



# Tamarack Water Alliance

## High Sulfide Mining

<https://tamarackwateralliance.org/>

October 20, 2024

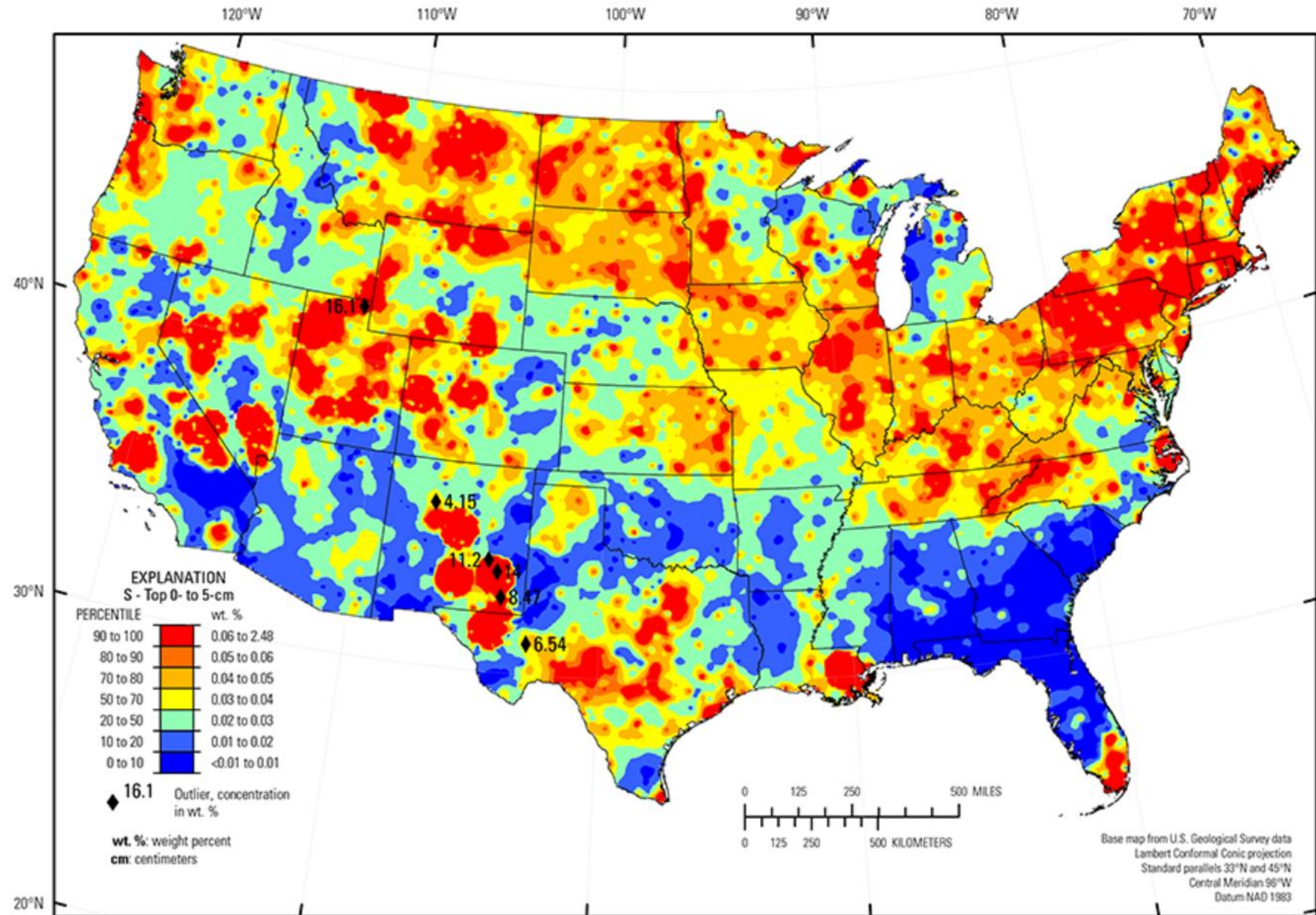
# Sulfur

**Sulfur** is an essential plant nutrient - **sulfur** cycling in soil is complex.

**Sulfur** is essential to all organisms, including humans, and is considered to be nontoxic - **EXCEPT**

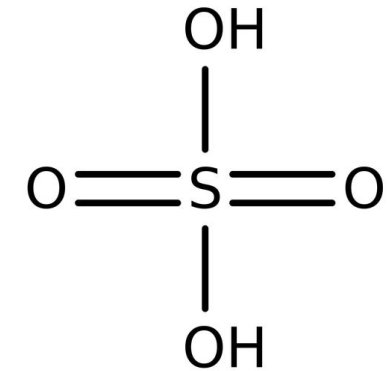
**Sulfur** compounds, such as carbon disulfide ( $\text{CS}_2$ ), hydrogen sulfide ( $\text{H}_2\text{S}$ ), sulfur dioxide ( $\text{SO}_2$ ), and of course, sulfuric acid ( $\text{H}_2\text{SO}_4$ ) are toxic.

[https://pubs.usgs.gov/sir/2017/5118/sir20175118\\_element.php?el=16](https://pubs.usgs.gov/sir/2017/5118/sir20175118_element.php?el=16)



# Sulfides and Extractive Industries

- ❖ Petroleum and natural gas - hydrogen sulfide (H<sub>2</sub>S) gas is often present
  - Hydrogen sulfide is a colorless gas, and is poisonous, corrosive, and flammable, with trace amounts in ambient atmosphere having a characteristic foul odor of rotten eggs
  - Exposures generally should not exceed 20 parts per million (ppm)
  - At higher and more dangerous concentrations of around 100 ppm, neurotoxicity occurs with olfactory paralysis
- ❖ Coal - typically coal contains anywhere from 0.2 to 5 percent sulfur by weight
  - Burning coal puts both sulfur dioxide and nitrogen oxide into the air
  - These gases mix with water droplets and oxygen to make sulfuric acid and nitric acid
  - So called (Acid Rain) that has affected large areas
  - SO<sub>2</sub> and NO<sub>x</sub> also can react in the atmosphere to form fine sulfate and nitrate particles that people can inhale into their lungs potentially causing increased risk of heart disease, and effects on lung function including breathing difficulties



**Sulfuric Acid**

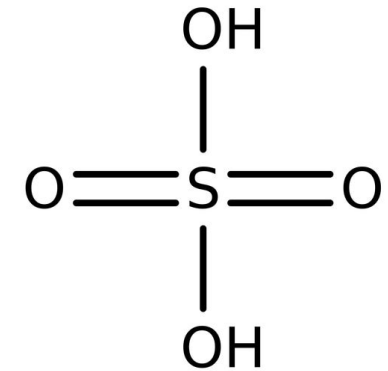
A very strong acid

Sulfide Mine Dust Can Have the Same Effect as Coal based Acid Rain

<https://www.epa.gov/acidrain/effects-acid-rain>

# Sulfides and Extractive Industries

- ❖ Iron Ore in Minnesota contains some sulfur
  - Taconite mines and coal plants are the largest dischargers of sulfate today in Minnesota.
- ❖ High Sulfide concentrations occur in Minnesota copper and nickel deposits
  - Nickel-Copper-Cobalt minerals in MN are bonded to sulfur mined as sulfide ores
  - When these ores are exposed to air and moisture, a chemical reaction occurs that generates **sulfuric acid** that migrates into the surrounding environment and, through leaching, releases heavy metals present in the waste rock, pit walls, and tailings basins of mining operations.
  - The sulfuric acid along with dissolved heavy metals released onto the land will seep into the rich aquifers below and then into streams and lakes at levels that are toxic to fish and other aquatic life
  - Sulfates interact with sulfate-reducing bacteria to produce the more bio-toxic form of mercury, methylmercury, a known neurodevelopmental toxin



**Sulfuric Acid**  
A very strong acid

The chemical reaction of sulfide ore / tailings to sulfuric acid can happen over long periods of time – many 100's of years

# Acid Mine Drainage (AMD)

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- ❖ AMD is primarily the result of sulfur from mine waste interacting with air/water to create sulfuric acid
- ❖ A literature review on acid mine drainage concluded that “no hard rock surface mines exist today that can demonstrate that acid mine drainage can be stopped once it occurs on a large scale.”
- ❖ Acid runoff from the Summitville Mine in Colorado killed all biological life in a 17-mile stretch of the Alamosa River. The site was designated a federal Superfund site, and the EPA has spent over \$210 million on clean-up.
- ❖ Zortman Landusky mine in north central Montana filed for bankruptcy in 1998 leaving the state of Montana with the liability for \$33 million in long-term water treatment and reclamation costs
- ❖ Torch Lake in Houghton County, MI is now a superfund site
  - The site includes several areas ranging in size from about 10 acres to over 200 acres.
  - Copper mining activities in the area from the 1890s until 1969 produced mill tailings (called stamp sands) that contaminated lake sediments and the shoreline
  - Cleanup, operation and maintenance activities are ongoing.

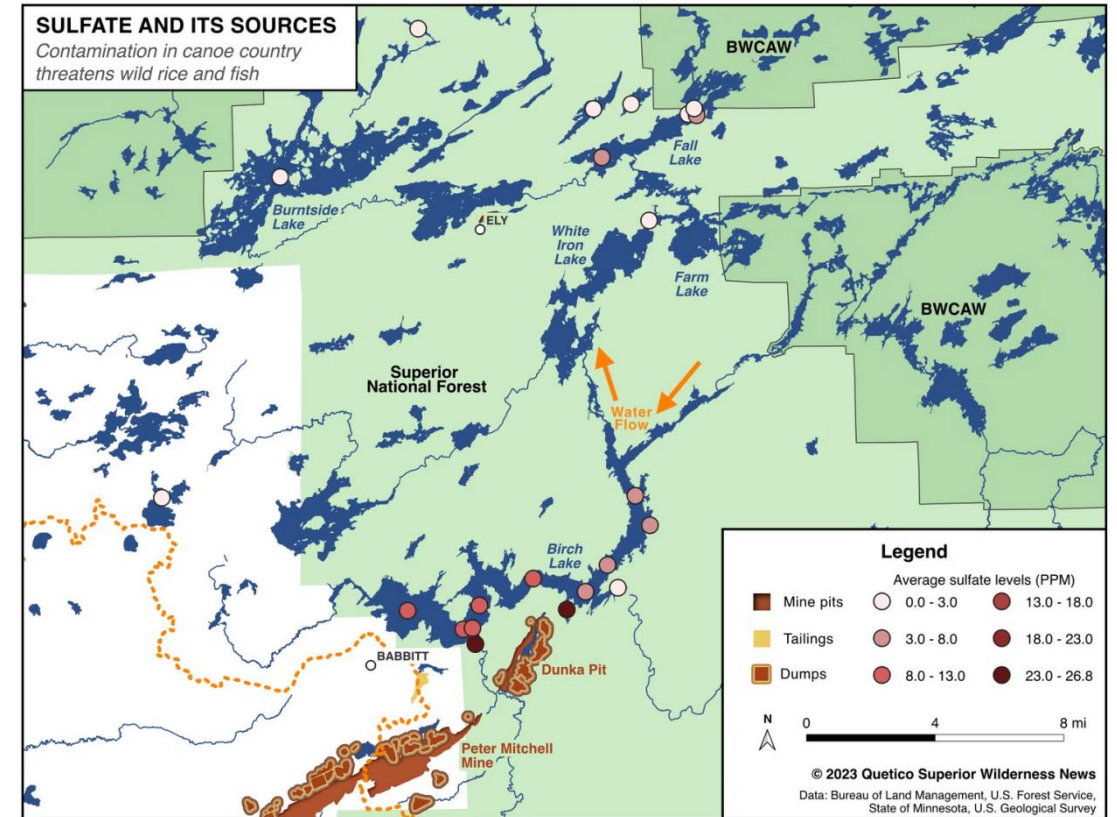
**There are NO examples of high sulfide mines in water rich areas that do not pollute**

**SOURCES:**

- [https://earthworks.org/issues/acid\\_mine\\_drainage/](https://earthworks.org/issues/acid_mine_drainage/)
- <https://www.usgs.gov/mission-areas/water-resources/science/mine-drainage>
- <https://www.epa.gov/nps/abandoned-mine-drainage-additional-resources>

# Acid Mine Drainage (AMD)

- ❖ MPCA recently announced that Birch Lake has excessive sulfate in its water (impaired)
- ❖ Several lakes and rivers upstream of the Boundary Waters Canoe Area Wilderness are contaminated with sulfate, which causes more mercury in fish and kills manoomin (wild rice), according to the Minnesota Pollution Control Agency and several citizen-led sampling efforts.
- ❖ Waters downstream of past and present iron mines exceed standards for sulfate levels designed to protect the environment.



<https://queticosuperior.org/birch-lake-near-bwca-polluted-by-sulfate-advocates-blame-taconite-mines/>

# Acid Mine Drainage (AMD)

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- ❖ For the 20 years that Wisconsin had a “Prove It First” law in place, the mining industry **could not find a non-polluting sulfide mine**. The law was repealed in 2017.
- ❖ Kuipers et al (2006) studied 25 operating hard rock mines and their EISs:
  - All predicted compliance with water quality standard within their EISs
  - However pollution from 85% of mines near surface water and 93% of mines near ground water exceeded water quality standards
  - 89% had inaccurately predicted that they would not create AMD.



Photo courtesy of the U.S. Geological Survey. 1998. Status and trends of the nation's biological resources. Vol. 1. Reston, VA: U.S. Department of the Interior. Available at: <http://www.nwrc.usgs.gov/sandt/>.

# Sulfide Mining Threatens Tribal Wild Rice Resources

- ❖ Wild rice is very sensitive to sulfide contamination
- ❖ Anishinaabe seasonally harvest tens of thousands of acres of wild rice in Northeastern Minnesota's undisturbed watersheds
- ❖ Manoomin is sacred to their way of life.
- ❖ Pristine water quality must be maintained for wild rice to germinate, grow, and survive.
- ❖ Sulfates bound in glacial/bedrock geology are released when the water is disturbed due to mining, endangering wild rice fields.
- ❖ Many lakes and streams around the Great Lakes have already lost their wild rice.
- ❖ Wild rice is hard to restore once it is gone.



Minnesota's wild rice sulfate standard limits sulfate to 10 parts per million (ppm or mg/L) in wild rice waters.



# Health Impacts of High Sulfide Mining

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## **Airborne particulates including dust from mine operations / venting**

- ❖ Inhaled, small particles lead to oxidative stress and inflammation with numerous health impacts:
  - Increased risk cardiovascular event
  - Long term increased risk of hardening of arteries
  - Increased risk of blood clots
  - Increased tendency toward metabolic imbalances
  - Emerging evidence of increased dementia risk
  - Higher risk for lung disease
- ❖ Across the environment
  - Effects on Acid Rain damage (plant kill)
  - Serious impacts on wild rice (very intolerant of sulfides)

## **Water based contamination in ground water, lakes and streams**

- ❖ Impacts on aquatic life and wetland plants including wild rice
- ❖ When the release of sulfur (e.g. from mining operations) reaches wetlands, it can stimulate “sulfate breathing” microorganisms that convert inorganic mercury to methyl mercury
- ❖ Highly toxic methyl mercury accumulates in the aquatic ecosystem including fish species
- ❖ As sulfuric acid migrates into the surrounding environment heavy metals present in the waste rock, pit walls, and tailings basins is released further polluting the environment

# Documented Health Risks of Sulfide Mining in Minnesota

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- ❖ Sulfide Mining and Human Health in Minnesota  
[https://pubs.royle.com/publication/?i=352462&article\\_id=2624726&view=articleBrowser](https://pubs.royle.com/publication/?i=352462&article_id=2624726&view=articleBrowser)
- ❖ Risks and costs to human health of sulfide-ore mining near the Boundary Waters Canoe Area Wilderness  
<https://www.tandfonline.com/doi/abs/10.1080/10807039.2019.1576026>
- ❖ Sulfide-ore mining AND human health in Minnesota - WHERE ARE WE NOW?  
<https://www.savetheboundarywaters.org/sites/default/files/resource-file/MNMedicine2022.pdf>
- ❖ Human Health and Sulfide Mining  
<https://www.tamarackwateralliance.org/docs/HumanHealthAndSulfideMining.pdf>
- ❖ Fond du Lac Band of Lake Superior Chippewa Health Impact Assessment. Expanding the Narrative of Tribal Health: The Effects of Wild Rice Water Quality Rule Changes on Tribal Health. Published online October 2018. Available at <http://www.fdlrez.com/RM/downloads/WQSHIA.pdf>

# Who is Talon Metals?

- ❖ Talon Metals is proposing a high sulfide underground nickel mine near Tamarack, MN
- ❖ Talon Metals is a mineral exploration and marketing company registered in the British Virgin Islands with offices in Toronto Canada and Tamarack MN.
  - The Tamarack Project is currently 51% owned by Talon Metals Corp. (Talon), and the remaining owned by Kennecott Exploration Company (Kennecott / Rio Tinto) and is operated by Talon.
- ❖ In August, 2024, Talon announced it only had sufficient working capital to operate through early 2025
  - They hope to receive an additional money in grants from the DoD.
  - Talon has incurred losses from operations and has an accumulated deficit of \$78 million US

Market Summary > Talon Metals Corp

0.068 USD

-0.07 (-51.07%) ↓ year to date

Oct 15, 11:05 AM EDT • Disclaimer

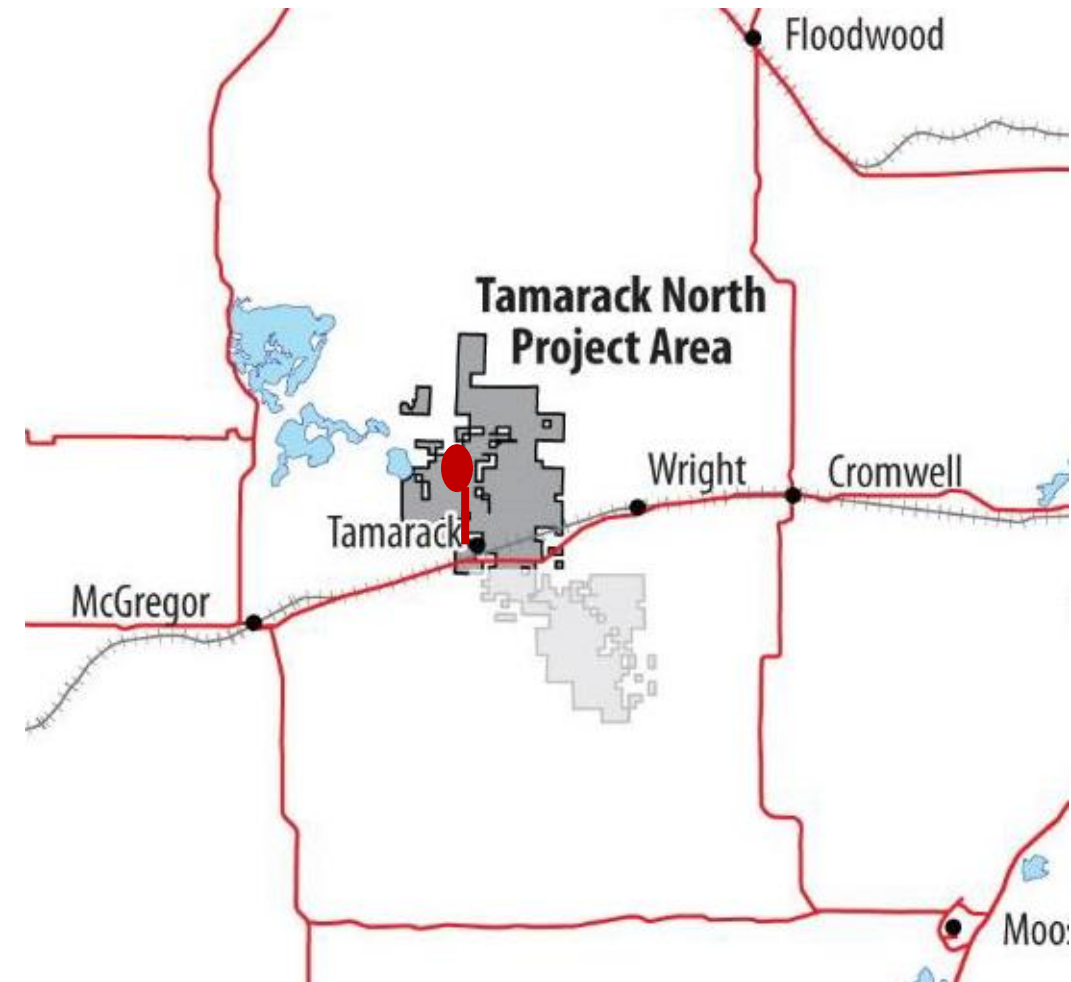
1D | 5D | 1M | 6M | YTD | 1Y | 5Y | Max



# Proposed Tamarack High Sulfide Nickel-Copper Mine

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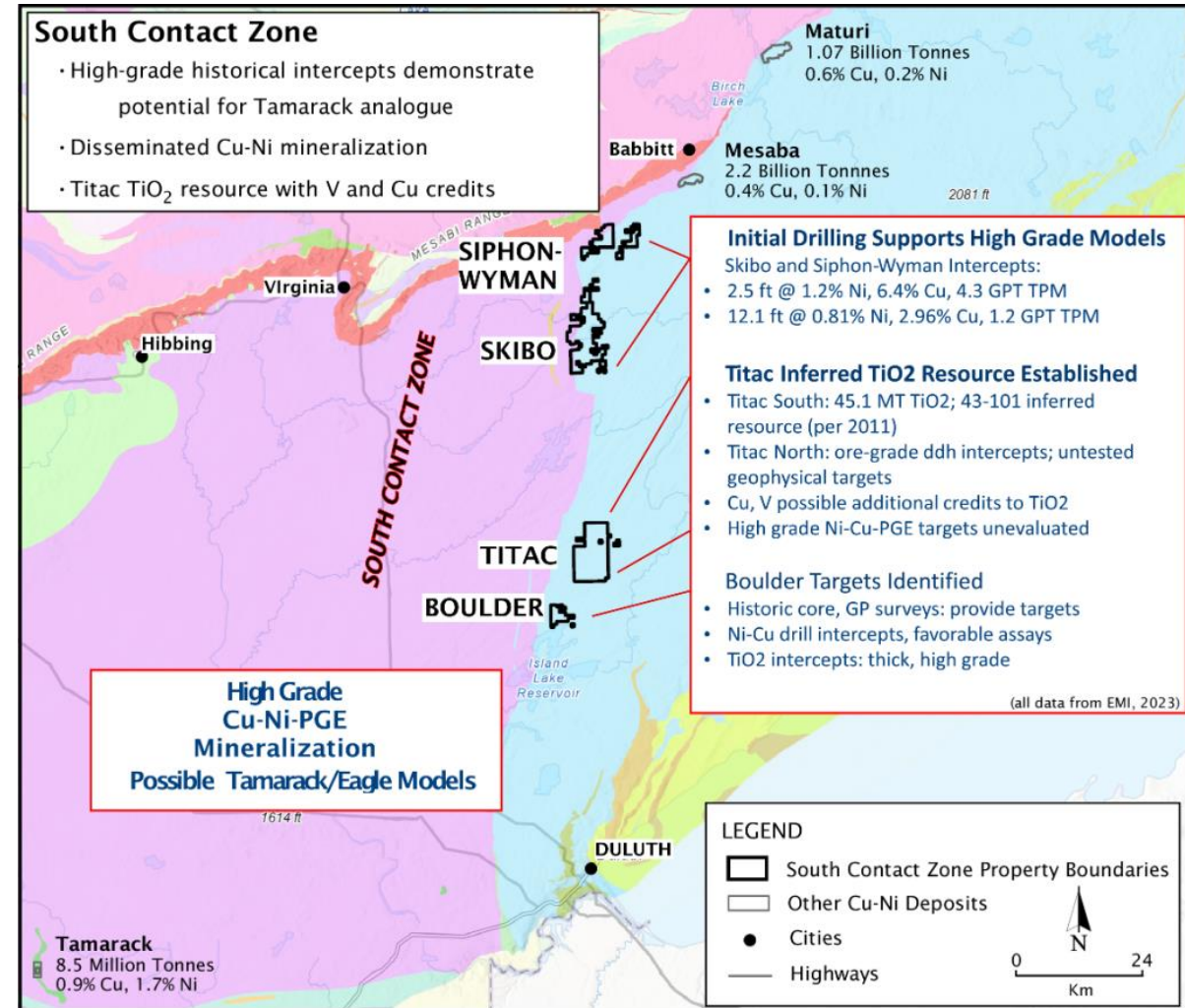
- ❖ The Tamarack North Project covers approximately 20,348 acres - Nearly **32 square miles** – but current EAW is looking at 447 acres (sq mile is 640 acres)
  - Plans to extract ~8 million tons of ore over a 7-10 year period
  - Concerns based on Talon's EAW Submission to the State of Minnesota (June 2023)
  - Vented airborne dust from blasting and ore handling is contaminated with sulfide particles and not addressed
  - Talon must pump 2.3 million or more gallons a day from the mine due to water entering from the aquifers and service water used in operations – Discharge of water as well as lowering of aquifer, lake and well levels are of concern
  - Mine site includes temporary holding piles which are not lined and will be subject to weather related spread of sulfides and other contaminants
  - Talon will be blasting daily which may cause local building foundation damage and can be felt for many miles
  - Rail transport will leak sulfides all along the route to the ND plant



# Green Bridge

- ❖ Vancouver, Canada – February 6, 2024 – Green Bridge Metals Corporation (CNSX: GRBM) announced that it has entered a letter of intent whereby the Company has an option to earn an 80% interest in the 8,460-hectare (84.6 square kilometre (km)) South Contact Zone Project
  - Targeting copper (Cu), nickel (Ni)-platinum group element (PGE) mineralization
  - The project area is located approximately 65 km north of the city of Duluth, Minnesota (Figure 1).
- ❖ Project Highlights:
  - Located in the Duluth Complex, host to world class copper – nickel deposits.
  - Four separate projects with known copper-nickel and/or titanium-vanadium-copper mineralization
  - Historical drilling and geophysical surveys provide clear drill ready targets across the underexplored portfolio.
  - Plans to initiate drill program within first year of the agreement.

<https://greenbridgemetals.com/green-bridge-metals-corporation-options-world-class-copper-nickel-exploration-portfolio-in-duluth-complex-minnesota/>



# Additional References

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- ❖ World Health Organization. Ten chemicals of major public health concern. Published 2020. Accessed Oct. 2023. <https://www.who.int/news-room/photo-story/photo-story-detail/10-chemicals-of-public-health-concern>
- ❖ Grandjean P, Landrigan PJ. Neurobehavioural effects of developmental toxicity. Lancet Neurol. 2014;13(3):330-338. doi:10.1016/S1474-4422(13)70278-3
- ❖ Kuipers JR, Maest AS, MacHardy KA, Lawson G. Comparison of Predicted and Actual Water Quality at Hardrock Mines: The Reliability of Predictions in Environmental Impact Statements. EARTHWORKS; 2006. [https://earthworks.org/resources/comparison\\_of\\_predicted\\_and\\_actual\\_water\\_quality\\_at\\_hardrock\\_mines/](https://earthworks.org/resources/comparison_of_predicted_and_actual_water_quality_at_hardrock_mines/)
- ❖ Myers T. Twin Metals Mining and the Boundary Waters Canoe Area Wilderness, Risk Assessment for Underground Metals Mining.; 2014. [https://www.savetheboundarywaters.org/sites/default/files/attachments/myers\\_2014\\_-\\_final\\_flow\\_transport\\_analysis\\_tm080914\\_-\\_risks\\_to\\_bwca.pdf](https://www.savetheboundarywaters.org/sites/default/files/attachments/myers_2014_-_final_flow_transport_analysis_tm080914_-_risks_to_bwca.pdf)
- ❖ Stock JH, Bradt JT. Analysis of proposed 20-year mineral leasing withdrawal in Superior National Forest. Ecol Econ. 2020;174:106663. doi:10.1016/j.ecolecon.2020.106663



Thank You!

# But Shouldn't We Mine Nickel Here Because of Poor Labor Practices in Indonesia?

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- ❖ US based companies do not import appreciable amounts of nickel from Indonesian nickel (into the US).
  - See <https://pubs.usgs.gov/periodicals/mcs2024/mcs2024-nickel.pdf>.
  - USGS primary nickel is from Canada, 46%; Norway, 9%; Finland, 7%; Russia, 7%; and Nickel-containing scrap, including nickel content of stainless-steel scrap: Canada, 40%; Mexico, 26%; United Kingdom, 9%; Russia, 5%. Note that recycled nickel in all forms accounted for approximately 57% of consumption.
- ❖ Indonesian nickel goes to China where it is primarily used for stainless steel (Indonesian nickel is predominately in iron deposits (NOT SULPHUR) and China has developed blast furnaces to make stainless steel directly for Indonesian nickel.
- ❖ Using Talon nickel has absolutely no affect on the Indonesian market
  - Indonesian nickel market is huge, providing 50% of world wide nickel mined (25% when you included recycled nickel)
  - Talon mine would likely only provide %0.47% of the worldwide demand for nickel - no impact on Indonesia (from USGS)
- ❖ Talon's mining of nickel supports the use of African cobalt in EV batteries and associated slave labor.
  - Africa / Congo is known to use poor practices and slave labor in their cobalt mines
  - Congo supplies 74% of the world wide supply of cobalt. <https://pubs.usgs.gov/periodicals/mcs2024/mcs2024-cobalt.pdf>.
  - But Talon's EV batteries that use nickel also use cobalt.
  - Therefore it would be much better to STOP using nickel and cobalt EV batteries but to switch to other chemistries such as Ferrous Phosphate (LFP) and eventually non-Li chemistries.



# But Don't We Need Nickel Mining for a Green/Sustainable Future?

- ❖ But don't we need nickel for solar panels, cell phones and all our electronic toys?

**NO – Solar panels and electronic devices use silicon ... from chips to solar cells ... made from sand**

- ❖ NOTE that mining by its very nature is NOT sustainable – minerals do not grow back like trees
- ❖ **What we NEED is more recycling** to create a sustainable economy



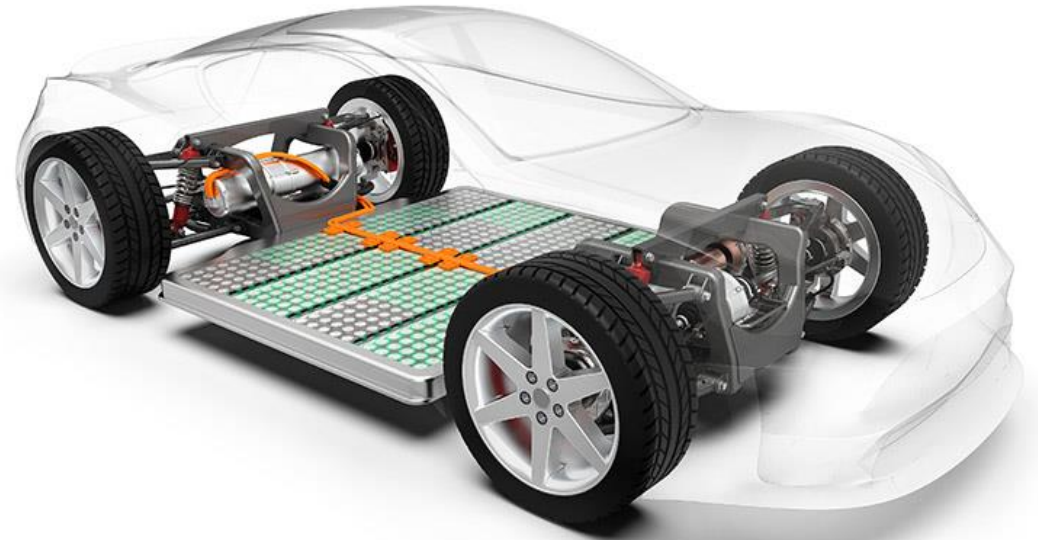
Price of nickel falling to pre-EV craze days ... making Tamarack nickel too pricey for stainless steel

# But Don't We Need Nickel for EVs?

- ❖ Tamarack North Mine Will Make NO difference in the Global Supply of Nickel
  - Only 0.47% of the world's supply of Nickel comes from the US (Michigan Eagle Mine)
  - US only possesses 0.26% of the worldwide reserves of Nickel (Michigan and Tamarack)
  - Instead of shipping this nickel onto global markets / China, should we not save our meager reserves for the future?

Tamarack Nickel will make no difference in the global supply of nickel ... but will serve to increase profits for Rio Tinto

From the USGS <https://pubs.usgs.gov/periodicals/mcs2024/mcs2024-nickel.pdf>



**Tesla publishes their list of mineral suppliers on an ongoing basis and guess what - TALON IS NOT ON THE LIST**

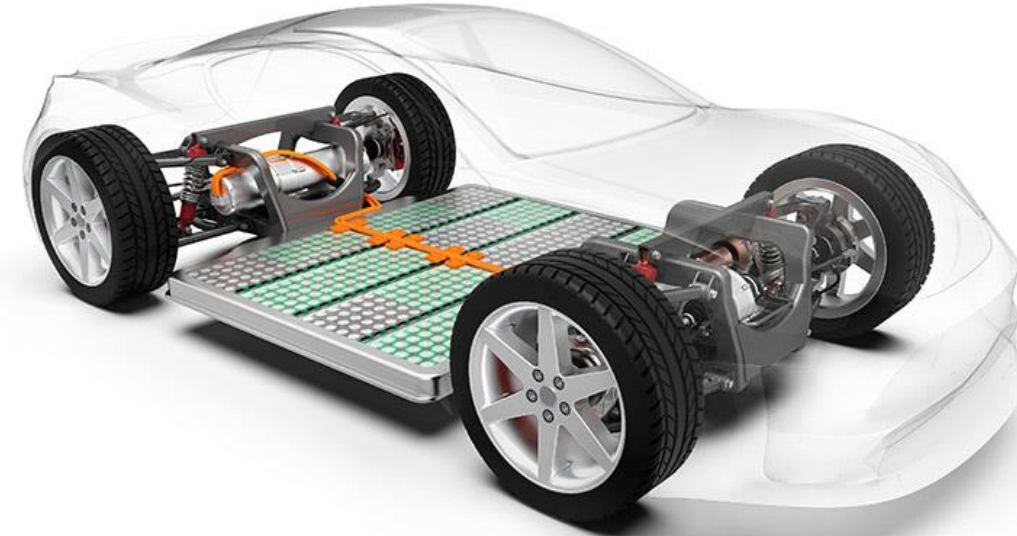
<https://electrek.co/2022/05/06/tesla-list-battery-material-suppliers-long-term-nickel-deal-vale/>

**Tesla has NEVER confirmed any agreement with Talon ... Is there really a supply agreement (probably not). And even if there were, it would have long expired by the time nickel could possibly be mined**

# But Don't We Need Nickel for EVs?

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- ❖ EV Batteries - Nickel costs \$18,000 per tonne (10/2023) and its use makes EVs unaffordable for most people
  - EV batteries using Li-Ion technology can cost \$20,000 when nickel was \$10,000 per tonne ... now battery costs have sky rocketed!
  - Nickel batteries can never be a solution to affordable EVs
- ❖ Tesla has announced a long term shift to (LFP) Lithium Ferrous Phosphate EV batteries – safer and longer life
  - Tesla 1Q22 quarterly report – nearly 50% of their vehicles in that quarter were already shipping with LFP (no nickel) batteries and
  - Tesla is transitioning their fixed battery product line to LFP
- ❖ Gotion and CATL unveiled a lithium manganese ferrous phosphate (LMFP) battery, with an energy density comparable Li-Ion (nickel based) batteries
- ❖ CATL is trialing a Sodium Ion EV battery – no nickel but made with locally sourceable inexpensive materials
- ❖ Lyten Corp and others are trialing a Lithium-Sulphur battery (no nickel) that has 2-3 times the energy density of the old Nickel based Lithium-Ion batteries – for much longer range vehicles.



Industry is moving away from Nickel & Cobalt based EV batteries due to the high cost of these materials