



BOLIDEN AREA

BIODIVERSITY GRI REPORT 2021

BOLIDEN

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1. GENERAL INFORMATION

Boliden area is a mining area consisting of three underground mines as follows: kristineberg (1,35 km depth), Renström (1,5 km depth), Kankberg (0,62 km depth) along with a recently closed mine in Maurleden. Boliden area also encloses the Boliden site with a concentrator with a gold & tellurium leaching plant (see figure 1). Apart from Kankberg mine, the main ore extracts contain copper, zinc, lead, gold, and silver.



Figure 1. Representation of the different locations of the four pit mines and the concentrator in Boliden Area.

1.1. Kristineberg

Kristineberg's mine is located on the westside of Boliden Area, about 100 km from the concentrator (see figure 2). Ore containing zinc, gold, silver, copper, and lead is mined in Kristineberg. What is more, among all four mines in Boliden area, Kristineberg has a yearly ore production capacity that exceeds 750,000t and it is, by far,

the largest tonnage contributor to the Boliden Area's concentrator.

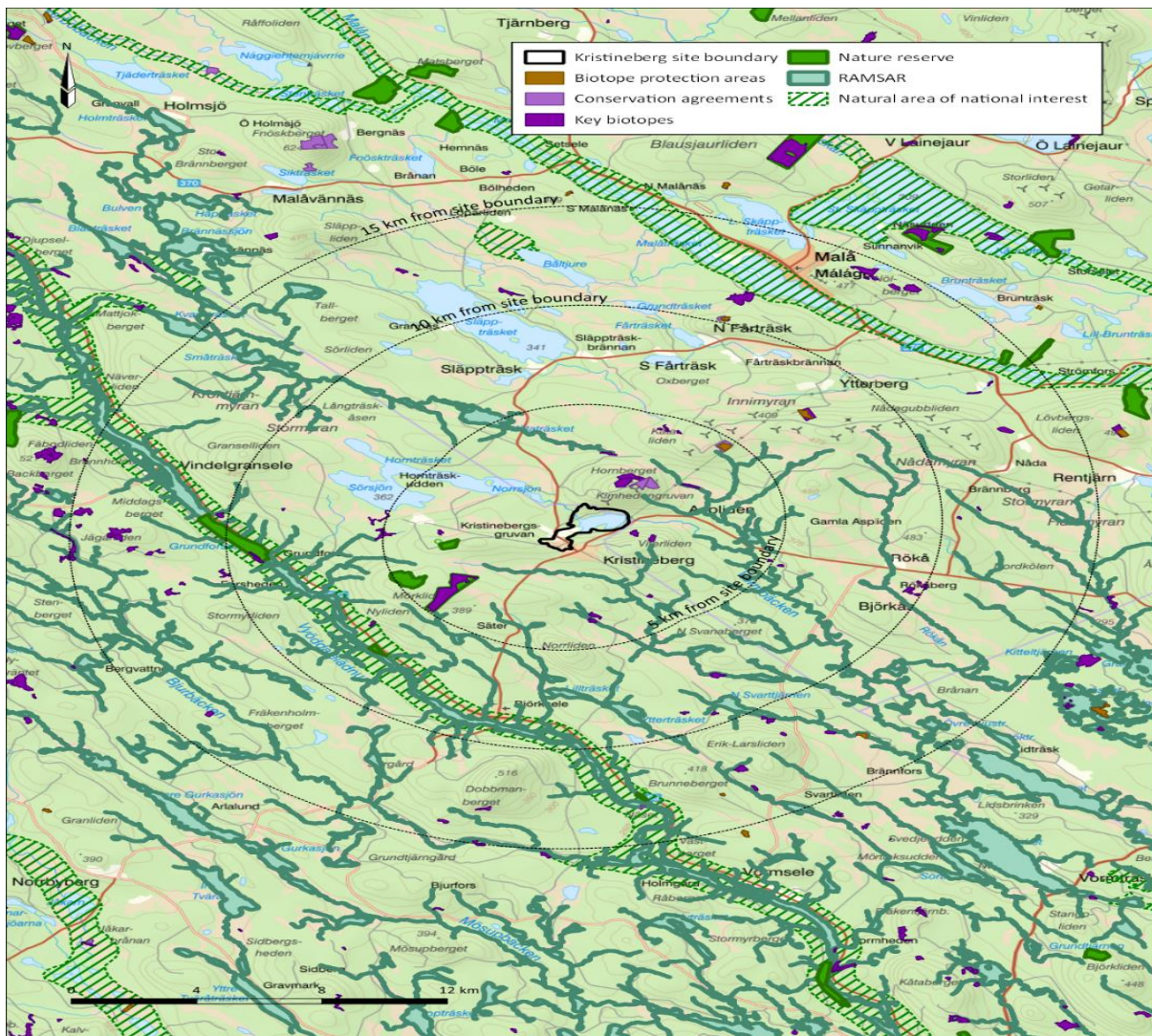


Figure 2. Map showing Kristineberg's site boundary and the surrounding area (5 km radius)

1.1.1. Natura2000 Areas

Water-based Natura2000

Vindelälven

Vindelälven is a natural river with no hydroelectric dams. It is one of Sweden's four large national rivers. The river runs on a length of 3210 kilometers, originating from the alpine region and stretching to the coast. Amongst the species in Vindelälven we find salmon, otter (*Lutra lutra*) and the shell (*Margaritifera margaritifera*). The streams from Vindelälven that are within the area of impacts are Vormbäcken, Kolbäcken, Vattuledningsmyrbäcken and Rävlidmyrbäcken (see figure 3).

Vormbäcken Water Recipient

Vormbäcken has a catchment area of 353 km², with an average lake percentage of 6%. The estimated average flow (MQ) at the mouth of the Vindelälven is 4.43 m³ /s. Just downstream of Kristineberg, where the Natura2000 area begins in Vormbäcken, estimated average flow is 0.7 m³ /s. The water recipient originates mostly from Hornträsket north of the business area/warehouse area. Excess water is discharged from the utility via an extension from reservoir 4 to Vormbäcken, approximately 1 km upstream of the country road between Aspliden and

Kristineberg.

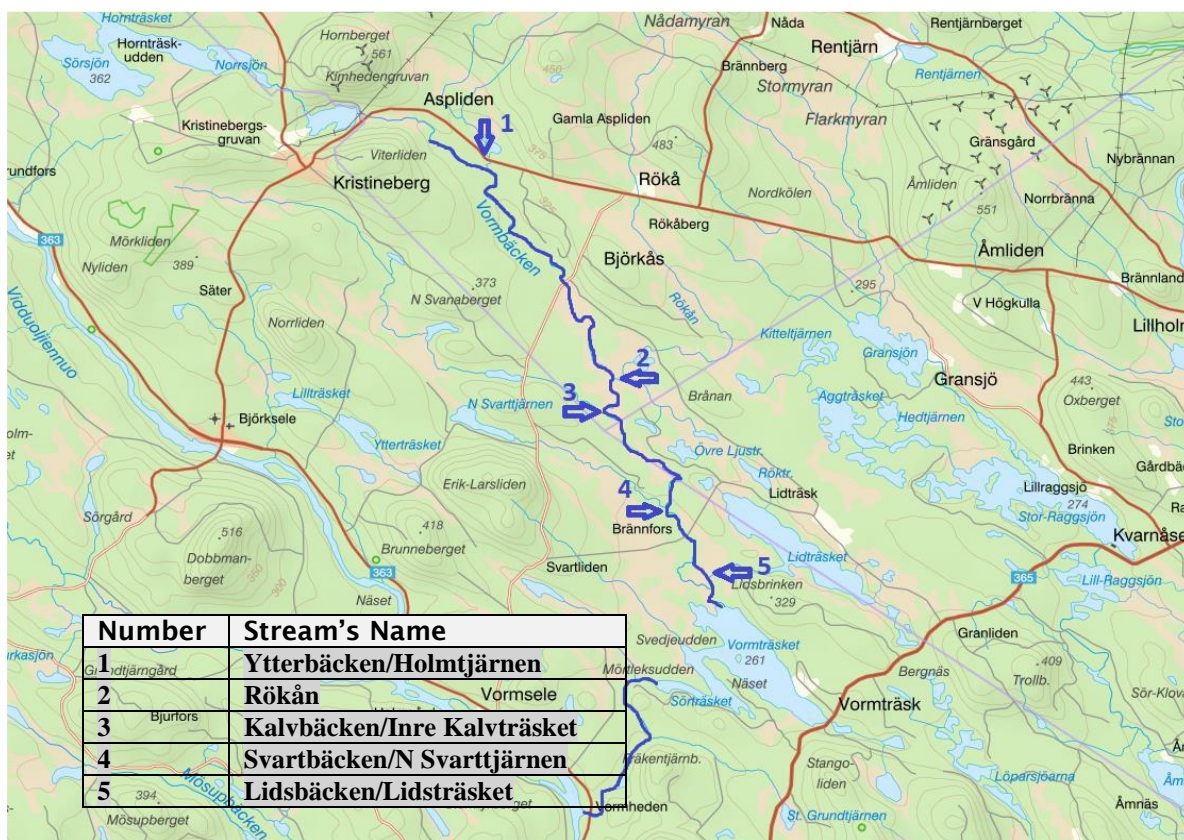


Figure 3. The map shows arrows and numbering that refer to larger streams drained to Vormbäcken before it flows into Vindelälven

The designated species that certainly occur in Vormbäcken are rockfish and otters. Salmon has not been found in recent years in Vormbäcken and it seems that Ävjepilört is not considered to have natural conditions for it. Overall, kristineberg's operations have a negligible impact on the natural water flow in Vormbäcken. Currently, there are no acidification impacts from the facility. Certain metal levels in Vormbäcken's water (in Vormträsket's sediment and in fish from Vormträsket) are still elevated. Still, there are no indications to engendered damages to the environment.

1.1.2. Land-Based Natura2000 Areas

The map below illustrates the surrounding natura2000 areas in the vicinity of Kristineberg (see figure 4). The following represent the land-based areas close to the site: **Rävliden, Vindel storforsen, Lomset, Norrvasund and Ransar.**

1.1.3. Nature Reserves

When it comes to Nature Reserves, we name the following: **Kalkkälltegen, Rävliden and Rävliden Gruvan.**

1.1.4. Water Protection Areas

For water protection areas near Kristineberg's site, we find **Aspliden.**

1.1.5. Key biotopes

Nature Protection Agreements

Regarding nature protection agreements, we distinguish **Hornberget.**



Figure 4. Map illustrating Natura2000 areas within Kristineberg Area (15 km radius)

1.1. Mauliden

The Mauliden (w)'s open pit mine is located to the northwest of Boliden Area, about 50 km from the concentrator Plant (see figure 5). Mauliden consists also of a sulfide deposit with Zinc as the primary metal. Operations began in 2000 and it was closed 2019.

Approximately 4.9 Mtonnes of waste rock is stored and 260,000 m³ of evacuation masses.

1.1.1. Natura2000 Areas

Land-based

According to the above map, we can distinguish the following land based natura2000 areas areas: **Borup, Borup Baksidan, Västra Finnliden, Östra Finnliden, Ol-Ersaberget, Svanselse, kryddgrovan, Gallejaur and Lill-Rörmyran.**

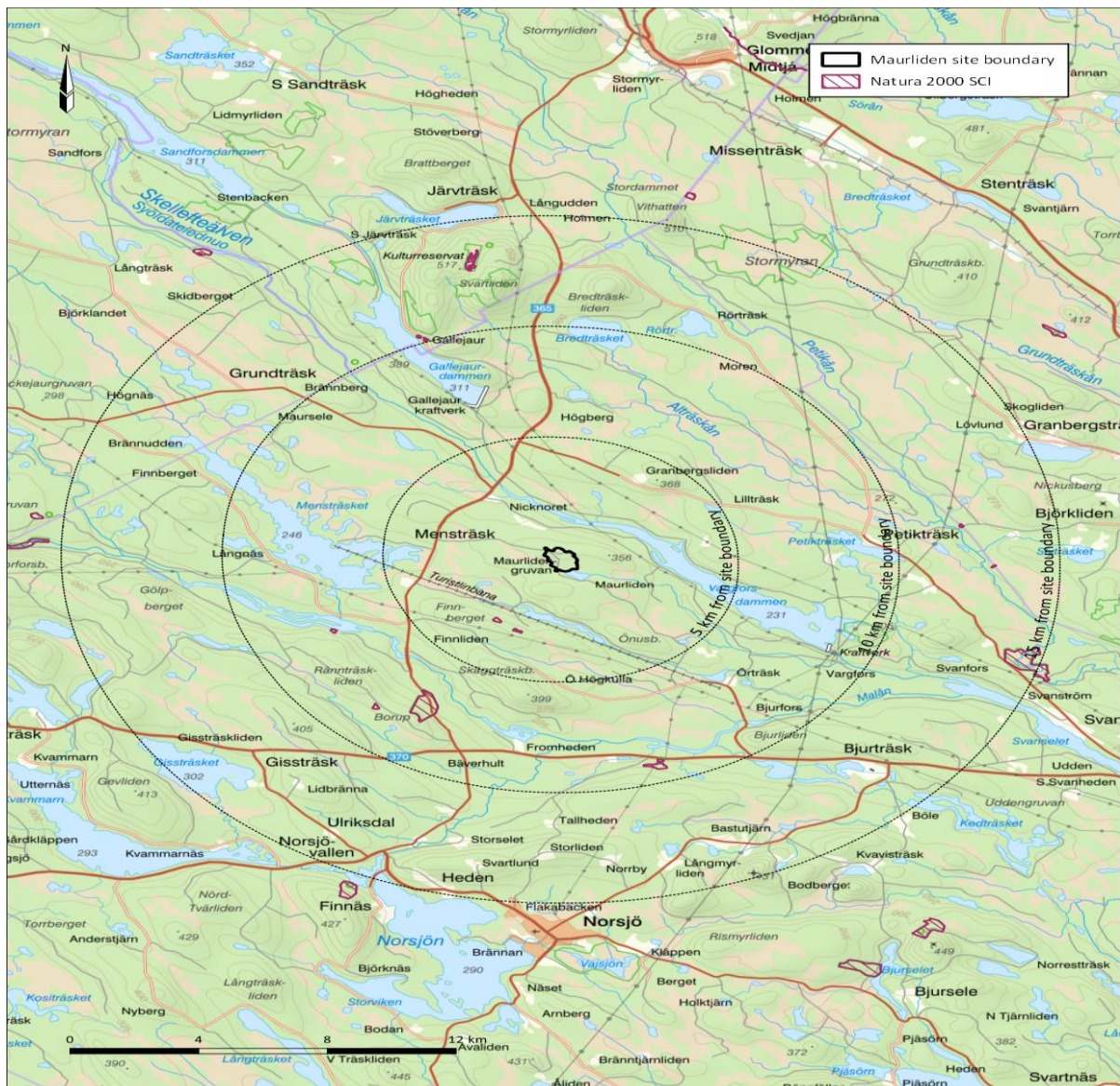


Figure 5. Map illustrating the site boundary of Mauriliden site and its surrounding natura2000 areas (15 km)

1.1.2. Nature Reserves

For nature reserves, the areas found close to Mauriliden's site are **Abbotjänberget, Borup, Kryddgrovan, Åheden, Gallejaur, Lill-Träsktberget, Svartliden, Whitberget, Bergmyrbäcken** and **Vithattsmyrän**.

1.1.3. Culture Reserves

Cultural reserves are valuable environments that have been granted special protection and are handled according to a specific plan by the county or municipality. Close to Mauriliden we have two culture reserves: **Gallejaur** by and **Rörträsk silänger**.

1.2. Kankberg

Kankberg mine is located within the vicinity of Boliden, Skellefteå municipality (see figure 6). Today, Boliden Mineral AB carries out ore and waste rock mining underground in Åkulla mineralization, under the old open pit Åkulla Östra. Ore is mined at a depth between 300-600 m, containing gold silver and tellurium. Up to 500 kt of

ore may be mined per year. With an increased potential for Kankberg’s mine, Boliden is planning for a depth expansion with a production up to 650 ktonnes per year.

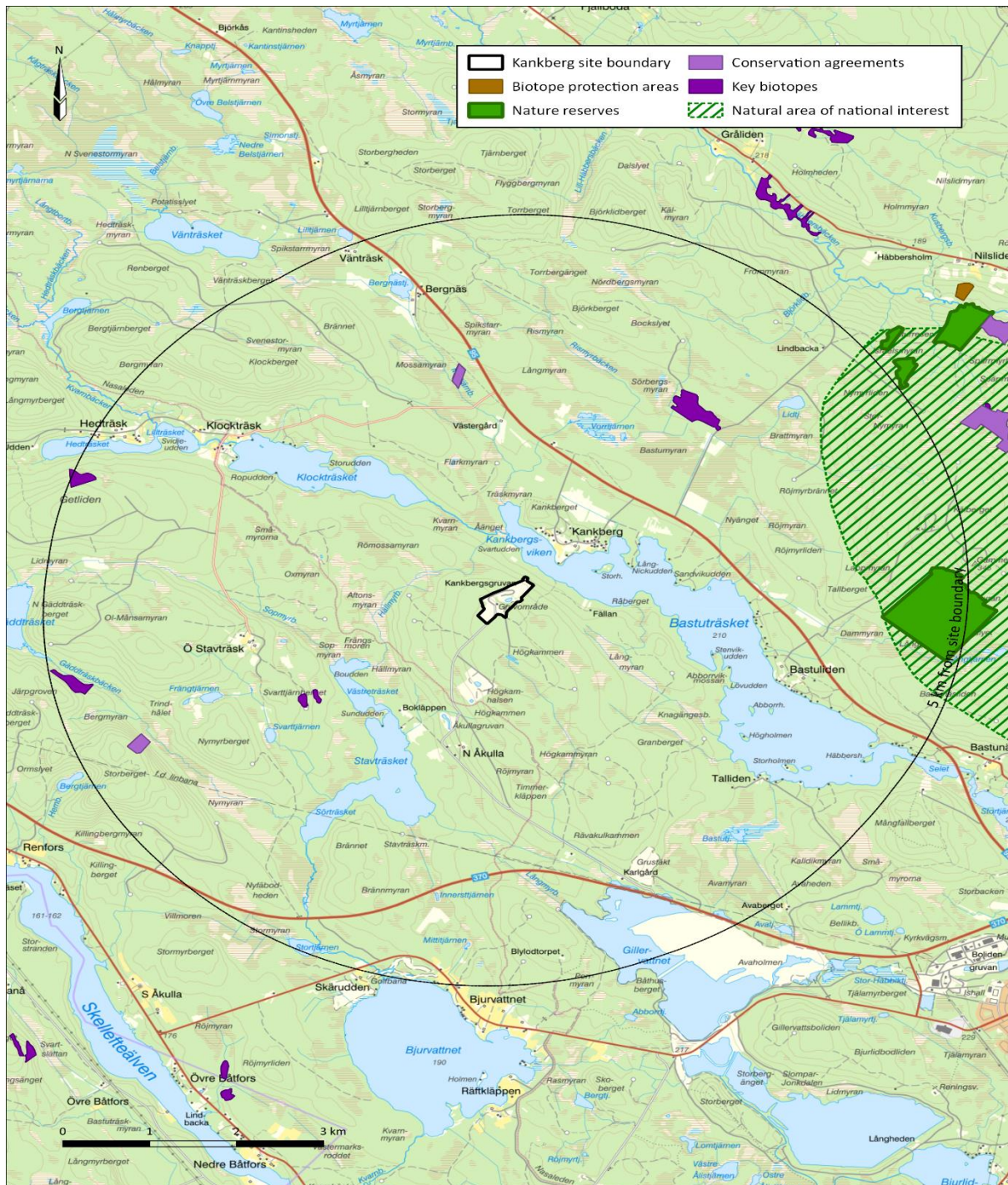


Figure 6. Map showing Kankberg’s site boundary and the surrounding area within 5 km radius

1.2.1. Natura2000 Areas and Nature Reserves

Land-Based Natura2000

The following areas are identified as land-based natura2000 close to kankberg’s site:

Blyodmyran, Brännberget description, Nymryliden, Spärmyrberget, Israelsmyran and Kälberget.

1.2.2. Nature Reserves

Touching upon nature reserves close to Kankberg's site, we have three areas which are both natura2000 and nature reserves such as **Blylodmyran, Brännberget** and **Nymyrliden**. The other three are exclusively nature reserves: **Kalkällmyran, Nördestmyran** and **Spärmyrberget**.

1.2.3. Biotope Protection Areas

Nature Protection Agreements

As for nature protection agreements, we have this type of areas, but they have not been named nor do they come with specific data. They are referred to as "Naturskogartad barrskog: boplats, spelplats and växtplats".

1.2.4. Water Protection Areas

Skelleftedalen is a water protection area located in Västerbotten's county impacting both municipalities of skellefteå and Norsjö. The area has a total size of 53,012.4 ha, of which 50 150.0 ha is land based (productive forest land is around 38,693.7 ha) and the rest is water based.

1.3. Renström

Renström mine is located approximately 17 km northwest of the Boliden Area (see figure 7). It produces from polymetallic mineralization of Volcanogenic Hosted Massive Sulphide type. The production in 2018 was 440kt with gold, silver, copper, zinc and lead. The mine has been in production since 1948 and the mining today is done underground between 600 and 1400 m depth.

1.3.1. Natura2000 Areas

As illustrated in figure 6 above, we can distinguish the following natura2000; **Nymyrliden, Spärmyrberget, Israelsmyran** and **Kälberget**.

1.3.2. Nature Reserves

As for nature reserves, we have overlapping areas which are both natura2000 and nature reserves such as **Nymyrliden, Spärmyrberget** and **Israelsmyran**. We also have an exclusive nature reserve: **Kalkällmyran**.

1.3.3. Water Protection Areas

For water protection areas, we have two: **Skelleftedalen** and **Bastuliden**.



Figure 7. Map Illustrating the site boundary of Renström's site and its surrounding natura2000 areas (15 km)

1.4. Boliden Site



Figure 8. Map illustrating the site boundary of Boliden Area and its surrounding

1.4.1. Natura2000 And Nature Reserves

Land-based

Both Boliden site and Kankerg share similar natura2000 areas, which can be spotted in figure 8. These are as follows: Blylodmyran, Brännberget, Nymyrliden, Spärmyrberget , Israelsmyran and Kälberget.

1.4.2. Nature Reserves only add the new ones (removes the ones that overlap)

As for nature reserves, we mention the following areas: **Kalkällmyran, Nördestmyran, Granbergmyran and Hornsmyran**

1.4.3. Biotope Protection Areas

Nature Protection Agreements

Once again, Boliden site also encloses this type of areas, but they have not been named nor do they come with specific data. They are referred to as “**Naturskogartad barrskog: boplats, spelplats and växtplats**”.

1.4.4. Water Protection areas

Skelleftedalen: No specific information was found on this area.

2. IMPACTS OF ACTIVITIES ON BIODIVERSITY

We have 6 criteria for which impacts on biodiversity should be evaluated: **Impact on Air, Discharge to Water, Land use, Noise and Disturbance and Greenhouse gases.**

2.1. Impact on Air

2.1.1. Kristineberg

The Environmental Assessment Ordinance dictates that Boliden's current operations within Kristineberg must always be assumed to engender substantial environmental outcomes. This assumption was made to provide a preventive and time-efficient consultation process with a comprehensive environmental impact assessment. An ecological impact is not automatically presumed to arise in the event the mines' operations.

New changes in the environmental impacts are more concerned with an additional area of influence around the new deposit in Rävliiden and the connection to Kristineberg, along with an increased amount of mining water to be treated in a new treatment plant around the area.

From a health perspective, consequences for emissions to air and dust are judged to range from small negative to insignificant when it comes to current guideline values and norms.

Emissions to air in connection with the current changes will continue to arise mainly from the combustion of diesel in work vehicles from loading and transport of ore in the mine and from transports between the mine and the concentrator in Boliden. Consumption of explosives, LPG and heating oils will also continue to generate emissions of nitrogen oxides (NO_x), carbon dioxide (CO₂) and sulfur dioxide (SO₂). Overall, as the business still consumes large amounts of diesel, consequences are expected to be moderately negative in terms of the climate impact and the conservative assumptions regarding the share of fossil-based fuel.

2.1.2. Kankberg

On the local level, no surveys have been carried out regarding the air quality in the area around Kankberg mine or Boliden [4], Skellefteå municipality has only performed air measurements related to traffic on the E4 and the major roads and in central Skellefteå. With regard to emissions to air from the current operations, they are limited to ventilation air from the mine and necessary transportation vehicles to and from the mine.

Regarding emissions of dust, some emissions to air were expected during the construction phase, mainly through emissions of fine particles (PM₁₀) (diffuse dusting). Sources of particles spread are mainly transport & work vehicles, and construction of necessary facilities for the business, e.g., water treatment plant.

As for emissions from transport and blasting, a certain emission of carbon, nitrogen and sulfur oxides and fine particles caused by exhaust emissions (particulate pollutants in exhaust gases) will occur from transport and work vehicles as well as a certain emission of explosive gases, mainly nitrogen oxides and carbon monoxide. Note that the emissions from transport and work machines as well as blasting work during the construction phase have not been calculated. Still, the extent is judged to be negligible compared with the number of transports arising during full operation of the mining operations. With the proposed measures, transports during the construction phase are not considered to cause inconvenience to humans or to the environment.

2.1.3. Maurliiden

Emissions to air from point sources are estimated to occur even though the mine is not in operation predominantly from diffuse dusting from waste rock dumps and rehabilitation work.

Overall, it is difficult to assess the extent of the expected diffuse dusting. However, given the limited size of the planned activities, the scope is not expected to be significant. Boliden intends to take necessary protective measures to minimize the occurrence of such diffuse dusting. Watering and salting of roads or through treatment with environmentally friendly dust control agents is the most important and most effective method to minimize dusting from dumps and various vehicle movements.

2.1.4. Renström

Emissions to air occur mainly from diesel engines during loading and transport of ore. Emissions also occur from, among other things, the combustion of heating oil during heating of ventilation air and from explosive gases when mining rocks.

Based on the annual consumption of fuel oil and explosives, the annual emissions of SO₂, NO_x and CO₂ from heating and blasting are calculated and reported in the corresponding table (see table 2). In case of new condition for the Renström mine, the use of heating oil (WRD oil) and explosives increase proportionally as the increase in production of ore, that is 52%.

Table 2: Summary of expected future emissions to air from Renström's mine

| Emissions at the mines | SO ₂ (kg) | NO _x (kg) | CO ₂ (ton) |
|------------------------|-------------------------|-------------------------|--------------------------|
| WRD oil | 640 | 1040 | 2100 |
| Explosive gases | | 280 | 60 |
| Total | 640 | 1320 | 2160 |

Dusting is largely due to the handling of enrichment sand and transport of sand and ore. Sand is transported by covered cars, which is why the spread of dust is judged to be limited to the mine's immediate area. Asphalt plans within the industrial areas and the transport route between them is swept, watered and salted if necessary to reduce dusting from transports.

To the east of the industrial area at Renström, specifically between the industrial area and the Gråbergssupp team, there is a small forest area. The forest there is visibly affected by a black layer of dust covering the ground. Dusting will occur, but its spreading extent is not expected to increase. The prevailing wind direction in the area around Renström is estimated to be westerly and north-westerly. This means that dust from the warehouse in the industrial area at Renström will be transported east, towards the adjacent forest. Wind speeds are generally weak in the area which limits the spread.

Measurements of particle concentrations in the air at Renström's industrial area have begun. Two funnels are set up east of the industrial area and are located in that direction the expected content of dust from the business is greatest. The meters will be emptied quarterly, and no results have been obtained yet.

2.1.5. Boliden Site

There is no direct information to indicate air quality around the concentrator and tailings pond. Majority of the surveys are done in relation with the dust measurement and trends.

2.2. Discharge to Water

3.2.1. Kristineberg

One impact which could arise from changed operations is concerned with reduced groundwater formation in soil at the new area of influence and the reduced flow in Rävliidmyrbäcken. The new above-ground operations at Rävliid mainly affect production forest and felling, hence, no natural values are affected. Likewise, the level of groundwaters is lowering, thus its formation in soil layers is expected to be small, meaning that soil moisture is mostly not considered to be affected in one way.

Impacts can primarily occur on watercourses and wetlands within the area of influence as well as swamp forests in connection with these environments. No significant impact is expected to occur for forest environments on dry to healthy soil, as trees and plants in these environments are mostly dependent on the water in the unsaturated zone (groundwater) and are therefore not as sensitive to a change in groundwater level.

The swamp forest is adjacent to the stream and is thus judged to be marginally affected by the groundwater lowering and reduced run-off. The swamp forest will remain, environment nevertheless could become rather drier, and the area of swamp forest may decrease somewhat in this part.

Looking from a bigger perspective, mining operations will cease, which means that emissions to air will cease, as will nitrogen emissions from the use of explosives. Vormbäcken ceases to be a receiving recipient when mining water is no longer pumped to Kristineberg's treatment plant. The acid mine water with elevated metal levels is thus considered to be at risk of affecting the surrounding environment, groundwater and recipients. Due to this, the mine will be treated after closure based on the planned conceptual treatment plan for the Kristineberg mine, in order to minimize the impact on the environment and establish a long-term sustainable restored area.

3.2.2. Maurliden

Both the Maurliden mine and Maurliden Östra are located in Maurbäckens catchment area. Maurbäcken, which has a total catchment area of about 24 km² is an inflow to the Skellefteälven river. The average runoff from the catchment area is estimated to be approx. 950m³/hrs. The aquatic environments have normal to slightly higher biodiversity than the average for the region and in relation to the size of the objects. No red lists species or particularly sensitive environments have been detected in or around the aquatic environments.

A recipient survey has been carried out in the area around the Maurliden mine, which included:

- Lilltistelmyrbäcken; recipient for purified water from the Maurliden mine, the stream empties into the Skellefteälven river about 2 km downstream of the mine (upstream of the Vargfors dam). Samples were taken for: water chemistry (including microtox), metals in brook plants as well as benthic fauna.
- Skellefteälven; water chemistry upstream and downstream of the point Lilltistelmyrbäcken.
- Maurträsket; located close to the Maurliden mine. Sampling was regarding aquatic chemistry, sediment and benthic fauna. Standardized test fishing has also been carried out and analysis of metals in fish liver from the European perch (*Perca Fluviatilis*). The perch also have age determined. The water flora in Maurträsket has been inventoried in general and also has a calculation of the flows in Lilltistelmyrbäcken and Skellefteälven performed to be able to calculate dilution effects.

Here in, results of this recipient survey shows that Lilltistelmyrbäcken is completely dominated by the quality of discharged water from the treatment plant in Maurliden, which is not so strange since the flow in the brook is dominated by discharged water from the mine. The water in Lilltistelmyrbäcken is characterized by almost a neutral pH, very good buffering ability, low levels of nutrients, high to very high levels of Zn, Cu and Cd but low levels of Pb, Cr, As and Ni. Sulphate content is very high.

A small dilution takes place along the brook down towards the Skellefteälven river. Skellefteälven, upstream and downstream of Lilltistelmyrbäcken's outlet are characterized by near neutral pH, good to moderate buffering ability, very low levels of nutrients, very low or low levels of metals, possibly with the exception of Pb (an elevated value that may well be due to contamination of the sample). The sulphate content is low. Interesting to note is that the difference in water quality is marginal upstream and downstream of Lilltistelmyrbäcken, but nevertheless, the content addition from Lilltistelmyrbäcken can be clearly distinguished. Most clearly can one see an increase of the sulphate levels and the Zn and Cd levels (an increase by about 25 - 50%). The reason why these particular substances are most clearly visible is that the relative concentration difference between watercourses is large (sulphate 700 times higher and Zn and Cd about 100 times higher in Lilltistelmyrbäcken than in Skellefteälven).

Maurträsket on the other hand, is characterized by near neutral pH, very good to good buffering capacity, very low or low levels of nutrients, low or very low levels of Cu, Cd, Cr and Ni, low or moderate levels of As, and moderate or high levels of Zn and Pb. A comparison with The background study (Rönblom, 1999) indicated increased sulphate and possibly Zn levels but sharply reduced As levels and reduced Cu levels in Maurträsket.

3.2.3. Kankberg

The planned mining operations is not likely to generate acid-forming waste rock. The low sulphide content gives low levels of comparable metals, which is reflected in the groundwater from test sites where the taken water samples taken showed levels comparable to drinking water quality.

Nitrogen leakage from explosives from excavation of localities has been calculated will amount to approximately 6.6 tonnes per year during the operational phase. The acidifying effect caused by the ammonium contribution by nitrification gives an increased acidifying effect on about 2.3 - 4.5 meq/l. All water from the mine will continue to be diverted to Gillervattnet and no discharges take place to a nearby recipient, Bastuträsket.

Construction of a water treatment plant in Kankberg for the disposal of mining water and stormwater from the business area will mean a major environmental improvement measure. Today, the sand reservoir in Gillervattnet is loaded with very high metal contents from Kankberg's leakage water. The increased water flow to Gillervattnet

as a result of the increased mining operations are considered to be of marginal importance. That untreated water will no longer be led in an open ditch to Gillervattnet means one improved safety, as the risk of widening of untreated water from the ditch will no longer exist available.

As for Groundwaters, the levels are affected around the ramp surcharge based in Kankberg mine's open pit. On behalf of Boliden Mineral AB, Envipro has carried out a survey of groundwater and drainage water from a potential new establishment of an ore mining mine in Boliden. The purpose of the investigation is to characterize the groundwater chemistry in the current situation and secondly, make forecasts for future changes in chemistry as a result of the business. During the operational phase, the quality of the surrounding groundwater is not affected as the surrounding groundwater is drained towards the mine and not out of it

Overall, there are no drinking water sources in the impact area for the groundwater lowering. Results from calculations of transport of trace elements and metals through groundwater flows show that there is no risk of contamination during operation because groundwater is drained towards the mine and not out of it as long as it is drained.

3.2.4. Renström

Expansion of the mine and waste rock storage at Renström will lead to an increased flow of groundwater for treatment. When applying the current conditions, it is assumed that the levels of water discharged from the treatment plants will be approximately the same as at present. However, the slightly larger water volumes, estimated at about 3% increase, will lead to a small increase, theoretically about 3% increase, of discharged quantities.

When the application of the provisional conditions is considered, the levels of zinc must be lower. The expansion of the system of collecting ditches around the areas of activity will reduce the diffuse spread of polluted water. The precipitation is collected and pumped to the treatment plants. Previously, the water quality in the ditch downstream of the waste rock storage was checked. Slightly elevated levels of sulfur (sulphate) and certain easily moving metals (especially Zn) were measured.

When the waste rock storage expands, the concentrations will probably also increase sulfur and metals to increase as well as the runoff of stormwater from the storage. This water will be taken care of in treatment plants that collect ditches. Part of the industrial area in Petiknäs will be treated and covered with waterproofing, which leads to stormwater draining from the area without permeating laid masses. Here, too, the network of ditches will be expanded to be able to collect surface and leakage water for purification to a greater extent. With increased production of ore and waste rock, released amounts of nitrogen from undetonated explosives will increase. Sampling in Rengårdsbäcken, Petikån, Kyrkvägstjärnenoch and Skellefteälven indicates excess nitrogen in the watercourses. The critical ratio between total nitrogen and total phosphorus in inland waters is estimated to be around 15:1 (N/P). In the sampled waters, both at reference and recipient points, the ratio is between 18:1 and 60:1.

The effects of the expanded system with collecting ditches and partial post-treatment of the storage at Petiknäs will be that the surface water deposits around the mine will have a smaller load of metals and sulfur. At the same time, the amount of purified water received from the treatment plants will increase slightly

Groundwater subsidence in rock can lead to the chemical character of the rock groundwater being affected in the direction of a groundwater. This typically means a lower pH, higher content of organic carbon, higher oxygen content and lower concentrations of dissolved elements. At present, however, incoming groundwater to treatment plants has the character of a typical bedrock with a slightly alkaline pH (7.5–8.1) and conductivity around 1500–2000 $\mu\text{S} / \text{cm}$. The further lowering of the groundwater should not lead to any major changes in the quality of the groundwater.

3.2.5. Boliden site

By performing biological tests on water discharges, one can get an idea of the combined effect of all constituents, including any interaction effects. Proportional daily samples of the overflowing water from the clarification reservoir were taken during the period December 2013 to March 2014, and April to June 2014. Collective samples were formed by respectively period. The pooled samples were then tested for their toxicological properties at three levels, namely algae, crustaceans and fish.

The toxicity of the samples varied slightly depending on the test system: Both pooled samples showed low or no toxicity to the green algae tested (*P. Subcapitata*) and against newly fertilized zebrafish eggs (*D. rerio*). In most cases, no effects were registered in undiluted overflow water, while in one case a dilution of **3 times** was required to not cause growth inhibition of the green algae.

The pooled sample from the spring months showed low toxicity to the tested crustacean (*Daphnia magna*), while this crustacean showed effects on exposure to the winter specimen in the form of mobility impairment and chronic toxicity. The dilution of the winter sample required not to cause any toxic effect on the crustacean was about **10 times**.

For most substances, for example all metals, the concentration in outgoing wastewater is expected to remain virtually unchanged regardless of the degree of recirculation. This is achieved by establishing equilibrium relationships between dissolved and precipitated forms in recipients.

On the other hand, a substance expected to increase in concentration in overflow water is sulphate. According to the trial period investigation U1 in case M 173-07, a 20% recirculation is estimated to lead to an increase in the sulphate content in outgoing overflow water by just under 14%, from the current average content 720 mg/l to about 820 mg/l.

The following applies to the number of substances released:

- With continued production at the current level, emissions will be reduced by about 20% for all substances except sulphate, as the flow of water is expected to decrease to the same degree. The amount of sulphate discharged is also estimated to decrease by about 9%;
- In the event of a future production's increase up to the authorized level, it is assessed that emissions will be approximately unchanged compared to the current situation for all substances except sulphate. The amount of sulphate released will increase in step with the increase in content, i.e., according to what has been done estimate by under 14%.

3.3. Land Use

Land usage in the area around the **Kristineberg** Mine is predominately forestry, reindeer herding and grazing. Hunting, fishing and other outdoor activities also take place there. Boliden maintains good working relationships with the Sámi people and forestry companies. There is a number of closed mines in the area, including the Rävliiden field, and Kimheden that were closed over 15 years ago. There, only complementary closure and rehabilitation measures are ongoing. The nearest inhabited area is the Kristineberg community, with houses located approximately 200m from the industrial area. There are approximately 195 residents in Kristineberg. Additionally, there are a few small villages and single homes located approximately 2km from the industrial area.

At **Maurliden**, the current areas are not planned in detail. The area is designated as a national interest for the reindeer herding and for mineral industry. In the area around Maurliden reindeer husbandry and active forestry are conducted. Hunting and outdoor life also occur in the area. The hunt in the area is leased by Fromheden's fishing camp, whose hunting is often based on Önusstugan is located about 1.5 km south of the planned operations in Maurliden Östra.

When it comes to land use at **Kanberg**, the land area, where Åkulla Östra, Västra and Kankbergsgruvan are located, is used for mining, while other land areas are mainly used for forestry. The area around the mine consists of reindeer pastures for Mausjaure Sami village. Boliden holds processing concessions for all areas where mining previously took place. The land affected by the business is owned by Boliden and the surrounding land by private landowners. At Kanberg, part of the private land has been allocated for mining activities according to the Minerals Act. Boliden also holds an exploration permit around the processing concessions. Other companies with exploration permit in the immediate area are Wiking Mineral AB, Mineralbolaget in Stockholm AB and Metal Mines Sweden.

As for **Renström**, a new permit for mine will not affect the intentions in Skellefteå and Norsjö municipalities' detailed plans. No additional properties will be affected since the expansion of the planned business area is being done within properties that are already affected at present and in connection with existing operations.

The number of transports to and from the Renström mine is estimated to increase by about 8,000 movements per year, from about 15,400 to 23,400. The average traffic per day for one year (ÅDT) on road 370 between Boliden and Renström in 2009 was 1,390 vehicles, of which 280 consisted of heavy traffic. The increase in heavy traffic to the Renström mine is estimated to be on average about 22 per day. The impact on the reindeer herding industry will not increase as only smaller land areas will be used. However, transports to and from the mine will increase with the planned production increase.

3.4. Noise and Disturbance

3.4.1. Kristineberg

It is estimated that there are some risks associated with avoidance effects in connection with the ventilation shaft due to noise and visual reasons. The estimated equivalent noise levels closest to the shaft amount to 60-75 dBA and are spread in the west with gradually decreasing noise levels for about 1km according to the noise investigation carried out at the stage of processing concession. How much the reindeer will avoid the air shaft is difficult to predict, but it is also judged that there is an opportunity and space for the reindeer to take detours around the air shaft if necessary, which is still within the migration route in general.

As a reference value, it can be mentioned that in the case of new construction of infrastructure, the Swedish Transport Administration uses a guide value of 50 dBA equivalent noise level for significant bird areas with a low background level.

3.4.2. Maurliden

The site has been closed in 2019, hence noise and disturbance are only connected to rehabilitation work.

3.4.3. Kankberg

The results from the vibration and noise investigation that was carried out show that there are good conditions for conducting mining operations within the planned area. Vibrations within this area mainly occur as a result of blasting work. The investigation shows that no properties along the access road will be exposed to vibration levels in excess of 1 mm/s despite the increase in traffic. The vibration levels are well below the levels where there is a risk of technical damage, even if residents may feel the vibrations at certain times.

3.4.4. Renström

Noise occurs mainly at ventilation systems, ore and waste rock transports above ground and at the excavation system. Noise measurements have been carried out at the Renström mine and the Petiknäs mine. According to the control program, measurements shall be carried out every 5 years in a nearby residential area.

With increased production, noise comes from transport and the incentive system to increase, which can have effects on the buildings in Renström and Petiknäs. New facilities that could constitute sources of noise, such as ventilation or incentives, will be equipped with noise reduction measures in order to meet the guideline values for external industrial noise. The distance to buildings is so great that it is considered possible to continue to meet the guideline values for noise for the business.

3. HABITATS PROTECTED OR RESTORED

3.5. Kristineberg

3.5.1. Natura2000 Areas

Water-based Natura2000

Vindelälven

Vormbäcken Water Recipient

3.5.2. Land-Based Natura2000 Areas

Rävliden: Rävliden area is under the Habitats Directive that is not linked to another Natura2000 site (SCI). It encloses a north slope with fire regeneration that is now about 125 years old. The area covers a forest with a good structure and has excellent prospects for the future. Old growing western taiga is scarce in the region; hence it is important to take in even the small areas to make up a covering layer of western taiga.

Vindel storforsen: Vindel Storforsen is also an area of interest under the Habitats Directive that is not linked to another Natura2000 site (SCI). It is also considered as a nature reserve with Boreal, hemiboreal and a near natural large river systems (about 50% of the area). In addition, the nature reserve is an important recreation area. There are some remaining from the log driving era. The scarce documentation on the site does not allow a precise description of the area (e.g., inventory reports).

Lomselet: Lomselet is an area under the Habitats Directive that is not linked to another Natura2000 site (SCI). The area has a mixed structure of a younger and an older generation of pine (about 100 years). The area shows several marks after old forestry operations. The area is important in the way that it have burned frequently, and today the remaining is a result of processes of natural succession and selection after fires. The area is also important for many tree-living vertebrates.

Norravasund: is an area under the Habitats Directive that is not linked to another Natura2000 site (SCI). Norravasund is characterized with lichen pine forest in both southern and northern sides, while the central area has more of spruce and pine. Additionally, the area is fire stamped. The forest has good quality as a naturally regenerated forest and has excellent prospects the future.

Ransar: No data was found on this area.

3.5.3. Nature Reserves

Rävliden Gruvan: Rävlidengruvan is a Nature reserve located in Västerbotten's County, within the vicinity of Lycksele's municipality. The total area is about 16.7 ha, of which we have 15.5 ha of productive forest land.

3.5.4. Water Protection Areas

Aspliden: Aspliden is a water protection area in Västerbotten's County and specifically Malå's municipality. **The area has a land size of 72.4 ha, of which 67.6 ha is productive forest land.**

3.5.5. Key Biotopes

Nature Protection Agreements

Hornberget: No data was found on this area.

3.6. Kankberg and Renström

3.6.1. Natura2000 Areas and Nature Reserves

Land-Based Natura2000

Blylodmyran: Blylodmyran's site has a total size of 223.7 ha, of which only 0.7 ha is water. The area is characterized with a rich vegetation (rich fen surrounded by forest) and a mix of species. Such variety of species is usually found in fields south of the country. As for the lake "Storkärret" located within Blylodmyran, it is seasonally changing its water level. Interestingly, the lake is also home for the Smooth newt (*Triturus vulgaris*) which comes across as rare in the region. Regarding the marsh complex, it is characterized by scattered pine and *Phragmites australis*. The mire is surrounded by a mixed cone-bearing woodland with a heterogeneous age structure. Some old growing sallow and aspen are also very common in the area. When it comes to national red listed species, we have lichens, moss and herbs.

Brännberget: It is an area of Community interest under the Habitats Directive as well as the Birds Directive (SPA/SCI). The total size of the area is around 175.1 ha and amongst the area's characteristics, we name mountain Nybrännberget containing an old-growing forest (pines with an age averaging 430 years). Overall, the bedrock consists of granite and the topography is mountainous. Traces from forest fires are also found with lots of dead wood and old windthrows. The forest has mostly a lushy vegetation with several herbaceous plants. Still, some sides of the forest are enclosing drier vegetation and are becoming less inviting for certain species. Examples of the trees found are birch, aspen, mountain ash, sallow and gray alder. Those trees which come with holes form a favorable home for the bird fauna. In general, the forest in this area has developed naturally and is not affected by human encroachments.

Nymyrliden: Nymyrliden is under the Habitats Directive that is not linked to another Natura2000 site (SCI). The area is positioned on a slight slope with scattered stones and has a total size of 5,9 ha. The forest has a mixture of pine, spruce, birch plus a small portion of (*Salix caprea*), which has an estimated age of 100 years. Overall, the quality of the site is focused on its richness alongside the existence of orchids such as (*Calypso bulbosa*) and (*Cypripedium calceolus*). Most habitats of this kind have been exploited by forestry's activities, and it is hence important to protect it to secure the longevity of species there.

Spärmyrberget: No data was found on this area.

Israelsmyran: Israelsmyran is also a site under the Habitats Directive that is not linked to another Natura2000 site (SCI). It is located on a gentle slope and has a fertile soil with a herb-rich vegetation. The area's is about 3.5 ha and also comes with a forest with a mixed stand (roughly 10 years old) of pine, spruce, birch and (*Salix caprea*), which is recovering from extensive cutting operations. Some species of orchids have been recorded in this site such as (*Calypso bulbosa*) and (*Cypripedium calceolus*) which are rare to the region.

Kälberget: is also a site under the Habitats Directive that is not linked to another Natura2000 site (SCI). The site is situated on a slope with dispersed stones on the north-east and an area of 18.8 ha. Like the previous natura2000 areas, this forest also comes with a stand (50 years of age) of pine, spruce, birch and small portion of (*Salix caprea*). It is a wet area, with fresh a water spring pumping out in the southern side. There are numerous signs of previous forestry activities, such as tree stumps. The site is also marked with the existence of *Calypso bulbosa* orchid which is rare to the region.

3.6.2. Nature Reserves

Kalkällmyran: kalkällmyran is a nature reserve located in Skellefteå's municipality, Västerbotten County. It is situated within Övre Kågedalen's rich wetland area, north of Boliden. This nature reserve runs on a size of 87.7 ha and consists of greenstone and limestone trails, which gives rise to a rich vegetation. Inside the area, we identify two topo genic marshes Kalkällmyran and Lill-Mullbergsmyran. Both wetlands have an interesting lime-influenced flora. What is more, the bogs are affected by the spring water in several places, including a very large crater spring on the central part of Kalkällmyran. Both pine and spruce forests grow in the surroundings of the bogs, and they consist of swamp forest. is also partly affected by calcareous water and spring outflows, which gives it an interesting flora with Lady's-slipper (*Guckusko*). The forests are affected by forestry activities, still they hold high natural values.

The following are examples of species found in Kallkällmyran: Eggleaf twayblade (Tvåblad), Dicotyledons, Guckusko, Platanthera bifolia, Longbract frog orchid (Grönkulla), Common spotted orchid (Skogsnycklar), Eriophorum latifolium (Gräsull), Carex capillaris (Hårstarr), Carex panicea (Hirsstarr), Yellow sedge (Knagglestarr), Carex buxbaumii (Klubbstarr), Rosa majalis (Kanelros), Saussurea alpina (Fjällskära), Moneses uniflora (Ögonpyrola), bäckblekmossa, guldspärrmossa, Philonotis fontana (Källmossa), kalltuffmossa, Bryum pseudotriquetrum (Kärrbryum), röd skorpio moss, kortskaftad ärgspik and Bryoria nadvornikiana (Violettgå tagellav).

Nördestmyran: Nördestmyran's nature reserve has an area of 35.1 ha and is located close to Övre Kågedalen's rich marsh area north of Boliden in Skellefteå's municipality. The site has a bedrock consisting of greenstone and limestone trails which results in an intermediate and rich vegetation. Within Nördestmyran we identify two rich wetlands Nördestmyran and Rörmyran which have a very interesting rich flora of the Early marsh-orchid (ängsnycklar), Eggleaf twayblade (tvåblad) and Lady's-slipper (guckusko). Alongside the main road, we find a mosaic of marshes, pine swamp forests and small open marshes rich with vegetation. The forest in the area consists partly of scarce, somewhat stratified older pine forest on swampy land, and partly of newly taken up felling. Instances of species found in the area: Black grouse, Western capercaillie, Tofieldia pusilla (Björnbross), Dactylorhiza maculata (Fläcknycklar), Early marsh-orchid (Ängsnycklar), Eriophorum latifolium (Gräsull), Dicotyledon, Lily of the valley (Liljekonvalj), Rough horsetail (Skavfräken), Marsh hawk's-beard (Kärrfibbla), Sphagnum subfulvum (Brun glansvitmossa) and Bryoria nadvornikiana (Violettgå tagellav).

Spärmyrberget: No data was found on this area.

3.6.3. Biotope Protection Areas

Nature Protection Agreements

Naturskogartad barrskog: boplats, spelplats and växtplats

3.6.4. Water protection areas

Skelleftedalen: Skelleftedalen is a water protection area situated within Västerbotten County in Skellefteå's municipality. Total area has a size of 50,150 ha, of which 38,693.7 ha forms productive forest land.

3.6.5. Water Protection Areas (Renström)

Bastuliden: Bastuliden is also a water protection area situated in Västerbotten county, Skellefteå. The area has a size of 15.7 ha with 13.9 forming productive forest land.

4. NOTABLE SPECIES IN AREAS AFFECTED

4.1. Kristineberg

The following section provides a description on the species of interest within the surroundings of Boliden Area.

In Rävliiden's area, considerable parts have been inventoried concerning the natural values and birds within the framework of the application for a processing concession for Rävliiden. Red-listed and protected species according to the Species Protection Ordinance observed within the framework of these inventories are reported in the table below (see table 3). Among plants, fungi and moss, only Orchidaceae spores are affected by changes in activities.

As for the red-listed or protected bird species, threatened species include Ortolan sparrow. The species is mainly associated with cultivated landscapes but has lately begun to use the felling for nesting.

The red-listed species that occur within the delimited natural value objects are all linked to trees in forest biotopes and are thus not considered to be negatively affected by the changed activity.

Table 3: Red-listed or Protected Birds Inventoried Within the Surroundings of Rävliiden's New Business Area

| Area | Nesting | Red-list 2020 | Species Protection Ordinance |
|---|---------|---------------|------------------------------|
| Whinchat/Saxicola rubetra (Buskskvätta) | x | NT | |
| Wood sandpiper/Tringa glareola (Grönbena) | x | | x |
| Goldcrest/Regulus regulus (Kungsfågel) | x | | |
| Black Grouse/Lyrurus tetrix (Orre) | x | | x |
| Ortolan bunting/Emberiza hortulana (Ortolansparv) | x | CR | x |
| Black woodpecker/Spillkråka (Spillkråka) | x | NT | x |
| Western capercaillie/Tetrao urogallus (Tjäder) | x | | x |
| Common swift/Apus apus (Tornseglare) | x | EN | |
| Eurasian three-toed woodpecker/Picoides tridactylus (Tretåig hackspett) | x | NT | x |
| Rustic bunting/Emberiza rustica (Videsparv) | x | NT | |

4.2. Vormbäcken

- [Cottus gobio \(European bullhead\)](#)

Cottus gobio (European bullhead, see figure 9) occurs in many different types of freshwater environments. Despite being fairly common in the area, the reason why this species is included in the Habitats Directive's annex is that it has decreased in other parts of Europe as natural watercourses have become a scarce commodity.

In Sweden, there are also *Cottus poecilopus* and *Cottus koshewnikowi*, and since, *Cottus gobio* has an eastern distribution in Norrland, it is often replaced in high altitudes by the latter species (*C. poecilopus* and *C. Koshewnikowi*). These three *Cottus* species are difficult to distinguish from each other, but after discussions with those who carried out the electrofishing alongside representatives from the county administrative board, it is highly likely that *Cottus gobio* have been found in Vormbäcken.



Figure 9. Picture of Cottus gobio (European bullhead) (Natura 2000-utredning Vormbäcken, Sweco (2020))

The densities vary considerably between the years and the electrofishing stretches. It is not possible to statistically ensure any improvement or deterioration of the occurrence of *Cottus gobio* since 2006. The trout fishing site Vormbäcken 5, near the mouth to Vindelälven, seems to have improved since 2003 when the Natura 2000 area was decided. The following table presents the occurrence density of *Cottus gobio* through the electrofishing surveys in Vormbäcken 1983-2020.

Table 4: Occurrence results of electrofishing surveys in Vormbäcken 1983-2020 (number / 100 m²)

| Area | Vombäcken5 | Vombäcken4 | V01 | V03 | Vo5 | Median value for densities |
|-------|------------|------------|-----|-----|-----|----------------------------|
| 1980s | 1.9 | | - | - | | |
| 1990s | 1.6 | | - | - | | |
| 2003 | 0.8 | | - | | | |
| 2006 | 4.4 | 12.4 | - | - | - | |
| 2007 | 2.3 | - | - | - | - | 6.2 |
| 2010 | 16.6 | 2.5 | - | - | - | 6.2 |
| 2012 | 4.2 | 0.8 | - | - | - | 6.2 |
| 2017 | 5.0 | 5.7 | - | - | - | 6.2 |
| 2020 | 3.9 | 6.8 | - | - | - | 6.2 |

- *Salmo salar* (The Atlantic salmon)

Salmo salar is a migratory fish species that uses streaming waters for both spawning and growing areas. The salmon in the Vindelälven migrate from the Baltic Sea, via the fish migration route in Stornorrfors, up into the

river and its tributaries in the spring and summer for mating during the autumn. The salmon is reliant on healthy flowing waters and gravel bottoms as well as free hiking trails for its reproduction.

The species is judged to be viable according to the latest red list. Threats to the species mainly consist of hydropower, habitat loss and fishing but also environmental toxins, which are possible threats in the longer term. Salmon is listed in Annex II to the Species and Habitats Directive, which means that its habitats shall be protected as Natura2000 sites. It is also listed in Annex V which means that the species requires special management measures.

The species has never been found during electrofishing surveys in Vormbäcken. According to an interview survey conducted in 2007 by the Vindelälven Fisheries Council, plenty of salmon were caught in the lower part of Vormbäcken, downstream of Vormträsket in the 19th century, but the species was considered to have disappeared as early as the 1940s. During the 1950s, Stornorrfor's power plant was built in Umeå and blocked the hiking trail for the Vindelälven salmon stock for several decades.

- [Luta lutra \(The Eurasian otter\)](#)

Lutra lutra lives near the shore, feeds on fish and is strongly attached to streaming watercourses. Nowadays, it occurs in most of the country, and this requires a variety of watercourses with a rich fish fauna to be able to maintain viable populations.

Otter species is listed in Annex II under Species and Habitats Directive, which means that its habitats shall be protected as Natura2000 sites. It is also listed in Annex IV (Directive for strict species protection). The classification according to the red list has been upgraded and in 2020, the otter species was assessed as Near Threatened compared with the category Vulnerable back in 2010.

Environmental toxins have described as a reason behind the decline of otter species during the 20th century and especially PCB (Polychlorinated biphenyls). In the action program for otters also mentions that cadmium in combination with lead has known effects on the reproduction of mammals but nothing more specific about elevated levels of other metals. A search in the Art Portal over the past 20 years shows that there are credible observations from the lower part of Vormbäcken, from a tributary to Vormträsket and from several other tributaries to Vindelälven. Otter species has fairly large home areas in northern Sweden, particularly in those parts of Vormbäcken including streams where they have good access to fish.

- [Margaritifera margaritifera \(Freshwater pearl mussel\)](#)

Margaritifera margaritifera is listed in Annex II under species and Habitats Directive, meaning that its habitats must be protected as Natura2000 sites. It is also listed in Annex V, which means that the species requires special management measures. The freshwater pearl mussel is classified as threatened in the Swedish redlist under the category Highly Endangered. Developments during the 20th century have been gloomy and the species is in the early 2000s has disappeared from just over a third of the watercourses where it existed in the early 1900s.

Expansion of hydropower, raft cleaning, pearl fishing, forestry and acidification are considered to be the main reasons behind such large decline. *Margaritifera margaritifera* is connected to running watercourses with clear and clean water and with access to sand and gravel bottoms. The species is also reliant on the brown trout (*Salmo trutta*), mainly rainbow trout (*Oncorhynchus mykiss*), for its reproduction. Since there has been no trout in the upper part of Vormbäcken in decades, the conditions for the presence of *Margaritifera margaritifera* are poor.

In isolated watercourses, however, older individuals of mussels have been able to survive despite the disappearance of trout or other salmonid species. There are viable stocks of freshwater pearl mussels in a handful of tributaries flowing in Vindelälven river, both upstream and downstream of Vormbäcken. However, after conducted surveys, it was assessed that proper conditions for *Margaritifera margaritifera*'s thriving are missing in Vormbäcken, seeing that is so clearly affected by raft joint clearances, even if some sections have been restored.

- [Dytiscus latissimus](#)

Dytiscus latissimus occurs in poor to weakly nutrient-rich lakes, ponds, calmer parts of watercourses and in artificial water ponds. The species is usually found in the outer parts of the beach vegetation, often with stands of tall sedges and water horsetails. It thrives best in fish-empty waters and becomes scarce in more fish-rich

environments. *Dytiscus latissimus* has a good flight capability and can spread between sea systems several kilometers away, and in Sweden, it is not redlisted. It is however, listed in Annex II under species and Habitats Directive, which means that its habitats must be protected as Natura2000 sites. The species has a very widespread distribution in Sweden with about 15 reported locations in Västerbotten County according to Artportalen. The nearest site from Vormbäcken is in Vindelälven where an individual was found in 2003.

Table 5: Typical species with confirmed occurrence in Vormbäcken are marked with x

| Species | Occurrence within Natura2000 sites | Occurrence in the Reference watercourse | Designate |
|---|--|---|--|
| Brown trout/ <i>Salmo trutta</i> | Downstream of Vormträsket, low density | Not followed up regularly | Free hiking trails, absence of major physical interventions, water quality |
| European grayling/ <i>Thymallus thymallus</i> | Downstream of Vormträsket, low density | Not followed up regularly | Free hiking trails, water quality |
| Eurasian minnow/ <i>Phoxinus phoxinus</i> | Downstream of Vormträsket, not found before 2006 | Not followed up regularly | Raw material of acidification, water quality |
| Stensimpa | Downstream of Vormträsket, low density | Not followed up regularly | |
| <i>Arctopsyche ladogensis</i> | Downstream of Vormträsket, not found before 2007 | | Raw material of acidification and eutrophication |
| <i>Hydropsyche saxonica</i> | Upstream of Vormträsket | X | |
| <i>Hydropsyche silfvenii</i> | Along the whole stream | X | Raw material of acidification and eutrophication |
| <i>Athripsodes cinereus</i> | Downstream of Vormträsket | X | |
| <i>Oecetis testacea</i> | Downstream of Vormträsket | X | |
| <i>Isoperla difformis</i> | Downstream of Vormträsket | | Raw material of eutrophication |
| <i>Isoperla grammatica</i> | Along the whole stream | X | moderate eutrophication |
| <i>Siphonoperla burmeisteri</i> | The whole stream | X | |
| <i>Nemoura avicularis</i> | The whole stream | X | moderate eutrophication |
| <i>Sialis fuliginosa</i> | The whole stream | X | Raw material of eutrophication |
| <i>Elmis aenea</i> | The whole stream | X | Raw material of eutrophication |
| <i>Hydraena gracilis</i> | Downstream of Vormträsket | X | |

4.3. Maurliden

An overall glimpse on the investigation's area reveals three zones (moisture pathways), all of which maintain high natural values. Likewise, there exists a peatland "Flakamyran", which seems undrained but where driving seems to have occurred recently. Wetlands are quite sensitive environments where driving should be avoided on unspoiled land.

Within these moisture pathways with swamp forest all around, there exit; birch plants such as *Carex juncella*, *Potentilla palustris*, *Caltha palustris*, *Calamagrostis canescent* and *Equisetum sylvaticum*. Dead wood also occurs but only in smaller dimensions. It was also noticed that at least one *Salix caprea* with a large epiphytic lichen grows in the stock. Tree lungwort, aka *L. pulmonaria* is one signal species indicating that the forest has a long continuity and high natural values. Here, one also takes note of the variety of moss species attached to the swampy

forestry environment. To the south, the area borders a clearcut bogging. The clearfelling goes on till the solid ground turns into a swampy forest, which are also considered a forest with natural value objects.

Flakamyrbäcken has a rich flora which streams to the east. The flora is rich with species such as the marsh grass of *Parnassia palustris*, *Rubus saxatilis*, *Carex flava*, *Carex vaginata* and *Cirsium helenioides*. Still, the dominant species is *Carex juncella*. When it comes to the variety of trees, the green layer consists of *Picea abies*, *Prunus padus*, *S. aucuparia* and birch. The brook is surrounded on both sides by a clearcut logging and is also has a couple of sides passed by forestry machines that left deep ruts. Still, the area is not forested key biotope or natural value object.

- **Vegetation**

Particularly, the flora within Maurtiden's area is common to the region's forest and wetland plants. A richer flora periodically occurs along the wetlands in the area (beach zones and creeks). The area also appears to encompass more demanding species such as *Selaginella selaginoides*, *Pinguicula vulgaris*, *Crepis paludosa*, *Melica nutans* and *Carex flava*. The richer flora indicates that the water holds alkaline minerals and nutrients.

As for the fungal flora; *Lactarius rufus*, *Lactarius mammosus*, *Cortinarius caperatus* are the characterizing species of the area. *Hydnum peckii* was found in the forest stand to the south of the road. Overall, the species there designate forest with long tree continuity. However, only isolated specimens were found. Nowadays, the forest does not have quite high natural values, and the presence of certain species gives a misleading indication of high natural values.

- **Birds**

Common forest birds such as *T. pilaris*, *Phylloscopus trochilus*, *Poecile montanus*, *Tetrao urogallus* and *Corvus corax* were observed as well as traces of *Dryocopus martius*. In connection with the investigation area, *Accipiter nisus*, *Bombycilla garrulus* and *Dryocopus martius* were also observed. The Maurtiden area contains no special rich bird environment, therefore, rare or protected species are considered to provisionally occur. No special inventory of birds was carried out and it was not judged as relevant either.

- **Benthic fauna**

The benthic fauna's community in this area depends partly on the water chemistry and on the current velocity and the composition of the benthic subsoil. A more homogeneous bottom substratum gives fewer niches and thus room for fewer species, but the population usually results in higher index values. Two conducted studies (2011) showed that for fewer species, it seems to be a good assessment of the waters in the area and can conclude that in the smaller deviations can be explained by the low number of certain insect species within the surroundings.

Lilltistelmyrbäcken, for instance, was considered too small a stream to make relevant follow-ups of Bottom fauna. The fauna is not varied and diverse enough to do an assessment. The proposal is that in future follow-ups in addition to water chemistry sampling instead carry out sampling of growth algae.

The two premises in Skellefteälven are clearly nutrient-laden according to the DJ index. As for the bottom fauna, one can see that the downstream area contains a lot of Earthworms (*Clitellata*), which are a clear sign of high nutrient content in the bottom sediments. One reason is that the river no longer functions as a natural river but more as a lake. Overall, the water level varies abnormally, and quite long periods of stagnation occur in the shore zone, while natural water level fluctuations are required to get a species-rich fauna and flora in the river's shore zone.

The following two tables (Table 6 and 7) present the variety and number of benthic and surface water species in Långjärnen and Kotjärnen. Note that the classification was done according to the Swedish Environmental Protection Agency assessment for environmental quality.

Table 6: Number of species of underwater and surface leaf plants in Kotjärnen

| Species | Frequencies | Indicator species |
|------------------------------|-------------|-------------------|
| <i>Potamogeton natans</i> | 4 | 6,7 |
| <i>Nuphar lutea</i> | 3 | 8,5 |
| <i>Chara spp</i> | 4 | 8,5 |
| <i>Potamogeton alpinus</i> | 2 | 7,3 |
| <i>Potamogeton gramineus</i> | 2 | 7,3 |

| | | |
|------------------------|---|-----|
| Sparganium spp | 1 | - |
| Nymphaea alba | 1 | 6,7 |
| Phragmites australis | 1 | 7,3 |
| Parnassia palustris | 1 | - |
| Peucedanum palustre | 2 | - |
| Caltha palustris | 1 | 7,3 |
| Menyanthes trifoliata | 1 | 5,3 |
| Potentilla palustris | 1 | 5,5 |
| Lysimachia thyrsoflora | 1 | 5,5 |
| Carex diandra | 1 | - |
| Carex lasiocarpa | 4 | - |
| Drepanocladus spp | 2 | - |

Table 7: Number of species of underwater and surface leaf plants in Långtjärnen

| Species | Frequencies | Indicator species |
|----------------------------|-------------|-------------------|
| Potamogeton filiformis | 3 | 10 |
| Potamogeton alpinus | 4 | 7,3 |
| Potamogeton gramineus | 3 | 7,3 |
| Sparganium spp | 2 | - |
| Subularia aquatica | 2 | 4 |
| Myriophyllum alterniflorum | 2 | 5,5 |
| Phragmites australis | 1 | 7,3 |
| Equisetum fluviatile | 3 | 7 |
| Caltha palustris | 1 | 5,3 |
| Potentilla palustris | 2 | 5,5 |
| Lysimachia thyrsoflora | 1 | 5,5 |
| Carex rostrata | 2 | 4,3 |
| Carex vesicaria | 1 | 7,3 |

4.4. Kankberg

- Benthic Fauna

The sampled premises all have a good ecological status, and the assessment is that all premises, except for the two in Bastuträsket, are very good for the benthic fauna sampling. The variation in bottom's substrate is worse than in both Stavträsket's premises and thus, settings are somewhat worse for finding an equally varied benthic fauna. Still, the premises in Bastuträsket are by no means bad, but just not the most optimal. The selection of suitable premises was made only on the western side of Bastuträsket to get as close to the mining environments on the mountain as possible.

- Higher Water Vegetation in Stavträsket

Knowledge of water vegetation provides together with other surveys on benthic fauna, fishing, vegetation and habitat types of inventories and water chemistry) a clearer picture of the natural environment and the state of the environment. A rich and varied aquatic vegetation is the basis for the existence of many other groups of organisms.

The survey of aquatic vegetation was carried out only in the central part of the lake (Stavträsket). The vegetation in Stavträsket was dominated by a reed along the shores. The beaches are mostly steep with hard bottoms. In sheltered bays and in the few basic areas available, vegetation is more widespread. Phragmites australis, Schoenoplectus lacustris, Nuphar lutea, Equisetum fluviatile and Potamogeton natans. At the shallow parts (on the soft bottom) there is a fairly widespread vegetation. The lake has one suitable composition of vegetation-rich parts in shallow soft bottom beaches interspersed with steeper hard bottom beaches with sparser vegetation. Stavträsket has a high ecological status according to conducted evaluation (2009).

- Algae

Algae play an important role as primary producers, especially in running water, and diatoms are often the dominant group in the avian community. Diatoms are good indicators of water quality and methods of classification and

assessments of watercourses. The species are also geographically well-distributed, which means that most of the species included for assessments that occur over large parts of Sweden.

IPS is the index that is calculated for the assessment of permit class and ecological status. Out of algae, only diatoms form the basis for index calculations and for assessing ecological status. In the seven investigated premises (Långmyrbäcken, Stavträskbäcken, Åkullabäcken, Råbergsbäcken, Klintforsån nedströms bastuträsket, Gäddträskbäcken and Klockträskbäcken), diatoms are the completely dominant growth algae group and normally make up 70-90% of the entire number of species. Other algae mainly consist of Chlorophyta and Cyanobacteria. Occasional Rhodophyta and Chrysophyceae may also occur.

EIA Continued and expanded operations at the Kankberg mine. All streams, including the two-reference premises Gäddträskbäcken and Klockträskbäcken, have high IPS values. Results are positive and indicate that the water systems in the area are not affected by pollutants and/or high nutrient loads. The diatoms community was normally composed and of the various species of diatoms found, there were no red-listed or particularly sensitive type that could be indicated.

4.5. Renström

The biological survey of water recipient water of the Renström and Petiknäs mines in 2011 included fishing in Rengårdsbäcken. The investigation did not result in any fish caught. However, the premises are such that there should be fish in them which either consist of stationary and/or migratory crowds from the river.

A supplementary electrofishing survey was conducted in 2012, during which, another recipient called “recipientlokal 2” was sampled, located right next to the outflow of Rengårdsbäcken in Petikån (See figure 10). During the investigation, a new ditch was discovered in the sediment in the vicinity of the brook at the reference site, upstream of the mining area. Turbidities or the cloudiness that occurs in connection with ditching in fine sediments has impaired the habitat for life in the brook. Rengårdsbäcken was negatively affected by forest digging in the 80s and 90s. Before the ditches, there was reportedly a stock of trout in the brook.



Figure 10. Sampling Locations of the electro-fishing surveys

4.6. Boliden site (Surroundings of the concentrator and tailings pond)

- Birds

The composition of the bird fauna reflects a typical northern inland landscape with low disturbance from buildings and with species such as capercaillie, magpie and silkworm. Nowadays, these are largely absent in the coastal parts of Norrland as a result of severe forestry and high human disturbance. Other species that are interesting are related to the swamp forest environments that are scattered throughout the area.

Many areas of *Emberiza rustica* also indicate slightly richer swamp forest environments and two nests of *Picoides tridactylus* reflect the existence of older undisturbed spruce forest environments. *Picoides tridactylus* species has undergone dramatic population changes in Sweden in recent decades and is now a red-listed species.

Note that the reporting of the area's birds is a lot clear. The field inventory in the area was done in June 2003. Below is a table of the species noted within the survey area. They are included in the EU species directive for birds. Other species in the area of mainly of interest and are also reported in the table.

Table 8: Species identified in the EU Birds Directive which occur within the study area and their status.

| Species | Nesting | Location | Threat Category |
|-----------------------------|---------|---|-----------------|
| <i>G. arctica</i> | X | Bjurlidträsket | |
| <i>Sterna hirundo</i> | X | Bjurlidträsket | |
| <i>Tetrastes bonasia</i> | X | Brubäcken Treskötemyran | |
| <i>Tetrao urogallus</i> | X | Lidmyran, Bjurlidbodiden, Brubäcken | |
| <i>Tringa glareola</i> | X | Hötjärn, Lomtjärn | |
| <i>Pernis apivorus</i> | | Hötjärnen | |
| <i>Dryocopus martius</i> | X | Brubäcken, Bjurlidbodliden | |
| <i>Picoides tridactylus</i> | X | Treskötemyran, Brubäcken | VU |
| Other species | | | |
| <i>Podiceps grisegena</i> | | Hötjärnen | |
| <i>Perisoreus infaustus</i> | X | Brubäcken, Långhedtjärnen | |
| <i>Bombycilla garrulus</i> | | Bjurlidbodliden, Brubäcken | |
| <i>Emberiza rustica</i> | X | Brubäcken – sumpskog, Bergmyran, NV Hötjärn, Lidmyran | |

- Herbs

Below is a list (table 9) of a selection of more unusual herbs in the study area. Several are also good indicators of fine or sensitive natural environments.

Table 9: List of unusual herbs spotted near the area of Boliden Site

| Species | Location | Threat Category |
|---------------------------------|---|---|
| <i>Carex media</i> | Bjurbodliden above the Dam boundaries | Rare but can be more common in the mountains |
| <i>Dactylorhiza incarnata</i> | All richer marchlands and sub-areas | Quite common in the area |
| <i>Tofieldia pusilla</i> | Richer marchlands Lidmyran and Hötjärnsmyran, all sub-areas | Rich indicators |
| <i>Eriophorum latifolium</i> | Area above Lidmyran | Rich indicators and by running groundwater |
| <i>Dactylorhiza viridis</i> | Bjurbodliden above the Dam boundaries | Rare with moving groundwater |
| <i>Goodyera repens</i> | Older forest along Brubäcken and sub-areas. | Less common in all in moss-rich areas and older spruce forest |
| <i>Carex buxbaumii</i> | In the richer Wetlands and all sub-areas | More common here than elsewhere in the county's coastal part |
| <i>Selaginella selaginoides</i> | Around Hötjärnen | Rare near the coast |

| | | |
|---------------------------|---|-------------------------------------|
| Saussurea alpina | Near the slopes and above dam's boundaries | Less common |
| Daphne mezereum | Above Lidmyran and along Brubäcken, Not the main area | Common in the right environment |
| Moneses uniflora | Along all watercourses and all sub-areas | - |
| Matteuccia struthiopteris | Down Brubäcken but not around the main area | Common in the right environment |
| Corallorhiza trifida | In swampy forests, and all sub-areas | Rare in unaffected swamp forests NT |
| Ranunculus lapponicus | In smaller swamp forests and in all sub-areas | Rare |
| Carex disperma | NV Treskötemyran | Rare |
| Carex loliacea | In finer swamp forests | Less Common |
| Milium effusum | Above dam's boundaries | - |

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