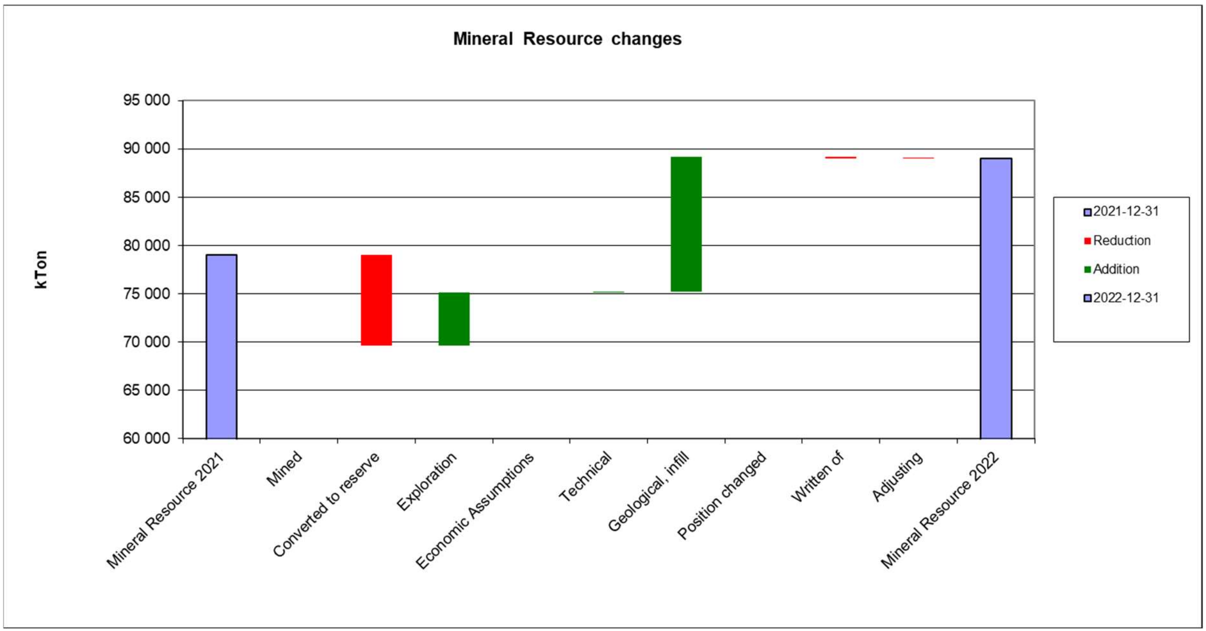

Figure 3-10. Changes to Mineral Resources between 2021-12-31 (leftmost column) and 2022-12-31 (rightmost column). The other columns show the causes for reduction (in red) and addition (in green) of tonnage. Note that the scale of the y-axis has been adjusted and starts at 60 000 kton.

In Dammsjön, DAMM 1100-1300z is upgraded from Indicated Resource to Probable Reserve (Figure 3-11). The previous Indicated Resource was reported for position 1125-1300z, but the reserves were adjusted to be consistent with the mining etages. The total tonnage of the new reserve position is 9.1 Mt with average metal grades of 0.25 g/t Au, 85 g/t Ag, 2.3% Zn and 1.1% Pb. Moreover, a new design was completed for Etage 1100, based on the last update of the block model in 2021. This etage was previously entirely reported as Probable Reserve, but the central part, which will be mined in its majority before year 2032, is now upgraded to Proved Reserve. The total combined tonnage of the reserve positions for level 925-1100z is 12.1 Mt.

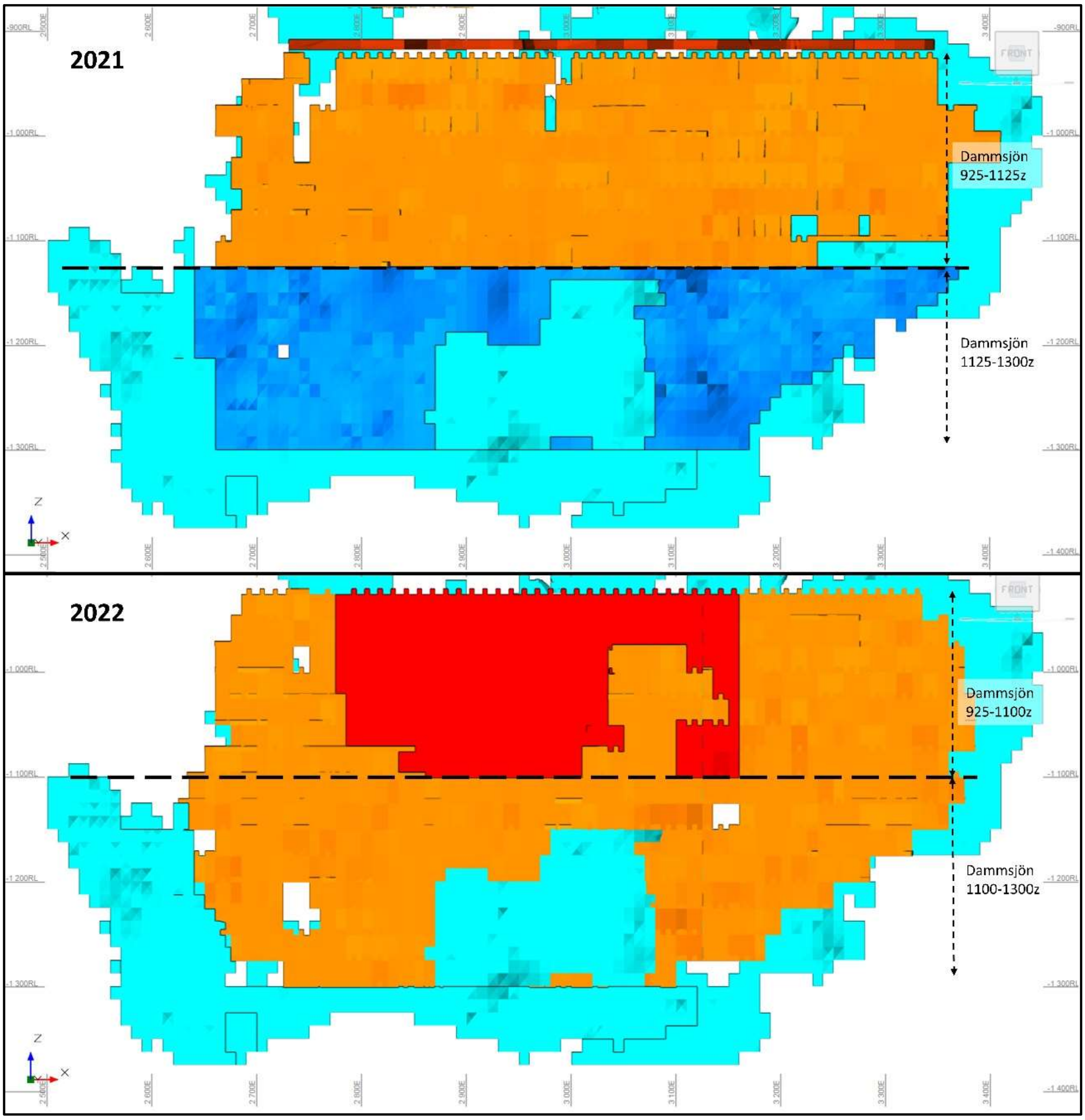

Figure 3-11. Changes in resources and reserves in Dammsjön below 900z. The image is a front view of the Dammsjön ore body, looking North.

In Huvudmalmen, a new block model update was completed in 2022, based on a new geological interpretation of the ore body and some new infill drilling, as well as an extensive campaign of re-sampling of historical drill cores. Following the resource update, a new mine design was generated for Etage 1100. The new design includes a main area mined with transversal longhole stoping, and a separate, longitudinal stoping area in the backside of the orebody. Etage 1100 (position HUVU 1005-1113z) is reported as Probable Reserve as previous, but the new reported tonnage is significantly higher, with a 4.1 Mt increase compared with the last reported tonnage (Figure 3-12). Moreover, part of Etage 1100, on the eastern edge and on the back side, is reported as Inferred Resource, due to the insufficient drilling coverage in this area.

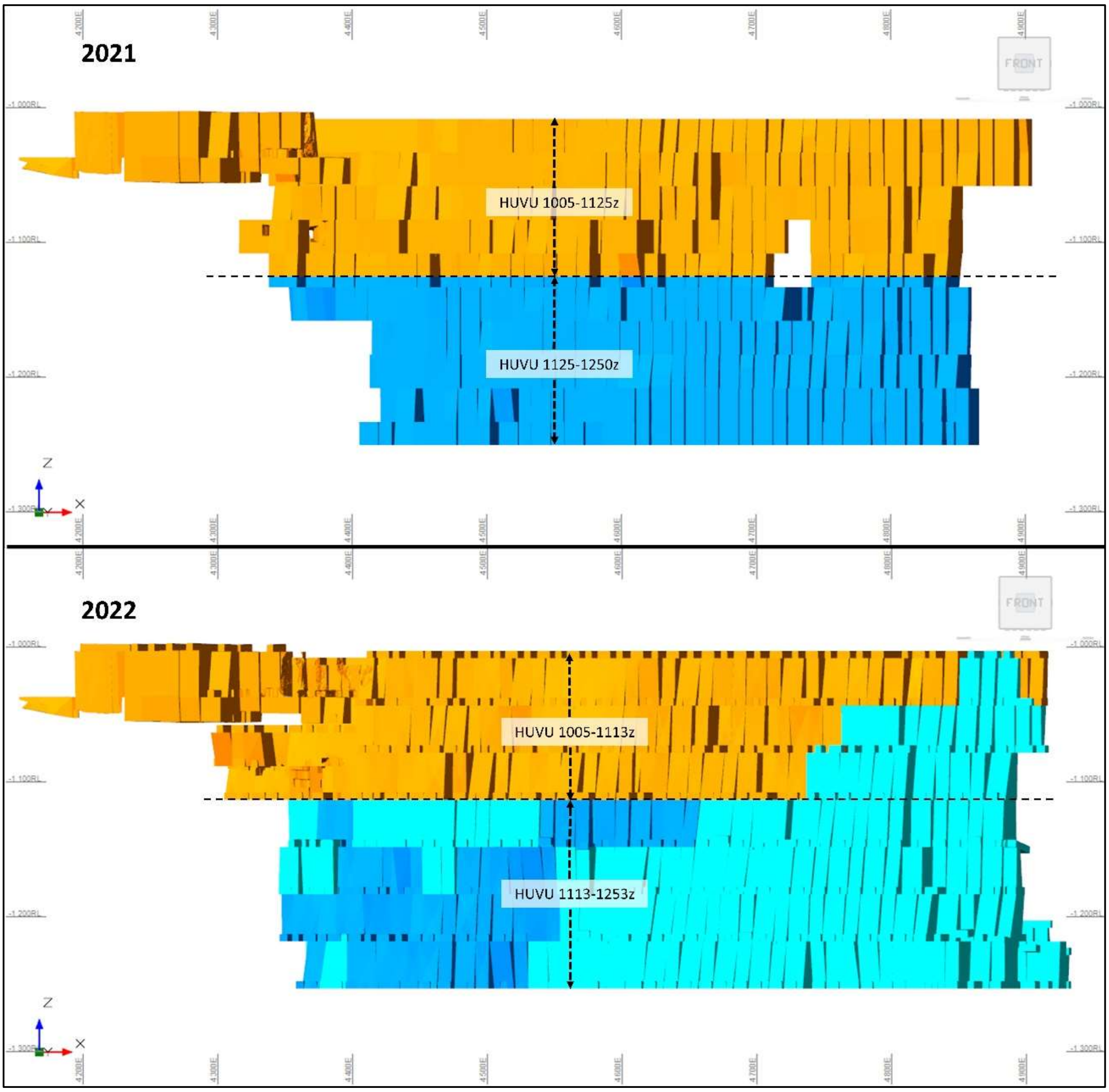

Figure 3-12. Changes in resources and reserves in Huvudmalmen between approximately 1000z and 1250z. The image is a front view of the Huvudmalmen ore body, looking North.

There are also significant changes in the reporting of the lower part of Huvudmalmen (HUVU 1113-1253z) (Figure 3-12). It was previously reported as Indicated Resource, but following the latest block model update, it has been decided to downgrade part of it to Inferred Resource because of the lower density of the drilling coverage. The combined tonnage of the resource positions for level 1113-1253z is 23.3 Mt (12.2 Mt Indicated Resource at 0.36 g/t Au, 79 g/t Ag, 2.31% Zn, 1.04% Pb and 11.1Mt Inferred Resource at 0.41 g/t Au, 68 g/t Ag, 2.02% Zn, 1.0% Pb), which is an 11.8 Mt increase (the grades are significantly lower than previously reported).

In Lappberget, relatively few changes were made in the reserves in comparison to 2021. Lappberget 358-410z was converted from Indicated Resource to Probable Reserve, but the tonnage is relatively small (less than 1 Mt addition to the reserve). Moreover, part of LAPP 840-1038 is converted back from Probable Reserve to Proved Reserve, after being downgraded in 2021. The reason is that most of this area will be mined before 2032.

When it comes to the resources, the exploration department drilled extensively towards a new mineralization in Garpenberg South that was named Stationen (see Section 3.9). The drilling allowed to define a new Inferred Resource of 5.5 Mt at 0.11 g/t Au, 98 g/t Ag, 3.1% Zn, 1.0% Pb.

Mined out tonnage in 2022 totals 3 041 Kton, which is a decrease by 11 Kton from previous year. Metal grades of the mined-out tonnage is as follows: 3.6% Zn, 1.4% Pb and 117 ppm Ag. Almost 75% of all mined out ore derived from Lappberget.

Table 3-13. Mineral Resources and Mineral Reserves in Garpenberg as per December 31, 2022. Numbers in brackets show changes from last year.

Classification	kton 2022-12-31		Au (g/t)		Ag (g/t)		Cu (%)		Zn (%)		Pb (%)	
Proved Mineral Reserve	18 658	(+10 958)	0.24	(+0.06)	97	(-38)	0.04	(+0.01)	3.1	(-0.1)	1.3	(+0.1)
Probable Mineral Reserve	90 640	(+4 640)	0.30	(-0.02)	85	(-4)	0.04	(-)	2.5	(-0.3)	1.1	(-0.1)
Total Mineral Reserve	*109 298*	*(+15 598)*	*0.29*	*(-0.01)*	87	*(-6)*	*0.04*	*(-)*	*2.6*	*(-0.2)*	*1.2*	*(-0.1)*
Measured Mineral Resource	68	(-)	0.24	(-)	108	(-)	0.03	(-)	2.8	(-)	1.0	(-)
Indicated Mineral Resource	21 556	(-8 969)	0.41	(+0.02)	70	(-13)	0.06	(-)	2.7	(+0.1)	1.3	(-)
Sum Measured and Indicated	*21 624*	*(-8 969)*	*0.41*	*(+0.02)*	*70*	*(-13)*	*0.06*	*(-)*	*2.7*	*(+0.1)*	*1.3*	*(-)*
Inferred Mineral Resource	67 413	(+18 976)	0.34	(-0.02)	57	(+8)	0.05	(-)	2.3	(-)	1.1	(-)
Total Mineral Resource	*89 037*	*(+10 006)*	*0.36*	*(-0.01)*	*60*	*(-2)*	*0.05*	*(-)*	*2.4*	*(-)*	*1.1*	*(-0.1)*

3.15 Reconciliation

In order to confirm the precision of the geological interpretation, modelling, grade interpolation etc., actual mining volumes times block model grades are checked against the measured results from the processing plant. This procedure called reconciliation is carried out every month and presented quarterly. Monthly estimates vary dramatically depending on the mine's logistics of stocks in the mine and on surface. The turnover of the stocks also varies a lot.

The grades of the mined-out ore are calculated from the block model using the tonnage reported as loaded from the stopes and surveyed tonnage from cut and fill and development ore. The ore can either be transported directly to the plant or put in stockpiles underground. Above ground, there is an ore storage facility which at the beginning of 2021 contained 30 Kton of ore. During the year the tonnage fluctuated between 19 Kton and 82 Kton. At the end of the year the storage contained 82 Kton of ore.

For the annual report of Reserves and Resources, the reconciliation is compiled from a weighted aggregation of the four quarters (rolling 4 quarters). Table 3-14 shows monthly and quarterly results for 2021 from the mine and the processing plant. The year total is shown on the bottom row. The official grades for Garpenberg are those of the processing plant.

Table 3-14. Comparing measured results from the processing plant with calculated results from the block model. Note that the numbers from the processing plant for December are preliminary.

	Metal Grades of Processed Ore						Metal Grades of Mined Ore from Block Model					
Quarter	kton	Au g/t	Ag g/t	Cu %	Zn %	Pb %	PP kton	Au g/t	Ag g/t	Cu %	Zn %	Pb %
jan	229.0	0.20	120	0.06	3.87	1.57	229.8	0.30	122	0.04	3.77	1.58
feb	243.4	0.28	127	0.06	4.52	1.79	239.4	0.33	113	0.04	4.24	1.70
mar	247.6	0.30	105	0.06	3.21	1.38	245.1	0.50	96	0.06	3.95	1.64
2022 Q 1	**720.0**	**0.26**	**117**	**0.06**	**3.86**	**1.58**	**714.3**	**0.38**	**110**	**0.05**	**3.99**	**1.64**
apr	272.0	0.38	129	0.06	3.55	1.35	266.9	0.35	109	0.03	2.87	1.18
maj	255.4	0.22	136	0.04	3.29	1.20	274.4	0.25	135	0.04	3.41	1.21
jun	276.4	0.20	105	0.05	3.84	1.44	264.1	0.26	108	0.05	3.55	1.41
2022 Q 2	**803.8**	**0.27**	**123**	**0.05**	**3.57**	**1.33**	**805.3**	**0.29**	**118**	**0.04**	**3.28**	**1.27**
2022 Q 1+2	**1523.8**	**0.26**	**120**	**0.05**	**3.71**	**1.45**	**1519.6**	**0.33**	**114**	**0.04**	**3.61**	**1.44**
jul	260.8	0.26	84	0.06	3.23	1.33	270.7	0.35	103	0.06	3.05	1.33
aug	260.6	0.17	152	0.05	3.28	1.34	255.1	0.27	154	0.03	3.47	1.40
sep	198.3	0.24	123	0.05	3.24	1.27	191.3	0.36	138	0.05	3.61	1.53
2022 Q 3	**719.7**	**0.22**	**119**	**0.05**	**3.25**	**1.32**	**717.1**	**0.32**	**131**	**0.05**	**3.36**	**1.41**
2022 Q 1-3	**2243.5**	**0.25**	**120**	**0.05**	**3.56**	**1.41**	**2236.7**	**0.33**	**119**	**0.04**	**3.53**	**1.43**
okt	272.3	0.30	98	0.06	3.23	1.42	268.6	0.37	87	0.04	3.49	1.56
nov	171.7	0.37	115	0.06	4.19	1.66	228.6	0.30	90	0.04	3.87	1.54
dec	301.6	0.22	111	0.04	3.75	1.38	306.8	0.27	134	0.04	3.11	1.21
2022 Q 4	**745.5**	**0.28**	**107**	**0.05**	**3.66**	**1.46**	**804.1**	**0.31**	**106**	**0.04**	**3.45**	**1.42**
2022 Q 1-4	**2989.0**	**0.26**	**117**	**0.05**	**3.59**	**1.42**	**3040.8**	**0.32**	**116**	**0.04**	**3.51**	**1.43**

The rolling 4-quarter graph for zinc, lead and silver is shown below in Figure 3-13. The graph shows the difference in % in weighted metal grades between processed ore and mined ore and is calculated with the following equation: (Metal Grade Processing Plant/Metal Grade Block Model)-1. Thus, a positive number means that the grade is higher in the processing plant than in the block model. The values for Q 1-4 2022 seen at the rightmost side of the graph are: +1.6% Zn, -0.8% Pb and +0.7% Ag.

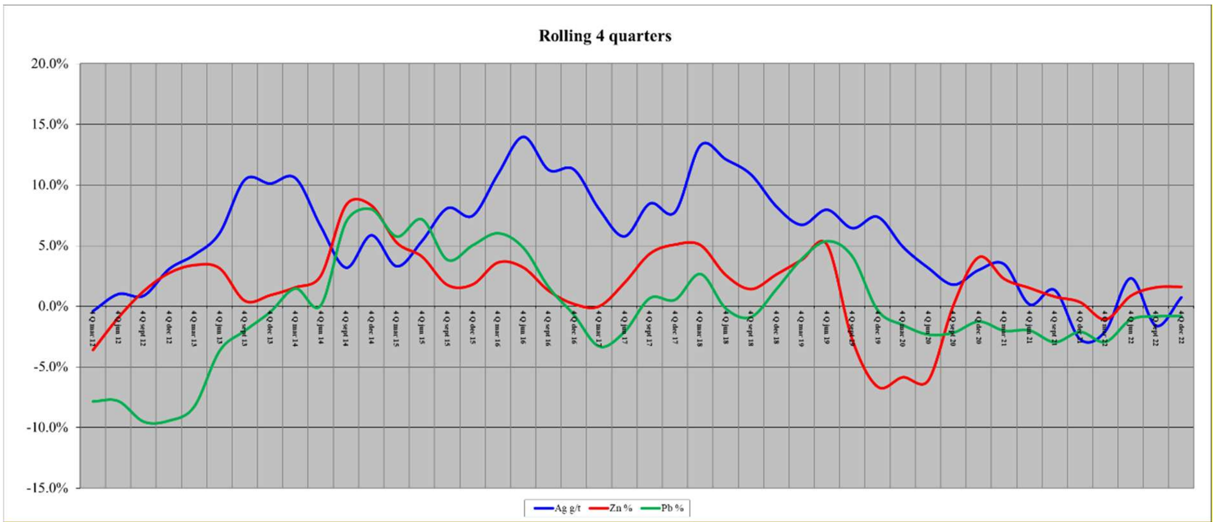

Figure 3-13. Metal grades in processed ore vs metal grades of the mined ore based on the block model, over a ten-year period.

4 REFERENCES

4.1 Public references

Allen, R.L., Bull, S., Ripa, M. and Jonsson, R. 2003. Regional Stratigraphy, Basin Evolution, and the Setting of Stratabound Zn-Pb-Cu-Ag-Au Deposits in Bergslagen, Sweden. Final report SGU-FoU project 03-1203/99, Geological Survey of Sweden.

Bindler R., Karlsson J., Rydberg J., Karlsson B., Berg Nilsson L., Biester H., Segerström U. 2017. Copper-ore mining in Sweden since the pre-Roman Iron Age: lake-sediment evidence of human activities at the Garpenberg ore field since 375 BCE. *Journal of Archaeological Science Reports* **12**: 99-108

Jansson, N.F., Allen, R.L. 2011. Timing of volcanism, hydrothermal alteration and ore formation at Garpenberg, Bergslagen, Sweden. *Geologiska Föreningens Förhandlingar* **133**: 3-18.

Pan-European Standard for reporting of Exploration results, Mineral Resources and Mineral Reserves (The PERC Reporting standard 2021). www.percstandard.eu

4.2 Internal references

Derrien, M. 2022a. Revised position in Mineral Reserves Garpenberg – Huvudmalmen 1005-1113 z. Boliden, DMS #1903237.

Derrien, M. 2022b. New Mineral Reserves Garpenberg – Dammsjön 1100-1300z. Boliden, DMS #1903235.

Derrien, M. 2022c. Garpenberg - årlig sammanfattning av QAQC resultat Infill och Gruvnära diamantborrning 2020. Boliden, DMS #1842920.

Höglund, S. 2022. BlUpdOnSiteG9 Boliden, DMS #562644.

Appendix 1

A historical overview

~1200	Mining operation commences
1544	Gustav Wasa takes over the mining operation
1840	Discontinuation of mining operation
1906	Mining operation resumed
1908	The first concentrator was built
1923	AB Zinkgruvor, Falun takes over the activity from AB Garpenbergs Odalfält
1928	A new concentrator was built
1950-53	New shaft, head frame and a new concentrator were built
1957	Boliden – new owner
1972	The Garpenberg Norra mine in operation
1989	Increased capacity in the concentrator
1994	Shaft extension to 800 m level in Garpenberg Norra
1996	New hoisting shaft, the Gruvsjö shaft, in the Garpenberg mine
1997	A 1000 m long drill hole was sunk towards the south from the ramp in Garpenberg Norra whereupon Kaspersbo and Lappberget were indicated
2000	Connection drift, development starts
2003	Lappberget diamond core drilling to 800 and 1000 meter level
2003	Lappberget in operation. Kvarnberget was indicated in a drill hole drilled from Lappberget. The connection drift between the two mines was completed – one mine.
2007	Paste plant was built and the mining method sublevel stoping commenced
2008	Pre-project study for extension to 2 Mt
2009	Concept study of Water-inflow in Garpenberg
2010	Pre-project study for extension to 2.5 Mt
2011	The expansion to 2.5 Mt commenced during the year Drainage drilling in 500 level in Lappberget started
2013	Drainage pumping has started. The expansion project 2.5 is nearing completion. Kvarnberget has prepared for mining with the first ore blast in December 2013.
2014	Expansion project to 2.5 Mt completed. New crusher, shafts, ore hoists etc. taken into use. First ore from Kvarnberget delivered to the concentrator. Level 1300 Z passed in Lappberget
2016	Production of 2.6 Mt successfully reached. Ventilation shaft to LAPP 554 ready. Record production of paste, 1005 Kton. First transverse stope mined in KVB.
2020	Production of 3.0 Mt successfully reached

2022	Level 1500 Z passed in Lappberget ramp