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To:	Steve Lines, Environmental Assessment and Permitting Manager	From:	Sheldon Smith, MES, P.Geo. Igor Iskra, Ph.D., P.Eng
	Greenstone Gold Mines GP Inc.		Stantec Consulting Ltd.
File:	160961223	Date:	May 25, 2018

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**Reference: Policy 2 Assessment for Phosphorus**

As discussed and agreed upon during a meeting on Friday May 11, 2018 with the Ministry of the Environment and Climate Change (MOECC), this Memo has been prepared to address and clarify future phosphorus loadings to Kenogamisis Lake, and in particular to demonstrate that the connection of the Project's temporary construction camp to the Geraldton municipal sewage treatment plant (STP) will not cause an increase in phosphorus loading to Kenogamisis Lake.

This Memo presents an overview of the baseline total phosphorus concentrations in Kenogamisis Lake, plans for the temporary construction camp connection to the municipal system as well as operation-associated population growth, and municipal system upgrades to address phosphorus treatment. The memo demonstrates how increased STP treatment capacity and upgraded treatment, particularly for phosphorus would improve total phosphorus concentrations in Kenogamisis Lake meeting the Policy 2 intent for phosphorus.

Phosphorus exceedances of the federal and provincial guidelines were common prior 1990s and continue to occur in Barton Bay East. The main source of phosphorus in Barton Bay East is related to sewage effluent discharge from the Geraldton municipal STP. The STP currently does not include phosphorus specific treatment.

The Draft and Final EIS/EA indicated that Barton Bay East represents the only basin of Kenogamisis Lake that had 75<sup>th</sup> percentile total phosphorus concentrations above the Provincial Water Quality Objectives (PWQO) during baseline conditions.

This memo shows that the total phosphorus loading will improve based on reasonable and practical Geraldton STP upgrades. This memo does not constitute a commitment on behalf of the Municipality to any particular STP rated capacity increase or treatment upgrade but is presented to demonstrate that achieving the Policy 2 goal of maintaining or improving total phosphorus in the lake is achievable using reasonable, practical and existing proven technology.

**BACKGROUND**

Baseline water quality monitoring for the Project was initiated in September 2013 and was summarized up to October 2016 for the Final EIS/EA. Total phosphorus concentrations generally are highest in Barton Bay East due to the effluent discharge to Hardrock Creek from the municipal STP. Total phosphorus concentrations decrease further downstream in the Central Basin and then out to the Outlet Basin. Summary data of total phosphorus concentrations in Kenogamisis Lake from 2013 to 2016 are presented in **Table 1** for each of the lake basins.

From the data, the 75<sup>th</sup> percentile concentration for total phosphorus is above the PWQO in Barton Bay East with all other basins well below the PWQO, including the Outlet Basin which represents the discharge point from Kenogamisis Lake to downstream receivers. Based on the fact that phosphorus is above the PWQO in Barton Bay East, it is our understanding that the MOECC considers Kenogamisis Lake a Policy 2 receiver for phosphorus, despite meeting the PWQO in all other basins of the lake. This is different than the Policy 2 determination for arsenic, which also exceeded the PWQO in Barton Bay, Central Basin and Outlet Basin (discharge point to downstream receivers).

Reference: Policy 2 Assessment for Phosphorus

**Table 1: Summary of Baseline Total Phosphorus Concentrations (mg/L) in Kenogamis Lake (2013-2016)**

Basin	Mean	75% Percentile
Barton Bay West	0.0038	0.0048
Barton Bay East	<b>0.0257</b>	<b>0.0329</b>
Southwest Arm	0.0099	0.0135
Central Basin East	0.0144	0.0188
Outlet Basin	0.012	0.0146

**Bold** indicates parameter above Interim PWQO of 0.02 mg/L (for lakes)

### GERALDTON SEWAGE TREATMENT PLANT

The Geraldton STP discharges to Hardrock Creek which discharges to Barton Bay East. The MOECC has expressed concern that total phosphorus conditions in Barton Bay East may increase, due to the current STP treatment capacity and effluent quality, and the Project plan to send effluent on a short-term basis from the temporary (construction) camp to the STP.

The Geraldton STP operates under CofA# 0172-6E7JZP issued on January 16, 2006 (MOECC 2006). Certificates of Approval (CofAs) are now referred to as Environmental Compliance Approvals (ECAs). The STP has a rated capacity of 2,500 m<sup>3</sup>/d and peak capacity of 7,500 m<sup>3</sup>/d. The plant is comprised of primary headworks screen channels, screenings washing and conveyance systems, vortex-type grit removal unit and flow diversion chamber, two extended aeration secondary treatment plants, return/waste activated sludge pumping and digestion systems, and chlorine disinfection followed by dichlorination. The Geraldton STP is operated for the Municipality of Greenstone by the Ontario Clean Water Agency (OCWA).

Average effluent flow of the Geraldton STP was 2,227 m<sup>3</sup>/day in 2016 and 2,317 m<sup>3</sup>/day in 2017 (OCWA 2017 and OCWA 2018a) and in both years below the rated capacity of the plant (2,500 m<sup>3</sup>/day).

Average total phosphorus influent and effluent concentrations were 1.979 mg/L and 0.617 mg/L, respectively, in 2016 and 1.441 mg/L and 0.483 mg/L in 2017 (OCWA 2017 and OCWA 2018a). The plant removal efficiency of phosphorus was 66% in 2017 and 69% in 2016. Average total phosphorus load was 1.37 kg/day (500 kg/year) in 2016 and was 1.12 kg/day (408.8 kg/year) in 2017. While the plant is required to monitor total phosphorus, there are no effluent limits or effluent objectives for total phosphorus in the existing ECA.

Geraldton is a part of the Municipality of Greenstone, where population has declined from 2001 (5,662) to 2016 (4,611) (Miller Dickinson Blais: The Municipality of Greenstone's Corporate Strategic Plan, 2015). The Project's temporary camp will house non-resident workers during the construction phase and the population of Greenstone is predicted to increase by approximately 1,000 persons during the operations phase, considering permanent workers, their families and new workers and families in ancillary businesses.

GGM has been actively working with the Municipality since 2015 towards understanding and resolving the required rated capacity expansion as well as plant upgrades to improve effluent quality, particularly for total phosphorus. The existing Geraldton STP is currently operating near capacity and would require a capacity increase to accommodate new inputs anticipated from the temporary camp and operational population growth. The existing Geraldton STP does not specifically target phosphorus removal, however does provide some phosphorus reduction. In order to meet new sanitary loads the

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**Reference: Policy 2 Assessment for Phosphorus**

STP would require a capacity increase and additional treatment technology to control and reduce phosphorus concentrations. Many technologies exist to reduce phosphorus in sanitary wastewater streams ranging from physical filtration and membrane technologies, chemical precipitation and physio-chemical adsorption processes and biological assimilation and enhanced biological phosphorus removal (EBPR), some of which can achieve very high total phosphorus removal rates (Oleskiewicz, 2015 and Saxe, 2017).

GGM has received three letters of support for the Project from the Municipality of Greenstone (Attached). The Municipality states in a letter dated January 11, 2018:

*"In support of the Project, the Municipality has agreed in principle, subject to financing, to expand the collection of municipal sewage to include the area south of Barton Bay which will include the temporary construction camp required for the Hardrock Project.*

*The design capacity of the existing municipal sewage collection system and treatment plant is adequate to accept the expected quantity of sewage from this expanded catchment area. Upgrades to the sewage treatment plant to achieve design capacity rates of treatment have been identified and will be implemented to maintain operational compliance of the facility and are planned to be in place in time for the Project's temporary construction camp. These upgrades include reduction in phosphorus loading of discharge stream and improvements to flow rates for potential future needs.*

*The Municipality of Greenstone is supportive of the Greenstone Gold Mines - Hardrock Project and is preparing for increases in population, tax base and business activity. This includes improvements to community services and infrastructure to coincide with the Project development."*

The sanitary effluent rate from the temporary camp is estimated at 150 m<sup>3</sup>/d. The existing STP rated capacity of 2,500 m<sup>3</sup>/d could accommodate an additional 150 m<sup>3</sup>/d but would require the plant to operate at full capacity. During operation, many mine workers are expected to come from the local municipality and surrounding communities.

To address MOECC concerns regarding Policy 2 and the Geraldton STP, total phosphorus loads from Geraldton STP are assumed to be capped at the 2016 annual loading mass of 500 kg for the purpose of showing net neutral or improvement for the future. Phosphorus removal to concentrations of 0.30 mg/L are achievable through EBPR supplemented by chemical and advanced filtration. As the existing plant already has a return and waste activated sludge chemical addition process the addition of an EPPR process may be a cost-effective and practical means of improving phosphorus removal efficiency to address receiving environment concerns. Increased treatment capacity and upgraded phosphorus treatment at the Geraldton STP will be able to accommodate the temporary camp and mine operation-related population growth to maintain or improve existing phosphorus concentrations in Barton Bay East as follows:

**Mine Construction Phase Temporary Camp:**

- Additional Geraldton STP influent volume: 150 m<sup>3</sup>/day
- 2016-17 average STP Effluent: 2,272 m<sup>3</sup>/day
- Total STP effluent with Camp: 2,422 m<sup>3</sup>/day
- Average 2016-17 STP influent Phosphorus concentration: 1.7 mg/L
- Enhanced phosphorus treatment target: 0.3 mg/L
- STP effluent phosphorus loading: 265 kg/year
- **Total phosphorus reduction from cap: 235 kg/year**

**Mine Operational Phase with Population Growth:**

- Additional Geraldton STP influent volume: 500 m<sup>3</sup>/day (1000 persons x 0.5 m<sup>3</sup>/person/day)
- 2016-17 average STP Effluent: 2,272 m<sup>3</sup>/day

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**Reference: Policy 2 Assessment for Phosphorus**

- Total STP effluent with population growth: 3500 m<sup>3</sup>/day (2,272 + 500 + capacity buffer of 20%)
- Average 2016-17 STP influent Phosphorus concentration: 1.7 mg/L
- Enhanced phosphorus treatment target: 0.3 mg/L
- STP effluent phosphorus loading: 383 kg/year
- **Total phosphorus reduction from cap: 117 kg/year**

During both the construction and operational phase there is a calculated net reduction on phosphorus load from the Geraldton STP.

**Contingency Plan**

The use of a third-party sewage disposal contractor is considered a contingency measure in the event the Geraldton STP upgrades are not addressed in time for the temporary camp. One option includes the Nakina Sewage Treatment system, also owned by the Municipality of Greenstone, has a rated capacity of 1,703 m<sup>3</sup>/day (5,030 m<sup>3</sup>/day wet weather flow). In 2017 the average flow was 506 m<sup>3</sup>/day (only 29% of rated capacity). During the winter months the average flow was 446 m<sup>3</sup>/day (only 26% of rated capacity).

The Nakina plant is located north of Geraldton along Highway 584 and would be a contingency treatment location with available capacity to accept the approximately 150 m<sup>3</sup>/d effluent volume anticipated by the temporary worker camp. The Nakina STP (Carousel-type treatment system) operates in extended aeration mode capable of achieving the level of treatment equivalent to secondary treatment. Tanker trucks have capacity ranging to approximately 40 m<sup>3</sup> and are subject to MTO gross weight and seasonal load limits. 150 m<sup>3</sup>/d could be transported the short distance of approximately 50 km to the Nakina plant over 4 trips/d.

**CONCLUSION**

In both the temporary camp and population increase cases, the above calculations demonstrate the feasibility of improving total phosphorus concentrations and loadings in STP effluent based on reasonable and practical capacity and treatment upgrades.

As part of the Final EIS/EA follow-up monitoring programs for Kenogamisis Lake have been developed to document the changes and confirm predictions through the construction, operation, and closure periods of the Project. The monitoring programs are outlined in the Water Management and Monitoring Plan and Appendix M1 of the Final EIS and will be advanced through the permitting stage of the Project.

**Stantec Consulting Ltd.**



**Sheldon Smith MES, P.Geo.**

Principal, Senior Hydrologist

Phone: 905-415-6405

Sheldon.Smith@stantec.com

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**Reference: Policy 2 Assessment for Phosphorus**

Attachment: Letter from the Municipality of Greenstone dated October 2, 2017  
Letter from the Municipality of Greenstone dated January 11, 2018  
Letter from the Municipality of Greenstone dated April 19, 2018

c. Piero Amodeo, Stantec Consulting Ltd.  
Michael O'Flaherty, Greenstone Gold Mines GP Inc.

## REFERENCES

MOECC (2006) Amended Certificate of Approval. Municipal and Private Sewage Works, # 0172-6E7JZP, Geraldton WPCP.

Oleszkiewicz J. (2015) Options for Improved Nutrient Removal and Recovery from Municipal Wastewater in the Canadian Context. Canadian Water Network. Available online at: <http://www.cwn-rce.ca/assets/End-User-Reports/Municipal/Oleszkiewicz/CWN-EN-Oleszkiewicz-5-pager-for-web.pdf>

Ontario Clean Water Agency (2017). 2016 Annual Report. Geraldton Wastewater Treatment Plant (Sewage Plant). March 2017

Ontario Clean Water Agency (2018a). 2017 Annual Report. Geraldton Wastewater Treatment Plant (Sewage Plant). March 2018

Ontario Clean Water Agency (2018b). 2017 Schedule 22 Annual Summary Report. Geraldton Drinking Water System. March 2018

Saxe D. (2017), Evaluating the Costs of Cutting Phosphorus in Ontario. Water Canada, November 2017. Available online at: <https://www.watercanada.net/feature/evaluating-costs-cutting-phosphorus/>

**LETTER FROM THE MUNICIPALITY OF  
GREENSTONE DATED OCTOBER 3, 2017**

ADMINISTRATION OFFICE  
1800 Main Street  
P.O. Box 70  
GERALDTON, ON P0T 1M0



Phone: 807-854-1100  
Fax: 807-854-1947  
Email:  
administration@greenstone.ca

October 3, 2017

Gavin Battarino, Special Project Officer  
Environmental Approvals Branch  
Ministry of the Environment and Climate Change  
[Gavin.Battarino@ontario.ca](mailto:Gavin.Battarino@ontario.ca)

Marc Léger, Project Manager  
Ontario Regional Office  
Canadian Environmental Assessment Agency/Government of Canada  
[Hardrock@ceaa-acee.gc.ca](mailto:Hardrock@ceaa-acee.gc.ca)

Dear Sirs:

#### SUPPORT FOR GREENSTONE GOLD HARDROCK PROJECT

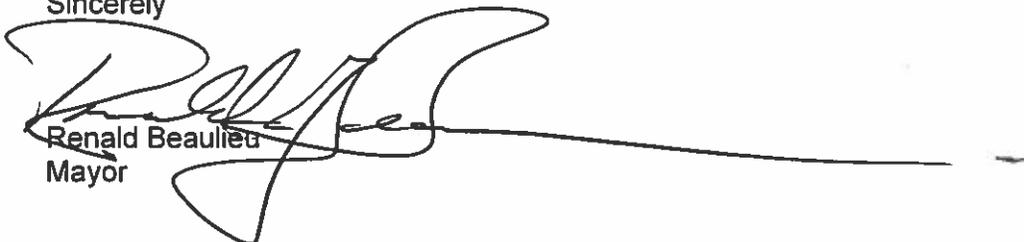
The Municipality of Greenstone is pleased to provide this letter of support for the Greenstone Gold Hardrock Project. This proposed mining development in Greenstone, Ontario will provide hundreds of well-paying jobs over an estimated 18-year construction and operating timeframe and will have a significant positive impact on the economy of both the municipality and the entire region of Northwestern Ontario.

Greenstone Gold has worked tirelessly with the community and Municipality throughout the Environmental Impact Statement/Environmental Assessment process to address any concerns that may have arisen. The respect shown to the Municipality of Greenstone, local stakeholders and local Aboriginal communities throughout the process has been greatly appreciated.

Greenstone Gold Mines has committed to using local and regional suppliers and this initiative will ensure that many of the substantial benefits of this \$1.2 billion project will remain within our Municipality. The project will see the creation of jobs for our residents and economic prosperity for our communities.

We are very supportive of this initiative and look forward to working with Greenstone Gold to realize the immense opportunity that this development offers to not only our municipality, but the surrounding region as well.

Sincerely

  
Renald Beaulieu  
Mayor

cc: Eric Lamontagne, Greenstone Gold, [eric.lamontagne@ggmines.com](mailto:eric.lamontagne@ggmines.com)  
Dina Quenneville, Grenstone Gold, [dina.quenneville@ggmines.com](mailto:dina.quenneville@ggmines.com)

**LETTER FROM THE MUNICIPALITY OF  
GREENSTONE DATED JANUARY 11, 2018**

ADMINISTRATION OFFICE  
1800 Main Street, P.O. Box 70  
GERALDTON, ON P0T 1M0



P: 807-854-1100 F: 807-854-1947  
E: [administration@greenstone.ca](mailto:administration@greenstone.ca)  
[www.greenstone.ca](http://www.greenstone.ca)

GREENSTONE

January 11, 2018

To Whom It May Concern

The Municipality of Greenstone manages all municipal infrastructure in the Ward of Geraldton. Development of the Greenstone Gold Mines - Hardrock Project will provide significant benefits to the Municipality and surrounding areas through the life of the Project. In support of the Project, the Municipality has agreed in principle, subject to financing, to expand the collection of municipal sewage to include the area south of Barton Bay which will include the temporary construction camp required for the Hardrock Project.

The design capacity of the existing municipal sewage collection system and treatment plant is adequate to accept the expected quantity of sewage from this expanded catchment area. Upgrades to the sewage treatment plant to achieve design capacity rates of treatment have been identified and will be implemented to maintain operational compliance of the facility and are planned to be in place in time for the Project's temporary construction camp. These upgrades include reduction in phosphorus loading of discharge stream and improvements to flow rates for potential future needs.

The Municipality of Greenstone is supportive of the Greenstone Gold Mines - Hardrock Project and is preparing for increases in population, tax base and business activity. This includes improvements to community services and infrastructure to coincide with the Project development.

Regards

Mark Wright  
CAO

**LETTER FROM THE MUNICIPALITY OF  
GREENSTONE DATED APRIL 19, 2018**



MUNICIPALITY OF  
**GREENSTONE**

April 19, 2018

The Honourable Chris Ballard, Minister of Environment and Climate Change  
Ministry of the Environment and Climate Change  
11<sup>th</sup> Floor, Ferguson Block  
77 Wellesley Street West  
Toronto, Ontario M7A 2T5

Dear Minister Ballard,

Re: Proposed Hardrock Project - Municipality of Greenstone, Ontario

On behalf of the 4,636 residents of the Municipality of Greenstone, Ontario I am writing to you to express both our strong support for Greenstone Gold Mines proposed Hardrock Project, and concern that we have been advised about significant delays with the environmental assessment process that could potentially jeopardize this important development for our Municipality and the region.

The Municipality of Greenstone continues to experience population decline and challenging economic conditions resulting from a downturn in industrial activity related forestry and other industries. The Municipality was once a thriving hub of development, particularly when mining was active. Greenstone Gold Mines is an important local employer, member of the community, and has demonstrated itself through sustained community consultation to be a responsible developer. The company has worked tirelessly with the community and Municipality throughout the environmental assessment process to address any concerns that may have arisen. The respect shown to the Municipality of Greenstone, local stakeholders, and local Aboriginal communities throughout the process has been greatly appreciated and paves the road for the future.

Greenstone Gold Mines has committed to using local and regional suppliers and this initiative will ensure that many of the substantial benefits of this \$1.2 billion Project will remain within our Municipality. The Project will see the creation of jobs for our residents, economic prosperity for our communities, and provide a strong foundation for long-term future and diversified opportunities. In addition, the Project includes important reclamation plans to improve the current impacts from historical mine tailings that are affecting Kenogamisis Lake, and the company is working with the Municipality to bring infrastructure improvements to the municipal sewage treatment system.

P O Box 70 1800 Main Street, Geraldton, ON P0T 1M0, Canada 807-854-1100

**NATURE'S HOME TOWN**





With the hope of realizing this important development opportunity and secure a strong future for the community, over 50 families in Geraldton are already fully committed to being relocated from the proposed mine footprint. These families and the Municipality are awaiting a positive EA decision so the company can secure financing and advance to construction. The Municipality has also commenced the rezoning process to accommodate the mine development.

I cannot underscore enough the value of moving this important Project forward in a timely manner and ask that you prioritize the advancement of the Hardrock Project with your staff.

Yours truly,



Renald Beaulieu  
Mayor

