IN THE MATTER of the Fast Track Approvals Act 2024 (FTA2024)

and

IN THE MATTER of the Application of Oceana Gold New Zealand Limited to extract minerals, in the Waihī and Wharekirauponga area

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EVIDENCE OF: STEVEN H EMERMAN

SUBJECT: OCEANA GOLD MINE APPLICATION AT WAIHI/WHAREKIRAUPONGA

DATE: 19/08/2025

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August 19, 2025

Evidence of: STEVEN H EMERMAN

Introduction

1. My name is STEVEN H EMERMAN
2. I have a B.S. in Mathematics from The Ohio State University, M.A. in Geophysics from Princeton University, and Ph.D. in Geophysics from Cornell University.
3. I have 31 years of experience teaching hydrology and geophysics, including teaching as a Fulbright Professor in Ecuador and Nepal, and have over 70 peer-reviewed publications in those areas. Since 2018 I have been the owner of Malach Consulting, which specializes in evaluating the environmental impacts of mining for mining companies, as well as governmental and nongovernmental organizations. I have evaluated proposed and existing mining projects in North America, South America, Europe, Africa, Asia and Oceania, and have testified on issues of mining and water before the U.S. House of Representatives Subcommittee on Indigenous Peoples of the United States, the European Parliament, the United Nations Permanent Forum on Indigenous Issues, the United Nations Environment Assembly, the Permanent Commission on Human Rights of the Chamber of Deputies of the Dominican Republic, and the Minnesota Senate Environment, Climate and Legacy Committee.
4. I am the former Chair of the Body of Knowledge Subcommittee of the U.S. Society on Dams and one of the authors of <u>Safety First: Guidelines for Responsible Mine Tailings Management</u>.

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While this is not a New Zealand Environment Court hearing I note that, in preparing my evidence, I have reviewed and agree to comply with the Code of Conduct for Expert Witnesses contained in Part 9 of the Environment Court Practice Note 2023. I confirm that the issues addressed in this statement of evidence are within my area of expertise, except where relying on the opinion or evidence of other witnesses, which I will specify. I have not omitted to consider any material facts known to me that might alter or detract from the opinions expressed.

I have also generally reviewed the first iteration of consent conditions. I have not reviewed, but seek an opportunity to review, the latest iteration of consent conditions, and related documents. Unfortunately these arrived too late in preparation of my evidence.

4. Each of my concerns regarding the proposed Waihi North Project is stated briefly in bold italics, followed by a more detailed explanation.

5.

1) ***Although OceanaGold will use cyanide to extract gold and silver and will store on-site 112,000 liters of liquid cyanide and 77.180 metric tons of solid cyanide, there is no cyanide management plan, OceanaGold is not a signatory of the International Cyanide Management Code, and OceanaGold has not committed to the Responsible Gold Mining Principles of the World Gold Council.***

6. Although OceanaGold has stated that they will use cyanide to extract gold and silver from the crushed ore, the application is remarkably lacking in information on the safe management of cyanide. According to the Pre-Feasibility Study that OceanaGold provided to its investors, “The silica associated gold is readily leached via conventional grinding and cyanide leaching flowsheets” (OceanaGold, 2024). The application further states that the project will store on-site

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112,000 liters of liquid cyanide and 77.180 metric tons of solid cyanide (OceanaGold, 2025a). However, there is no cyanide management plan and OceanaGold is not a signatory of the International Cyanide Management Code (The Cyanide Code, 2025). Haile Gold Mine, Inc., a wholly owned subsidiary of OceanaGold, is a signatory of the International Cyanide Management Code, while the three other operating mines owned by OceanaGold (the Didipio mine in the Philippines, and the Macraes and Waihi mines in New Zealand) are not signatories (OceanaGold, 2025b; The Cyanide Code, 2025). Thus, OceanaGold is fully aware of the International Cyanide Management Code and is fully capable of becoming a signatory when it is an expectation of the relevant regulatory agencies. Based on the above, OceanaGold cannot be trusted to safely manage cyanide at its proposed Waihi North Project.

7. The development of the International Cyanide Management Code began with the failure of the tailings dam at the Aurul S.A. gold mine near Baia Mare, Romania, in January 2000. The tailings dam failure released 100,000 cubic meters of cyanide-rich water into the Somes and Tisza Rivers, which then flowed into the Danube River and finally into the Black Sea, a distance of over 2000 kilometers. The cyanide spill resulted in massive fishkill and the destruction of aquatic species (ICOLD and UNEP, 2001). The public and governmental response led to a concern in the gold mining industry that governments would begin banning the use of cyanide, which would effectively put an end to the gold mining industry in those jurisdictions.

8. In fact, following the tailings dam failure at Baia Mare, the use of cyanide in ore processing was banned in Costa Rica, Czech Republic, Germany, and Hungary (Laitos, 2013). Turkey had already banned the use of cyanide in 1997 (Laitos, 2012). In 2010 the European Parliament called for a ban on the use of cyanide in mineral processing throughout the European Union, stating that a ban "is the only safe way to protect our water resources and ecosystems against cyanide pollution from mining activities" (Environment and Natural Resources Law & Policy Program, 2010). In the United States, the state of Montana had already banned the use of cyanide

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at open-pit mines in 1998 (Laitos, 2013). The states of Wisconsin and Virginia banned the use of cyanide in 2001 and 2024, respectively (Wisconsin State Legislature, 2001; Virginia's Legislative Information System, 2024). Eight provinces of Argentina have prohibited the use of cyanide in mineral processing, although there is no nationwide prohibition (Laitos, 2013).

9. In an effort to forestall such governmental bans and their existential threat to the industry, the gold mining industry created the International Cyanide Management Code for the Manufacture, Transport, and Use of Cyanide in the Production of Gold (called the International Cyanide Management Code in this report) (The Cyanide Code, 2025a). The International Cyanide Management Code is a voluntary commitment that includes third-party audits for full certification. Thus far, over 225 companies are signatory to the International Cyanide Management Code, including mining companies, cyanide producers, and cyanide transporters. There are no signatory companies in New Zealand, where there is no expectation for compliance with the International Cyanide Management Code, but signatory companies in neighboring countries include 15 in Australia, seven in Indonesia, and two in Papua New Guinea (The Cyanide Code (2025b). The Responsible Gold Mining Principles, which were developed by the World Gold Council are even broader than the International Cyanide Management Code because they incorporate the International Cyanide Management Code, in addition to other requirements. According to the Responsible Gold Mining Principles, "Where our operations use cyanide, we will ensure that our arrangements for the transport, storage, use and disposal of cyanide are in line with the standards of practice set out in the International Cyanide Management Code" (World Gold Council, 2019a).

10. It should be noted that the International Cyanide Management Code is not a guidance document, but a certification program. Thus, a company cannot commit to the requirements of the International Cyanide Management Code without engaging in the certification process. The Introduction to the International Cyanide Management Code begins, "The 'International

Cyanide Management Code For the Manufacture, Transport, and Use of Cyanide In the Production of Gold' (Cyanide Code) is a voluntary, performance driven, certification program of best practices for gold and silver mining companies and the companies producing and transporting cyanide used in gold and silver mining … The objective of the Cyanide Code is to improve the management of cyanide used in gold and silver mining and to improve the protection of human health and the reduction of environmental impacts, while assuring stakeholders of the safe handling of cyanide through the disclosure of results from periodic audits by independent professional auditors. Implementation of the Cyanide Code is verified through triennial audits conducted by independent third-party auditors. Companies that adopt the Cyanide Code must have their operations that use, transport, or produce cyanide audited to determine the status of Cyanide Code implementation. Those operations that meet the Cyanide Code requirements are certified" (International Cyanide Management Institute, 2021a). The detailed procedures for carrying out audits are described in International Cyanide Management Institute (2021b-c). Although OceanaGold has never stated a commitment to comply with the International Cyanide Management Code, but without the third-party audits that would be required by becoming a signatory, it has been my experience that companies with such commitments do not comply with the actual International Cyanide Management Code, but with their own version of the code.

11. A signatory company does not need to have an operating facility to obtain certification, so that a regulatory agency could reasonably require certification for proposals alone. According to the International Cyanide Management Institute (2021c), "The Code allows for pre-operational certification of a mining operation that is not yet active but that is sufficiently advanced in its planning, design, or construction that its plans and proposed operating procedures can be audited for conformance with the Code … Since mines that are not yet active cannot be audited for their actual operation, pre-operational certification is based on their commitments to design, construct and operate the mine in full compliance with the Cyanide Code's Principles and Standards of

Practice. Auditors of mines seeking pre-operational certification must determine if the operation can reasonably be expected to be in full compliance with the Code's Principles and Standards of Practices once its plans are implemented and it becomes active … A preoperational facility found in full compliance is conditionally certified, subject to an on-site audit to confirm that the operation has been constructed and is being operated in compliance with the Code." Thus, OceanaGold could become a signatory on behalf of the Waihi North Project at the present time without waiting for the mine to begin operation.

12. In a similar way, OceanaGold has never made a public commitment to align with the Responsible Gold Mining Principles of the World Gold Council, and could not do so without providing third-party assurance. According to World Gold Council (2019a), "The Principles require implementing companies to:

1. Make a public commitment to align with the Responsible Gold Mining Principles
2. Develop internal systems, processes and performance that conform with the Principles
3. Report publicly on the status of their conformance with the Principles
4. Obtain independent assurance on their conformance with the Principles."

World Gold Council (2019a) continues, "Two public reports are associated with the assurance:

1. An annual report on implementation of the Responsible Gold Mining Principles produced by the implementing company
2. An Independent Assurance Report produced annually by the assurance provider."

World Gold Council (2019b) describes the detailed procedures for implementation and assurance of the Responsible Gold Mining Principles. It should be noted that OceanaGold has never made a public commitment to align with the Responsible Gold Mining Principles of the World Gold Council.

13. The failure of OceanaGold to include a cyanide management plan within the application, to become a signatory of the International Cyanide Management Code, and to align with the

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Responsible Gold Mining Principles of the World Gold Council should be sufficient cause to reject the application for the Waihi North Project without further consideration.

14.

2) ***Although the application confirms that the mining operation will leak mercury into groundwater, the application incorrectly states that mercury is immobile in groundwater.***

15. The application repeatedly confirms that the mining operation is expected to leak mercury into groundwater, but then quickly dismisses any concerns based on the assumed immobility of mercury in groundwater. For example, according to OceanaGold (2025c), "The results indicate that elevated concentrations of number of parameters associated with tailings discharge are likely within the shallow groundwater west of the Gladstone pit during the long-term TSF scenario. This includes iron, mercury and zinc which are predicted to exceed the receiving water quality criteria. Mercury is typically immobile in groundwater due to volatilization and/or precipitation processes and has not been reported in significant persistent concentrations by OGNZL (2020). It is not a parameter of concern for these reasons … Groundwater discharge from the TSF to the surface water receiving environment in the long-term TSF scenario is predicted to be in the order of 65 m^3/day to the west of the pit (Table 3.16). Of this discharge, approximately 5 m^3/day is predicted to comprise tailings porewater, with the remainder being groundwater and infiltrated rainwater that has migrated through rock backfill to the point of discharge from the pit. Shallow groundwater quality following mixing and geochemical equilibrium (AECOM, 2021a) is predicted to result in an increase in the concentration of iron and mercury within the shallow groundwater to levels exceeding the receiving water quality criteria … Emplacement of rock at the NRS [Northern Rock Stack] will result in leachate generation during both operation and after closure that will percolate downwards through the rock stack … The predicted concentrations of mercury are greater than the RWQC [Receiving Water Quality Criteria] as the laboratory

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detection limit of this parameter is greater than the criterion. As discussed previously, mercury is typically immobile in groundwater due to volatilization and/or precipitation processes and has not been reported in significant persistent concentrations by OGNZL (2020). It is not a parameter of concern for these reasons." OceanaGold (2025d) continues, "The mass flux leaving the TSF3 and expected to enter the Ohinemuri River is provided in Table 5.15 … The predicted concentrations of mercury are greater than the RWQC as the laboratory detection limit of this parameter is greater than the criterion. Mercury is typically immobile in groundwater due to volatilisation and/or precipitation processes and has not been reported in significant, persistent concentrations by OGNZL (2020)."

16. It is not correct to state that mercury is typically immobile in groundwater. It is certainly not warranted to dismiss any considerations of the circumstances under which mercury will be transported through groundwater, simply based upon its assumed immobility. Mercury can be highly mobile in groundwater under acidic conditions, if mercury attaches to colloidal particles, if biological processes transform mercury into methylmercury or other organo-mercury compounds, or if mercury forms complexes with chloride, bromide, or dissolved organic matter.

17. For example, according to the review paper "Mercury in Groundwater – Source, Transport and Remediation," "Precipitation-dissolution, oxidation-reduction, adsorption-desorption, and aqueous complexation reactions control Hg transport and fate in groundwater. Adsorption of Hg^{2+} onto goethite and hematite or co-precipitation with/ or adsorption onto mackinawite or HgS along the flow path (Johannesson and Neumann, 2013) can restrict Hg mobility unless Hg is bound to colloids (particles <1 um) … The quality and quantity of dissolved organic matter (DOM) can also control the aqueous transport and the formation of toxic MeHg under various environmental conditions … under oxidizing conditions, Hg sorbed on FeOOH particulates could become mobilized in groundwater systems … Several investigations revealed that mobilization, transport, and fate of Hg in groundwater are strongly controlled by (1) redox

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processes that support precipitation-dissolution and microbial activity (including methylation of Hg^{2+}) within the aquifer; (2) a pH condition favorable to adsorption-desorption and the availability of Fe and DOM in the groundwater" (Aleku et al., 2024). The earlier review paper "Occurrence and Mobility of Mercury in Groundwater" summarized, "Oxidation-reduction, precipitation-dissolution, aqueous complexation, and adsorption-desorption reactions will strongly influence the fate and transport of Hg in groundwater" (Barringer et al., 2013).

18. It should be noted that, even when contaminants are immobilized in groundwater due to a particular chemical and biological environment, those contaminants can later be re-mobilized as a result of a change in groundwater chemistry or biology. For this reason, immobilized mining-related contaminants are often referred to as the "chemical time bomb."

19. In summary, the mobility in groundwater of mercury resulting from the Waihi North Project requires a serious investigation, rather than a simple dismissal.

20.

3) Although the application emphasizes the high arsenic, antimony and mercury contents in the ore body and the tailings, there is no consideration of the ability of cyanide to mobilize those elements and, thus, increase the arsenic, antimony and mercury concentrations in the tailings pond and tailings pore water.

21. According to the Pre-Feasibility Study that OceanaGold (2024) provided to its investors, "The GOP [Gladstone Open Pit] orebody contains significant levels of mercury at levels higher than currently experienced in the mill (up to 4 g/t Hg) [4 parts per million]." Since, according to Aleku et al. (2024), "Hg is one of the least abundant elements in the upper continental Earth's crust, with an estimated concentration ranging from 12.3 to 96 μg/kg [0.0123 to 0.096 parts per million]," the GOP ore body has a mercury concentration that is 42 to 325 times the global

background concentration. From another perspective, since the gold grade of the GOP is in the range 1.00 to 1.44 grams per metric ton (equivalent to parts per million), the GOP would be primarily a mercury mine, not a gold mine (see Figs. 1a-b).

22. The application repeats the above point, but also with regard to arsenic and antimony. According to OceanaGold (2025e), "The static field tests confirmed that in general, Andesite and Breccia material from GOP is elevated in mercury, antimony, and arsenic relative to the historical Waihi dataset and mean concentrations in the earth's crust … Of note is mercury, which has largely been recorded below the laboratory method detection limit in site mine waters and shows an order of magnitude increase in total concentration within the Gladstone rock … Elevated trace element concentrations (antimony, arsenic and mercury) in the rock (and ore body) relative to historical mined areas need to be assessed for potential implications for consent compliance at the point of discharge (both to water and to air). An assessment of the distribution of trace elements within the rock shows that mercury is elevated in the highly clay altered Andesitic material located near the surface and associated with the Breccia material … Mercury is more elevated in Gladstone ore and is therefore the primary focus area with regard to management of mine tailings."

23. In fact, the application states even higher mercury concentrations than were reported in the Pre-Feasibility Study (OceanaGold, 2024). According to OceanaGold (2025e), "From the figure, a pattern of decreasing mercury concentration with depth can be observed with the higher mercury concentrations (red > 10 ppm, orange 5-10 ppm) focused on the Breccia rock material or within the Andesitic material bordering the Breccia material."

24. As with the release of cyanide into groundwater, the application concludes that elevated concentrations of arsenic, antimony and cyanide are not a matter of concern. According to OceanaGold (2025e), "When compared to historical rock trace element data, the proposed

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Gladstone Pit rock is generally depressed in trace element concentrations with the exception of antimony, arsenic, and mercury, which are elevated. Although these elements are elevated, geochemical controls such as co-precipitation and complexion, along with the current on-site treatment facilities will control the trace element concentrations from the mine area to within the current operating limits for treated water. It is predicted that elevated trace element concentrations in mine waters arising from elevated concentrations within the rock material (with respect to historical mining areas) will not impact the site's ability to meet the existing discharge consent conditions."

25. What is entirely missing from the application is the recognition that the ability of cyanide to extract arsenic, antimony, and mercury, as well as gold and silver, from crushed ore is well-established. Thus, the concentrations of dissolved arsenic, antimony and mercury in the tailings pore water have been under-estimated, so that the releases of arsenic, antimony and mercury into groundwater and surface water have also been under-estimated.

26. The explanation of the above point requires some detail on the use of cyanide in mineral processing. An excellent reference on this subject is the SME (Society for Mining, Metallurgy and Exploration) handbook Basic Cyanide Chemistry (Botz, 2024). The process of gold ore processing using cyanide involves dissolving a cyanide salt (such as sodium cyanide) in water, so that it dissociates to form the cyanide ion (CN^-) and hydrogen cyanide (HCN). The gold ore is crushed and is either placed onto a heap leach pad, where cyanide solution is poured over it, or mixed with the cyanide solution in a vat. The cyanide ion extracts the gold from the ore to form a dissolved gold-cyanide complex. The solution with the gold-cyanide complex is called the pregnant solution.

27. There are two important processes for removing the gold-cyanide complex from the pregnant solution. In the first process, the pregnant solution is mixed with or passed over activated carbon,

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so that the gold-cyanide complex leaves the solution and attaches to the activated carbon, after which the solution is referred to as the barren solution. Further steps (called stripping or elution) remove the gold from the activated carbon and restore the cyanide to the barren solution. Any lost cyanide is replaced in the barren solution and the solution is then recycled to extract additional gold from more gold ore. The second important process is called zinc cementation or the Merrill-Crowe process. In this process, the addition of zinc dust to the pregnant solution creates a highly-reducing (low-oxygen) environment. The highly-reducing environment causes gold to be reduced to its elemental (metallic) state, so that it precipitates as solid particles of gold. As with the activated carbon process, any lost cyanide is replaced in the barren solution and the solution is then recycled to extract additional gold from more gold ore.

28. Cyanide can also be used to extract silver from crushed ore. However, there are other, safer methods for the processing of silver ore and cyanide is rarely used to extract silver, unless there is a desire to extract both gold and silver from the same ore body. The reaction of silver with free cyanide will form a dissolved silver-cyanide complex and both of the above processes can then be used to remove the silver-cyanide complex from the pregnant solution. The silver-cyanide complex will attach to activated carbon, although not as strongly as the gold-cyanide complex, so that gold can out-compete silver for adsorption sites. The addition of zinc dust will also cause the reduction of silver to its elemental state and its precipitation as solid particles of silver. Generally, the Merrill-Crowe process is preferred when there are higher concentrations of silver in the ore with the activated carbon process used for lower concentrations (Botz, 2024). The combined cyanide extraction of gold and silver results in a semi-pure gold-silver alloy called doré, after which further refining can be carried out to produce pure gold and pure silver.

29. Aside from the question of the persistence of cyanide in the environment (which will be addressed in Point #4), a considerable portion of the environmental toxicity that is a consequence of the use of cyanide in gold ore processing is not the cyanide itself, but the by-products of the

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use of cyanide. Cyanide is equally effective in extracting mercury from crushed ore, so that any mercury present in the gold ore also appears as a dissolved mercury-cyanide complex within the pregnant solution. There is a mercury-cyanide complex that could attach to activated carbon along with the gold-cyanide complex, but not the particular mercury-cyanide complex that forms under the alkaline conditions that are necessary for processing with cyanide. Some of the hydrogen cyanide that develops when sodium cyanide is dissolved to form the cyanide solution remains in the dissolved form, but most of it volatilizes to escape as hydrogen cyanide gas. Hydrogen cyanide gas would be lethal to the mineworkers and would be economically undesirable, even if it could be ventilated, because it represents a loss of cyanide from the processing circuit. In order to minimize the production of hydrogen cyanide and maximize the production of the cyanide ion, the cyanide solution is maintained in a very alkaline state, in the pH range of 10-11 (Botz, 2024). In such a high pH range, the mercury-cyanide complex remains in the barren solution. Thus, every passage of the cyanide solution through the processing circuit causes the solution to encounter more ore that may contain additional mercury. As a consequence, the cyanide solution becomes increasingly enriched in mercury, which can be far more toxic to the environment than cyanide.

30. Other contaminants can be mobilized into the cyanide solution solely as a result of the high pH. These contaminants include elements that form oxyanions (negatively-charged ions that include oxygen) in the dissolved form. Examples of such elements are arsenic, antimony, molybdenum, selenium, and uranium. As with mercury, since none of the preceding oxyanions will attach to activated carbon, they will remain in the barren solution. Thus, every passage of the cyanide solution through the processing circuit will cause the solution to become increasingly enriched in arsenic, antimony, molybdenum, selenium, and uranium, if those elements are present in the gold ore.

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31. It should be noted that the tailings pore water is simply the barren cyanide solution as it has been incorporated into the tailings. In summary, the tailings pore water should be expected to be enriched in arsenic, antimony, and mercury over and above what has been predicted in the application.

32.

4) ***The application does not include any consideration of the impact of a failure of the tailings dam on the water quality of downstream waterways.***

33. Although OceanaGold (2025f) analyzes the impact of a dam breach on downstream waterways, the analysis is concerned only with physical parameters, such as the depth of the tailings flood, the tailings flow velocities, and the arrival times of the tailings flood. There has not been any analysis of the chemical impact of the release of the tailings and the tailings pond on the downstream waterways and the aquatic life in those waterways. It has already been mentioned that predictions of the chemistry of the tailings pore water are overly optimistic. It is even more important that there is no analysis whatsoever of the chemistry of the tailings pond, especially in terms of arsenic, antimony, cyanide and mercury. In this respect, it should be borne in mind that, according to the application, TSF3 will have a perpetual water cover after closure, so that the threat of a release of the tailings pond into downstream waterways will never end (OceanaGold, 2025a; see Fig. 2). It should also be noted that, although the Pre-Feasibility Study (OceanaGold, 2024) describes a plan for oxidation of water with hydrogen peroxide for destruction of cyanide prior to the intentional release of mine wastewater into the environment, it does not describe any corresponding plan for the destruction of the cyanide in the tailings pore water prior to deposition of the tailings in TSF3. The lack of a plan for the destruction of cyanide in tailings pore water is, of course, consistent with the lack of any cyanide management plan, as was discussed under Point #1. Even if there were such a plan, the destruction of cyanide in tailings pore water is always partial.

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34. It is often said in mining corporate communications that cyanide does not persist in the environment, since it rapidly breaks down into carbon dioxide and ammonia as a result of processes such as oxidation, volatilization, photo dissociation, and biodegradation. The statement is generally true, but requires three critical qualifications. The first qualification is that the processes of cyanide attenuation in surface water can require days to weeks, depending upon many factors, such as the extent of aeration or mixing of the water, the depth of the water, the intensity of sunlight, and the presence of the appropriate microbial community. During that time period of days to weeks, extensive destruction of aquatic life and impacts on municipal water supply are still possible. For example, the leakage of cyanide-enriched water from the Summitville gold mine in Rio Grande County, Colorado (USA), destroyed nearly all aquatic life along a 37-kilometer reach of the Alamosa River (Laitos, 2013). In the case of the spill of cyanide-enriched water from the Aurul S.A. gold mine near Baia Mare, Romania, in 2000, the cyanide plume traveled over 2000 kilometers down the Danube River to the Black Sea.

35. The second qualification is that dissolved cyanide can disappear from the water column as carbon dioxide and ammonia, which is true destruction of the cyanide. On the other hand, cyanide can also disappear from the water column as a result of the adsorption of cyanide onto solid particles or the precipitation of a solid cyanide salt, such as iron cyanide. In these cases, the cyanide has not been destroyed, but is only being stored in the solid form. This type of storage is referred to as the "chemical time bomb," because a change in water chemistry or photo dissociation can cause the transfer of adsorbed cyanide back into the dissolved form or the dissolution of the precipitated cyanide salts. According to Johnson (2015), "Of these fates, dispersal to the atmosphere and chemical transformation amount to permanent elimination of the cyanide, whereas sequestration amounts to storage of cyanide. If physicochemical conditions change, stored cyanide can potentially be released to infiltrating waters by means of dissolution or desorption reactions."

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36. The third and most important qualification is that most of the processes leading to destruction function only for surface water and can be absent for groundwater. In particular, groundwater can have low oxygen levels, be disconnected from the atmosphere or sunlight, or lack the microbial community that can biodegrade cyanide. According to Laitos (2013), "In contrast to surface waters, because groundwater lacks ultraviolet light and has less available oxygen, cyanide will persist for longer periods of time if it works its way underground." Johnson (2015) drew attention to the problematic aspects of both large-scale spills of cyanide into surface water and leakage into groundwater. According to Johnson (2015), "From an environmental perspective, the most significant cyanide releases from gold leach operations have involved catastrophic spills of process solutions or leakage of effluent from solid wastes to the unsaturated [soil water] or saturated zones [groundwater]. Key to the environmental significance of spills and leakage is that these release pathways are unfavorable for two important cyanide attenuation mechanisms that can occur naturally: catastrophic spills allow little time for offgassing of free cyanide to the atmosphere, and effluent leakage to the subsurface does not allow for photodissociation of strong cyanometallic complexes to give free cyanide that can offgas." Free cyanide refers to cyanide in the highly toxic forms of either the cyanide ion or hydrogen cyanide.

37. In summary, the impacts of a release of a tailings pond and tailings pore water that is enriched in arsenic, antimony, cyanide, and mercury have not been analyzed at all.

38.

5) ***Based on the high precipitation and the past history of sulfide-ore mining, the release of acid mine drainage and the contamination of groundwater and downstream waterways should be an expected outcome of the Waihi North Project.***

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39. The ore that would be mined at the Waihi North Project is a classic sulfide ore. According to OceanaGold (2024), "Gold occurs mostly as small inclusions of electrum (averaging 38 % silver) occurring as both free grains in the quartz and as inclusions in sulphides such as pyrite, galena, sphalerite and less commonly chalcopyrite."

40. The central issue with the mining of sulfide ores is the release of acid mine drainage and heavy metals into groundwater and downstream waterways. Acid generation occurs when sulfide minerals from beneath the surface are excavated and exposed to oxygen and water on the surface, so that the reaction with oxygen and water (called oxidation) converts the sulfides into sulfuric acid. The conversion of sulfide minerals to sulfuric acid is promoted both by crushing the sulfide minerals, which increases the surface area that is exposed to oxygen and water, and by the permanent aboveground disposal, which allows for an extended time over which the acid-generating reactions can occur.

41. A by-product of acid generation is the mobilization of heavy metals into the dissolved form. For example, the oxidation of pyrite (iron sulfide) results in the mobilization of dissolved iron, while the oxidation of galena (lead sulfide) results in the mobilization of lead. However, most sulfide minerals include a variety of other heavy metals that can substitute for the primary metal (such as substitutes for iron in the mineral pyrite), so that the oxidation of pyrite can result in the mobilization of a wide range of other heavy metals.

42. Acid mine drainage can induce a positive feedback in that the downstream load of dissolved metals can greatly exceed the dissolved metals that result from the oxidation of the exposed sulfide minerals. Stream sediments typically include clay minerals, whose surfaces have negatively-charged sites that bind cations (positively-charged ions). Most dissolved metals are cations, although there are some exceptions, such as arsenic (actually a metalloid), molybdenum and uranium, which occur in dissolved form as oxyanions (polyatomic negatively-charged ions

that include oxygen). When acidic water interacts with these stream sediments, the hydrogen cations in the water displace other cations (such as metallic cations) from the negatively-charged sites on stream sediments, so that metals are no longer fixed onto sediment, but are mobilized in the stream column as dissolved metals. Stream beds can also include tailings from previous episodes of mining that have heavy metals attached to surface sites. As above, these heavy metals can be mobilized by the introduction of new acid mine drainage into streams or by other anthropogenic increases in stream acidity. For this reason, mine tailings in stream beds are often referred to as another example of the "chemical time bomb."

43. The application clarifies that not only will the ore body and, thus, the tailings, be potentially acid forming (PAF), but also the overburden, the waste rock, and even the walls of the open pit. The various means for preventing acid mine drainage and metal leaching from PAF materials include mixing with limestone to neutralize the acidity, placement of liners underneath PAF materials, capping PAF materials with NAF (non-acid forming) materials, and the permanent submergence of PAF materials. Permanent water covers are not recommended by the mining industry, which is discussed in Point #6.

44. The application includes considerable doubts as to how much PAF material should be expected and is filled with multiple possibilities. According to OceanaGold (2025a), "The design of the WRS [Willows Rock Stack] incorporates clean water diversion drains to separate the balance of the catchment water from the WRS contact water … Limestone will be used to neutralise any PAF materials … This will involve backfilling the pit with 5 Mt of suitable rock material and the reworking and capping of PAF pit walls if required … In the instance that any PAF material is to be placed within the Western Borrow Area, a low permeability liner will be established within the area … Initially the working areas of the NRS [Northern Rock Stack] will consist of converting the existing NAF Northern Stockpile into a potentially acid forming PAF stockpile … During construction, any PAF working surfaces will be regularly tested and limed as

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required, and extensive geochemistry and water quality monitoring will continue to be undertaken. The cover design for the NRS will be consistent with the existing TSF embankments, including progressive and final rehabilitation of outer surfaces with layers which limit oxygen and water ingress … The proposed embankment and impoundment design for TSF3 … takes into consideration: … • The need to encapsulate PAF rock with low permeability NAF rock to minimise the potential for sulphide oxidation and the generation of acid leachate, and to collect and contain any leachate that forms for pumping to treatment; • The need to add crushed limestones to any PAF material within the TSF3 embankment to delay acid generation during construction until the capping layers are in place … The TSF3 embankment will be constructed with low permeability liners and capping to limit oxygen and water ingress to any PAF materials used in the embankment construction. Limestones may also be placed in the embankment to minimise any acid generation potential during constriction … The key works associated with mining the GOP will include: … • Rehabilitation of the GOP TSF, including its capping with NAF rock … The Closure Plan for TSF3 includes: • A partial dry capping of the perimeter of the impoundment as has been done at TSF2; • A wet capping of the tailings in the centre of the impoundment not covered by the dry capping." The lack of knowledge as to how much PAF material will exist and the existence of sufficient NAF material to cap the PAF material will be discussed in Point #8.

45. Although mixing with limestone, placement of liners, and capping of PAF material with NAF material are typical tools for prevention of acid mine drainage, it is crucial to recognize that there has never existed a sulfide-ore mine that has not caused environmental contamination. In response to the concerns regarding acid mine drainage and metal leaching, in 1997 the Wisconsin (USA) legislature enacted Statute 239.50 entitled "Moratorium on Issuance of Permits for Mining of Sulfide Ore Bodies" (National Wildlife Federation, 2012). The statute defined "a sulfide ore body" as "a mineral deposit in which nonferrous metals are mixed with sulfide minerals" (Wisconsin Statutes Archive, 2023). The statute then stated, "Beginning on May 7,

1998, the department [Department of Natural Resources] may not issue a permit under s. 293.49 for the purpose of the mining of a sulfide ore body until all of the following conditions are satisfied: (a) The department determines, based on information provided by an applicant for a permit under s. 293.49 and verified by the department, that a mining operation has operated in a sulfide ore body which, together with the host nonferrous rock, has a net acid generating potential in the United States or Canada for at least 10 years without the pollution of groundwater or surface water from acid drainage at the tailings site or at the mine site or from the release of heavy metals. (b) The department determines, based on information provided by an applicant for a permit under s. 293.49 and verified by the department, that a mining operation that operated in a sulfide ore body which, together with the host nonferrous rock, has a net acid generating potential in the United States or Canada has been closed for at least 10 years without the pollution of groundwater or surface water from acid drainage at the tailings site or at the mine site or from the release of heavy metals" (Wisconsin Statutes Archive, 2023).

46. In other words, the Wisconsin statute implicitly recognized the theoretical possibility of sulfide ore mines that had either operated or been closed without environmental contamination, but also implicitly insisted that Wisconsin should not be the testing ground. Another implicit implication was that any successful proposal for a sulfide ore mine in Wisconsin should demonstrate how it would incorporate the lessons from any previous sulfide ore mines that had been free from environmental pollution, as well as the myriad of sulfide ore mines that had resulted in environmental pollution.

47. Over the next two decades, despite the generally-recognized inevitability of environmental contamination by sulfide ore mining, eight candidates were formally or informally put forward as model sulfide ore mines that met the requirements of the Wisconsin statute (see Table 1). Each of the eight candidates were rebuffed because, in fact, they each had extensive records of environmental contamination. As a consequence, no sulfide ore mines were approved in

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Wisconsin during the tenure of the statute (National Wildlife Federation, 2012). The impasse was broken in favor of the mining industry when the statute was repealed in 2017 with effect in 2018 (Frye, 2018).

48. Each year since 2021 a bill for a similar statute has been introduced into the Minnesota legislature entitled 93.2501 "Moratorium on Issuing Permits for Nonferrous Sulfide Ore" and popularly known as the "Prove It First Bill." The bill defines "nonferrous sulfide ore" as "any ore, other than iron ore, consisting of sufficient sulfide minerals to generate acid mine drainage" (Minnesota Legislature, 2021). According to the bill, "The commissioner [of Natural Resources] may not issue a permit required to mine nonferrous sulfide ore unless the commissioner and the commissioner of the Minnesota Pollution Control Agency both determine, based on published, peer-reviewed scientific information and public records, that a mine for nonferrous sulfide ore has operated commercially for at least ten years and has been closed for at least ten years without resulting in a release of a hazardous substance, hazardous waste, or pollutant or contaminant as defined under section 115B.02. The mine must have operated in the United States in a similar environment to the mine for which the permit is sought and must have used reclamation techniques substantially similar to those proposed in the permit application. The applicant for a permit required to mine nonferrous sulfide ore bears the burden of demonstrating each of the conditions necessary for a determination under this paragraph that a permit may be issued" (Minnesota Legislature, 2021). "Similar environment" is defined as "a location with similar abiotic ecological features, such as average annual precipitation and average monthly temperature, and in which the proximity of surface water and groundwater to mining operations is similar to the proximity of surface water or groundwater to the Minnesota site or sites for which the permit is sought" (Minnesota Legislature, 2021). The Prove It First bill refers to "nonferrous sulfide ore" presumably because it is unheard of to exploit sulfide ores for iron due to the possibility of acid mine drainage, a variety of processing challenges, and the remaining abundance of iron oxide ore bodies in the world.

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49. Since the opening of the public discussion over the Minnesota Prove it First Bill, again despite the generally-recognized inevitability of environmental contamination by sulfide ore mining, ten candidates have been informally put forward as model sulfide ore mines that would meet the requirements of the Minnesota bill. The proposals for model mines have been informal, such as in communications from elected officials or blogs or letters to the editor, since there is not yet any formal process. The irony is that, out of the ten candidates that have been put forward as model sulfide ore mines that would meet the requirements of the Minnesota Prove It First Bill, eight are the exact same candidates that were put forward and rebuffed during the tenure of the Wisconsin statute, the only new candidates being the Musselwhite gold mine in Ontario and the Rainy River gold-silver mine in Ontario (see Table 1). The fact that only two new potential candidates for model mines have emerged over the past 25 years is the best evidence of all that there has never been a sulfide ore mine that did not result in environmental contamination. The evidence for actual environmental contamination by each of the ten candidates for sulfide ore mines without environmental contamination was compiled in an earlier report by the author (Emerman, 2023).

50. It is now appropriate to return to the ten candidates for sulfide ore mines that have operated or been closed without environmental contamination (see Table 1). Note that the evidence that all of these candidate mines actually do have extensive records of environmental contamination has been compiled by Emerman (2023). Out of the ten candidate mines, two are in arid regions (annual precipitation less than 250 mm), while three more are in semi-arid regions (annual precipitation between 250 and 500 mm) (see Table 1). The candidate mine in the wettest climate is the Flambeau mine in Wisconsin with a mean annual precipitation of 860.3 mm (see Table 1).

52. By contrast, according to OceanaGold (2025c), “The average annual rainfall adopted for this assessment is 2,110 mm/year.” If a sulfide ore mine were to be operated and then eventually

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closed at the site of the proposed Waihi North project, it would be the first example of a sulfide ore mine that had operated or been closed without environmental contamination. Based on the preceding discussion and the high rainfall at the site of the Waihi North Project, it seems highly unlikely that the Waihi North Project could be the first example of a sulfide ore mine without environmental contamination. Certainly there is no discussion in documents from OceanaGold as to what technology or site characteristics would separate the Waihi North Project from every other sulfide ore mine.

53. In summary, OceanaGold is invited to submit an example of a sulfide-ore mine in a climate similar to that of the Waihi North Project that has been operated and closed without environmental contamination. In the absence of such an example, it should be expected that the release of acid mine drainage and the contamination of groundwater and downstream waterways should be an expected outcome of the Waihi North Project.

54.

6) *The proposal for a permanent water cover on TSF3 is not recommended by the mining industry because of its detrimental impact on the physical stability of the tailings dam.*

55. According to OceanaGold (2025c), "The Closure Plan for TSF3 includes: • A partial dry capping of the perimeter of the impoundment as has been done at TSF2; • A wet capping of the tailings in the centre of the impoundment not covered by the dry capping" (see Fig. 2). A permanent water cover is not recommended by the mining industry due to its detrimental impact on dam stability and, thus, should be regarded as a desperate act to somehow prevent the oxidation of sulfidic tailings that will be permanently exposed on the surface.

56. The panel that investigated the failure of the Mount Polley tailings storage facility in British Columbia (Canada) in 2014 concluded that "The goal of BAT [Best Available Technology] for

tailings management is to assure physical stability of the tailings deposit. This is achieved by preventing release of impoundment contents, independent of the integrity of any containment structures. In accomplishing this objective, BAT has three components that derive from first principles of soil mechanics: 1. Eliminate surface water from the impoundment … In short, the most serious chemical stability problem concerns tailings that contain sulfide minerals, particularly in metal and coal mining. In the presence of oxygen, these sulfides react to produce acid that then mobilizes a variety of metals in solution. There are a number of ways to arrest this reaction, and one is to saturate the tailings so that water replaces oxygen in the void spaces. This saturation is most conveniently achieved by maintaining water over the surface of the tailings. Hence, so-called water covers have sometimes been adopted for reactive tailings during operation and for closure. It can be quickly recognized that water covers run counter to the BAT principles … But the Mount Polley failure shows why physical stability must remain foremost and cannot be compromised. Although the tailings released at Mount Polley were not highly reactive, it is sobering to contemplate the chemical effects had they been. No method for achieving chemical stability can succeed without first ensuring physical stability: chemical stability requires above all else that the tailings stay in one place" (Independent Expert Engineering Investigation and Review Panel, 2015a). The subsequent revisions to the mining legislation in British Columbia concurred in writing, "Physical stability is of paramount importance, and options that require a compromise to physical stability should be discarded" (Ministry of Energy and Mines, 2016).

57. Plans to maintain permanent water covers over reactive mine waste after mine closure in order to prevent the reaction of sulfide minerals with oxygen in perpetuity should be regarded as especially problematic. Independent Expert Engineering Investigation and Review Panel (2015b) defined an "active tailings dam" as "a tailings dam whose impoundment contains surface water," even for tailings storage facilities that are no longer receiving tailings. Independent Expert Engineering Investigation and Review Panel (2015a) continued, "BAT principles should be

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applied to closure of active impoundments so that they are progressively removed from the inventory by attrition. Where applicable, alternatives to water covers should be aggressively pursued." The SME Tailings Management Handbook further concurred in writing, "Where tailings subaqueous disposal is employed behind constructed dams, the dam safety liability associated with maintaining the tailings in a flooded condition also remains … A dam that retains a large water pond is inherently less safe than an embankment that does not. There are no case records of impoundments designed for perpetual submergence behind constructed dams that have been perpetually submerged. So, there is no demonstrated precedent for the legacy of permanent submergence being constructed today. We have only just started the clock" (Andrews et al., 2022).

58. Besides the detrimental impact on dam stability, the application provides no information regarding how the permanent water cover will be maintained. Presumably, the permanent water cover will result from the balance among precipitation, surface runoff, infiltration, and evapotranspiration. However, considering all of the ways in which the climate could change in the indefinite future, it is difficult to imagine how the proper balance could be maintained in perpetuity simply as a result of natural processes without any human intervention. The application certainly does not include any plan for perpetual maintenance of the water cover. On that basis, it could be assumed that, eventually, the water cover will dry up and the exposed sulfidic tailings will be converted into sulfuric acid.

59.

7) ***Based upon mining industry guidance, it should be assumed that the eventual collapse of the tailings dam at the proposed Waihi North Project with the release of the confined tailings into downstream waterway is inevitable.***

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60. At the end of its useful life, or when it is no longer possible to inspect and maintain a water-retention dam, the dam is completely dismantled. A water-retention dam cannot simply be abandoned or it will eventually fail at an unpredictable time with consequences that are difficult to predict. However, the permanent storage of tailings, which has already been mentioned several times, cannot be overemphasized. A tailings dam can never be dismantled unless the tailings can be moved to another location, such as an exhausted open pit. Typically, a tailings dam is expected to confine the often toxic tailings in perpetuity, although normally the inspection, monitoring, maintenance, and review of the dam cease at some point after the end of the mining project.

61. The overall problem with the closure plan for the tailings storage facility at the Waihi North Project is that there is no plan for long-term monitoring, inspection, maintenance and review of the facility. The need for perpetual care of tailings storage facilities is, in fact, the official view of the mining industry. According to the SME (Society for Mining, Metallurgy and Exploration) Tailings Management Handbook, "The mining industry has a significant challenge in that these TSFs [Tailings Storage Facilities] will last for perpetuity. Unfortunately, humans have no experience in designing facilities to last forever, so responsible tailings management is required for as long as the TSF exists" (Morrison and Lammers, 2022). In the absence of a plan for perpetual monitoring, inspection, maintenance and review of the tailings storage facility, the eventual collapse of the facility should be assumed.

62. The need for perpetual maintenance of a tailings dam, as well as the realism of such a prospect, was discussed in the guidance document Safety First: Guidelines for Responsible Mine Tailings Management. According to Morrill et al. (2022), "It is imperative that the reclamation and closure of tailings facilities be a factor in their initial design and siting … A tailings facility is safely closed when deposition of tailings has ceased and all closure activities have been completed so that the facility requires only routine monitoring, inspection and maintenance in

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perpetuity or until there are no credible failure modes … Currently, there is no technology to ensure that an active tailings facility can be closed in such a way so as to withstand the PMF [Probable Maximum Flood] or MCE [Maximum Credible Earthquake] indefinitely without perpetual monitoring, inspection, and maintenance ... Given that operating companies will not exist long enough to accomplish perpetual monitoring, inspection, maintenance, and review, the operating company's ability to eventually eliminate all credible failure modes must be a key consideration during the permitting process. If a regulatory agency does not believe an operating company can carry out perpetual care and financial responsibility, or eliminate all credible failure modes, they must not approve the facility."

63. The world expert on tailings dams is Professor Steven Vick, who is the author of the textbook Planning, Design and Analysis of Tailings Dams (Vick, 1990). The view of Prof. Vick is that the eventual collapse of a tailings dam is inevitable, regardless of any plan for perpetual maintenance, simply due to the multitude of things that could go wrong given enough time. In a conference presentation, Vick (2014a) concluded that "System failure probabilities much less than 50/50 are unlikely to be achievable over performance periods greater than 100 years … system failure probability approaches 1.0 after several hundred years." Vick (2014a) continued, "For closure, system failure is inevitable … so closure risk depends solely on failure consequences." In the accompanying conference paper, Vick (2014b) elaborated, "Regardless of the return period selected for design events, the cumulative failure probability will approach 1.0 for typical numbers of failure modes and durations. This has major implications. For closure conditions, the likelihood component of risk becomes unimportant and only the consequence component matters … This counterintuitive result for closure differs so markedly from operating conditions that it bears repeating. In general, reducing failure likelihood during closure—through more stringent design criteria or otherwise—does not materially reduce risk, simply because there are too many opportunities for too many things to go wrong. In a statistical sense, all it can do is to push failure farther out in time. System failure must be accepted as inevitable, leaving

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reduction of failure consequences as the only effective strategy for risk reduction during closure."

64. In summary, the critical decision that is facing the government and people of New Zealand is whether the eventual collapse of the tailings dams at the Waihi North Project would be an acceptable outcome. This decision should involve taking into consideration the acid-generating potential of the tailings, as well as the presumed high concentrations of arsenic, antimony, and mercury in the tailings pond and the tailings pore water, which was discussed in Point #4.

65.

8) ***The lack of any mining plan means that it is impossible to meaningfully assess the environmental impact of the proposed Waihi North Project at the present time.***

66. There is no mining plan for the Waihi North Project because OceanaGold still does not know whether there is anything worth mining. This extraordinary finding results from the fact that, in their latest report to investors, OceanaGold (2024) did not report any measurable resources for any of their mining areas (see Fig. 1a), no proven reserves for any of their mining areas (see Fig. 1b), and not even any probable reserves for either the MOP (Martha Open Pit) or the GOP (Gladstone Open Pit) (see Fig. 1b). Mining plans are developed based upon the sum of probable reserves plus proven reserves. OceanaGold (2024) confirms, "Mineral Resources that are not Mineral Reserves do not have demonstrated economic viability" (see Fig. 1a). It has been my experience that all environmental impact studies and other similar documents are based upon the assumption that the project proponent will mine the sum of probable reserves plus proven reserves and will produce the corresponding quantities of tailings and waste rock.

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67. I will clarify the above finding with more explanation on the distinction between mineral resources and mineral reserves. In general terms, mineral resources refer to the size of an ore body containing a commodity of value (typically, above some specified cut-off grade), while mineral reserves refer to the quantity of ore that can be economically mined given current technology. Since OceanaGold trades on the Toronto Stock Exchange and because the Pre-Feasibility Study (OceanaGold, 2024) follows the requirements for an NI 43-101 Technical Report, the precise definitions of the Canadian Institute of Mining, Metallurgy and Petroleum (CIM) will be reviewed here. According to CIM (2014), "A Mineral Resource is a concentration or occurrence of solid material of economic interest in or on the earth's crust in such form, grade or quality and quantity that there are reasonable prospects for eventual economic extraction." Since there must be "reasonable prospects for eventual economic extraction," the conversion of an ore body into a commodity cannot be only a theoretical possibility. In other words, the estimation of resources must be based upon a particular cut-off grade with an assumed commodity price, along with many other factors. The conversion of resources into reserves is based upon "Modifying Factors," which may include "mining, processing, metallurgical, infrastructure, economic, marketing, legal, environmental, social and governmental factors" (CIM, 2014).

68. Mineral resources are then subdivided into inferred resources, indicated resources and measured resources, according to the level of confidence in the existence of the resources, with the greatest confidence placed in measured resources, and the least confidence in inferred resources. CIM (2014) explains, "An Inferred Mineral Resource is that part of a Mineral Resource for which quantity and grade or quality are estimated on the basis of limited geological evidence and sampling." On the other hand, "An Indicated Mineral Resource is that part of a Mineral Resource for which quantity, grade or quality, densities, shape and physical characteristics are estimated with sufficient confidence to allow the application of Modifying Factors in sufficient detail to support mine planning and evaluation of the economic viability of

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the deposit" (CIM, 2014). The difference between indicated resources and measured resources is that measured resources can be used to support "**detailed** mine planning and **final** evaluation of the economic viability of the deposit" (emphasis added; CIM, 2014).

69. By contrast, "a Mineral Reserve is the economically mineable part of a measured and/or Indicated Mineral Resource" (CIM, 2014). Note that an inferred mineral resource cannot be regarded as a mineral reserve, or economically mineable. By analogy with mineral resources, mineral reserves are subdivided into probable reserves and proven reserves. According to CIM (2014), "A Probable Mineral Reserve is the economically mineable part of an indicated, and in some circumstances, a Measured Mineral Resource. The confidence in the Modifying Factors applying to a Probable Mineral Reserve is lower than that applying to a Proven Mineral Reserve ... A Proven Mineral Reserve is the economically mineable part of a Measured Mineral Resource. A Proven Mineral Reserve implies a high degree of confidence in the Modifying Factors." Clearly, the specified cut-off grade and the anticipated commodity price are important factors in determining which portion of an indicated or measured resource is an economically mineable reserve and whether a reserve is probable or proven.

70. The absence of any mineral reserves and, thus, the absence of any mining plan means that the most basic information is missing. Some categories of missing information include the following:

1. the duration of the mining project
2. the quantity and schedule of ore extraction
3. the quantity and schedule of tailings production
4. the quantity and schedule of production of PAF waste rock
5. the quantity and schedule of production of NAF waste rock

71. As a consequence of the lack of a mining plan, it is impossible to evaluate the environmental impact of a mining project that is essentially only in the conceptual stage. For example, although

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there are numerous commitments to cover or encapsulate all PAF waste rock with NAF waste rock, it is not known whether there will be enough NAF waste rock to accomplish this task. As another example, the application calls for the use of NAF waste rock that has a low mercury content for construction of the tailings dam. According to OceanaGold (2025c), "AECOM has recommended that high mercury NAF is not used in NAF zones which perform a liner function or are exposed to the surface." OceanaGold (2025g) also states, "PAF mine overburden material and high mercury (>3.5 mg/kg) is not permitted for use in Zones A, G, H and I," in which Zone A is the "low permeability zone (earth liner) that restricts seepage from mine overburden material into underlying ground," Zone G is the "outer sealing layer of the embankment that restricts entry of oxygen and water," Zone H is the "plant growth layer," and Zone I is "structural fill forming downstream section of the Perimeter road where it is in fill." It is impossible to evaluate the above claims when there is no information as to how much low-mercury NAF waste rock will be available or whether there will be any low-mercury NAF waste rock.

72. In summary, the current application for the Waihi North Project is premature and should be paused until OceanaGold has established the existence of mineral reserves and developed a mining plan (sometimes called the general plan of operations).

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Table 1. Candidates for model sulfide ore mines with comparison to precipitation at the site of the Waihi North Project[1]

Mine	Location	Principal Commodities	Opening – Closure	Mean Annual Precipitation (mm)
Bagdad	Arizona (USA)	Copper	1928-2101	424.4
Cactus	Arizona (USA)	Copper, silver, gold	1972-1984	235.5
Cullaton Lake	Nunavut (Canada)	Gold	1976-1985	244.0
Eagle	Michigan (USA)	Nickel, copper	2014-2026	739.9
Flambeau	Wisconsin (USA)	Copper, gold, silver	1993-1997	860.3
McLaughlin	California (USA)	Gold	1985-2002	798.1
Musselwhite	Ontario (Canada)	Gold	1997-2029	717.4
Raglan	Quebec (Canada)	Nickel	1997-2027	401.0
Rainy River	Ontario (Canada)	Gold, silver	2017-2032	709.5
Stillwater	Montana (USA)	Palladium, platinum	1986-2055	458.5
		Site of Waihi North Project[2]		2110.0

[1]Table adapted from Emerman (2023)

[2]OceanaGold (2025c)

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Table 1-1: Summary of Mineral Resources Estimate as of June 30, 2024

Area	Indicated					Inferred				
	Tonnes (Mt)	Grade (g/t Au)	Grade (g/t Ag)	Au (Moz)	Ag (Moz)	Tonnes (Mt)	Grade (g/t Au)	Grade (g/t Ag)	Au (Moz)	Ag (Moz)
MOP	6.50	1.95	13.4	0.41	2.81	2.3	2.1	12.1	0.2	0.9
GOP	3.22	1.44	3.76	0.15	0.39	0.8	1.0	2.6	0.03	0.1
MUG	6.42	5.29	25.5	1.09	5.27	2.7	4.7	27.1	0.4	2.4
WUG	2.39	17.9	28.0	1.37	2.15	1.3	9.6	17.1	0.4	0.7
Total Mineral Resources	18.5	5.07	17.8	3.02	10.6	7.1	4.3	17.6	1.0	4.0

Notes:

- Mineral Resources are reported inclusive of Mineral Reserves. Mineral Resources that are not Mineral Reserves do not have demonstrated economic viability.
- Mineral Resources estimate was reviewed and approved by, or is based on information prepared by or under the supervision of, Leroy Crawford-Flett, BSc Geology, MAusIMM CP (Geology), the Company's Exploration and Geology Manager and a qualified person under NI 43-101.
- Mineral Resources are reported at a gold price of $1,950/oz.
- Mineral Resources estimate for MUG is reported below the MOP design and constrained to within a conceptual underground design based upon the incremental cut-off grade of 2.15 g/t Au.
- Mineral Resources estimate for Wharekirauponga WUG is reported within a conceptual underground design at a 2.10 g/t Au cut-off grade.
- Mineral Resources estimates for MOP and GOP are reported within conceptual pit designs and incremental cut-off grades of 0.50 g/t and 0.56 g/t, respectively. The MOP conceptual pit design is limited by infrastructural considerations.
- Tonnage and grade measurements are in metric units. Gold ounces are reported as troy ounces and "g/t" represents grams per tonne.
- No dilution is included in the reported figures and no allowances for processing or mining recoveries have been made.
- All figures have been rounded; totals may therefore not sum exactly.
- OceanaGold is not aware of any environmental, permitting, legal, socio-economic, marketing, political, or other factors that might materially affect the Mineral Resource estimates. The QPs acknowledge that the consenting timeline is a risk, however, are satisfied with the Company's risk mitigation plans.
- MUG and WUG Resources are reported within conceptual stopes, only for material above the nominated cut-off grade. This constrains the tonnes and grade reporting to the mineralized or vein interpretation as shown in Figure 1-3.

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Figure 1a. OceanaGold reported to its investors that it has zero measurable resources at any of its mining areas. Even so, the table clarifies that "Mineral Resources that are not Mineral Reserves do not have demonstrated economic viability" (see table of mineral reserves in Fig. 1b). Table from OceanaGold (2024).

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Table 1-2: MUG and WUG Combined Mineral Reserves Estimate as of June 30, 2024

Reserve Area	Class	Tonnes (Mt)	Au (g/t)	Ag (g/t)	Au (Moz)	Ag (Moz)
MUG	Proven	-	-	-	-	-
	Probable	4.4	3.8	16.1	0.5	2.3
Total MUG		4.4	3.8	16.1	0.5	2.3
WUG	Proven	-	-	-	-	-
	Probable	4.1	9.2	16.1	1.2	2.1
Total WUG		4.1	9.2	16.1	1.2	2.1
Total Mineral Reserve		8.5	6.4	16.1	1.7	4.4

Note:

- The WUG Mineral Reserves estimate was reviewed and approved by, or is based on information prepared by or under the supervision of, Euan Leslie, MAusIMM (CP), the Company's Group Mining Engineer and a qualified person under NI 43-101.
- The MUG Mineral Reserves estimate was reviewed and approved by, or is based on information prepared by or under the supervision of, David Townsend, MAusIMM (CP), the Company's Mining Manager and a qualified person under NI 43-101.
- Mineral Reserves are reported based on OceanaGold's mine design, mine plan, mine schedule and cash flow model at a gold price of $1,750 /oz.
- Tonnages include allowances for losses resulting from mining methods. Tonnages are rounded to the nearest 100,000 tonnes.
- Ounces are estimates of metal contained in the Mineral Reserves and do not include allowances for processing losses. Ounces are rounded to the nearest hundred thousand ounces.
- All figures have been rounded; totals may therefore not sum exactly.
- Tonnage and grade measurements are in metric units. Gold ounces are reported as troy ounces and "g/t" represents grams per tonne.

Figure 1b. OceanaGold reported to its investors that it has zero mineral reserves at the MOG (Martha Open Pit) and Gop (Gladstone Open Pit) mining areas and only probable reserves at its other mining areas. Note the statement that "Mineral Resources that are not Mineral Reserves do not have demonstrated economic viability" (see Fig. 1a). In other words, at the present time, OceanaGold is unable to tell its investors that there is anything worth mining at the MOP and GOP areas. Table from OceanaGold (2024).

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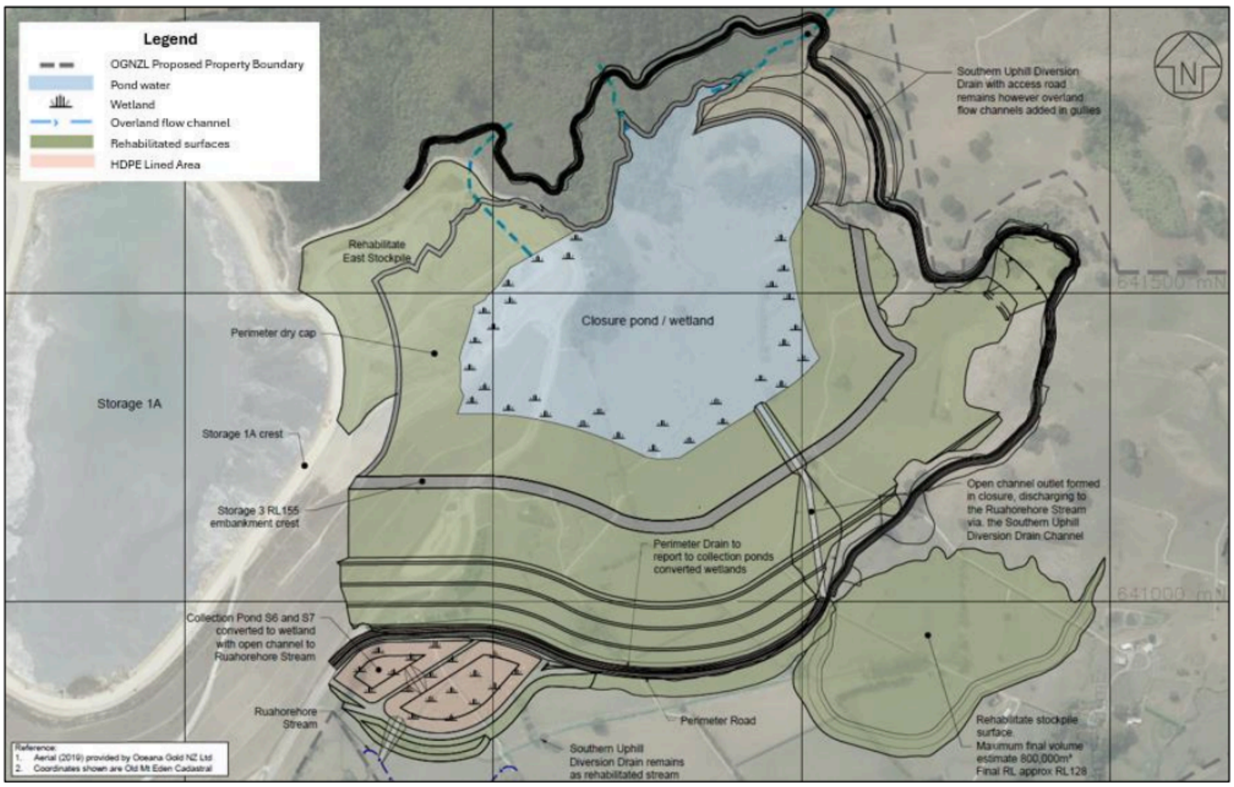

Figure 2-77: TSF3 RL 155 Closure Layout (EGL (2025c))

Figure 2. According to the application, TSF3 will have a permanent water cover after closure in order to prevent oxidation of the tailings and the generation of acid mine drainage. Permanent water covers are not recommended by the mining industry due to their detrimental impact on mine stability. Figure from OceanaGold (2025a).

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August 22, 2025

The Chair, The Fast Track Panel
Waihi North Project

To the Chair:

I have reviewed the four reports by Denis Tegg with the following titles:

1) "Critique: Environmental and Socio-Economic Impacts of a Tailings Dam Breach"
2) "Lessons from the Waitekauri (Golden Cross) Landslide for the Oceana Gold Waihi Tailings Storage Facility Fast Track Application"
3) "Re-evaluation of Hikurangi Subduction Zone Seismic Hazard to Waihi Tailings Storage Facilities"
4) "The Te Puninga and Kerepehi Faults - Seismic Design Safety of Waihi Goldmining Tailings Dams"

I am summarizing the respective conclusions of each report as follows:

1) The application for the Waihi North Project should consider all of the potential environmental and socioeconomic impacts of the failure of the tailings storage facility from the toe of the facility to the ocean.
2) The application for the Waihi North Project should fully incorporate the lessons learned from the Waitekauri (Golden Cross) landslide, including the importance of geotechnical site characterization and foundation stability, hydrological vulnerability and water management, seismic hazard and liquefaction susceptibility, the potential for a "perfect storm" scenario of compounding natural hazards, and long-term environmental and financial liabilities.
3) The application for the Waihi North Project should re-evaluate the Maximum Credible Earthquake based upon the potential for a mega-earthquake along the Hikurangi subduction zone.
4) The application for the Waihi North Project should re-consider the seismic design based upon new studies regarding the seismic potential of the Te Puninga and Kerepehi faults.

The quality of these reports shows that Mr. Tegg has a deep understanding of the issues addressed in his reports.

I am in full agreement with the conclusions reached by Mr. Tegg.

Steven H. Emerman