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BEFORE THE STATE OF NEVADA
STATE ENVIRONMENTAL COMMISSION

In the Matter of:

Appeal of Groundwater Pollution Control Permit No. NEV2020104

OPENING BRIEF

Appellant, Great Basin Resource Watch, ("GBRW" or "Appellant"), by and through its attorney of record, Cavanaugh-Bill Law Offices, hereby respectfully submits its Opening Brief pursuant to NAC 445B.8925 and the Nevada State Environmental Commission's ("SEC") Order Regarding Brief Scheduling dated April 15, 2022.

STATEMENT OF FACTS

The Nevada Division of Environmental Protection (NDEP) issued a Water Pollution Control Permit for the first 10-year phase of the Lithium Nevada Thacker Pass mine in northern Nevada, which is anticipated to be a 41-year mining project with five years of reclamation operated by Intervenor Lithium Nevada Corp. (LNC). The proposed filtration of clay tailings is a new technology with no operating mines currently using same, as set forth more fully in the Report of Steven H. Emerman attached hereto as Exhibit 4. Concerns regarding errors in NDEP's issuance of the permit were raised via Appeal by GBRW on March 7, 2022 with analysis and argument contained herein.

Over all, there is no attention to the Observational Method, which is the basis for nearly every other mining project. Unlike nearly every other mining project, LNC does not appear to have any preplanned actions ready for execution in the event of adverse observations, such as unanticipated seepage from the CTFS, nor does NDEP require them to have such preplanned actions. (See generally, materials referenced in exhibits 15-18, attached hereto.)

ANALYSIS and ARGUMENT

I. Standard of Review

In reviewing a decision of a state agency regarding a question of fact, the court is limited to a determination of whether substantial evidence in the record supports the decision. *Town of Eureka v. State Engineer,* 108 Nev. 163, 165 (1992). An administrative decision may also be reversed, remanded or set aside if it is "affected by an error of law." *Dredge v. State ex rel. Dep't Prisons,* 105 Nev. 39, 43 (1989). Further, the administrative decision may be reversed, remanded or set aside if the decision constitutes an "abuse of discretion" because the decision maker acted arbitrarily or capriciously. *Id.*

II. Arguments

A. The final decision was affected by an error of law and was arbitrary and capricious in determining that there would be no degradation of water and with no variance or requirement that all tailings be neutralized.

According to LNC documents[1] the tailings with salt samples were reconstituted at a ratio of 64.1 percent LFilterCake, 17.3 percent NFilterCake, and 18.6 percent Salt, as measured by dry weight all to go to the tailings facility (CTFS). The LFilterCake (leached) tailings will contain residual sulfuric acid, which is expected to result in very toxic seepage based on the Meteoric Mobility Water tests[2]. NDEP does state a preference for the tailings to be neutralized, but also that NDEP does not have the authority to require neutralization.

There are requirements on stabilization of tailings and spent ore contained in NAC 445A.430 and NAC 445A.431. NAC 445A.430 Part 1 that are not satisfied for the Thacker Pass mine, since the tailings are acidic. This includes the proposed yet to be determined process of air drying the tailings as an intermediate step prior to emplacement at the CTFS. Part 2 allows for an exception to be made if the requirement cannot be achieved. There has been no determination that the requirement in Part 1 cannot be satisfied. In fact, the permit clarifies in Part I N.3. (Continuing Investigations) "The Permittee shall initiate and continue neutralization studies of tailings material prior to its filtration and stacking on the CTFS." Therefore, a determination of unachievable neutralization has not been made, and needs to be for a variance to be issued by NDEP. There is nothing in the permit regarding a variance to Part 1, and the text in the continuing investigation says nothing about the

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1. Newfields, "Engineering Design Report CTFS, WRSF, CGS, Mine Facilities and Process Plant StormwaterManagement," April 2, 2020. p 13.

2. SRK Consulting, "Thacker Pass – Baseline Geochemical Characterization Report," October 2019. (Tables 5-26, 5-27)

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studies to be used for NDEP issuance of a variance to Part 1.

NAC 445A.431 also specifically requires that "tailings must be stabilized during the final closure of a facility so as to inhibit the migration of any contaminant that has the potential to degrade the waters of the State." The agency erroneously believes that the 80 mil HDPE line will stabilize any contaminant release. NDEP stated in response to public comment:

> based on the approved tailings impoundment design, i.e., fully lined 80-mil high-density polyethylene containment (HDPE), once the HDPE is buried beneath the emplaced tailings, the potential for mechanical damage/failure of the liner system is reduced to near zero percent, so the potential for release of the material is essentially non-existent.

There exist analyses of HDPE liner failure that contain a range of expected lifetimes, so there is considerable uncertainty. It is also an industry definition that lifetime is essentially a half-life - the time it takes for 50% loss of integrity. This means that a study concluding a lifetime of 150 years could still fail prior to 150 years, since the integrity is likely compromised in some way with unclear consequences.

Furthermore, these analyses assume that there have been no errors in the construction of the overall liner. It is also reasonable that the liner will eventually fail, and if seepage is still occurring, then waters of the State have the potential to be degraded. In fact there was no analysis of seepage through the liner due to expected permeation and common defects, so we don't know how well the containment will be. NDEP's assertion of "near zero percent" loss on containment over the longer term cannot be substantiated. The agency must ensure that all efforts are used to stabilize mine waste and prevent toxic drainage.

B. The final decision was arbitrary or capricious or characterized by abuse of discretion - The agency has not assured the minimization of release of contamination

NAC 445A.433 Part 1 subpart (b) is also not satisfied since the source of contamination, the tailings, is not designed to minimize the release of the contamination, but the source would be minimized if the tailings were neutralized. LNC has provided no data on water quality for neutralized tailings and NDEP needs to require this to assess the hazard reduction. But, there is little doubt from chemical principles and field experience with acidic drainage that neutralized tailings would have significantly lower release of toxins. If there is a method available to minimize toxic release then it needs to be part of the design. Even if NAC 445A.437 is satisfied NAC 445A.430 and

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NAC 445A.433 above must still apply.

NDEP should have required more detailed and clear data and analysis on how the CTFS would perform given the unique nature of the facility. The design for the CTFS includes a structuralzone composed of clay tailings and a non-structural zone composed of tailings blended with sulfate salts (see Fig. 7, Emerman), with the target geotechnical water content for both zones being 46% (NDEP, 2022b)[3]. As is typical, the non-structural zone would have a wider range of acceptable geotechnical water contents. According to NDEP (2022b),"The material placed in the structural zone must have the moisture content required to achieve structural stability (46± 6 percent) ...... If placed in the nonstructural zone, the material must have a moisture content of 46± 12 percent." It is important to note that the above geotechnical water contents are far higher than what is typical for filtered tailings storage facilities (15-20%). In fact, the geotechnical water content would be twice as high as is typical for the tailings pile (excluding any overlying tailings pond) for even conventional tailings impoundments (see Fig. 4, Emerman[4]). Despite the persistent use of the phrase "dry stack" by NDEP (2022c)[5], the CTFS at the Thacker Pass mine would probably have the highest geotechnical water content of any tailings storage facility that has ever been constructed.

Given that field experience is not available for the CTFS proposed at Thacker Pass, NDEP needed to make the extra due-diligence effort to ensure that all concerns and questions on the potential for water pollution are addressed with data and analysis on this experimental design.

C. **The agency allowed a faulty analysis to guide the permitting decision.**

Seepage analysis was conducted by two contractors Newfields and Piteau and NDEP relied on results from two different analyses for different aspects of the seepage analysis without justification. In fact, both seepage analyses contain questionable results or are so incomplete that NDEP should have rejected them and required further data and analysis.

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3. NDEP (Nevada Division of Environmental Protection), 2022b. Fact Sheet (Pursuant to NevadaAdministrative Code [NAC] 445A.401)—Permitee Name: Lithium Nevada Corp. —Project Name: Thacker Pass Project—Permit Number: NEV2020104: Prepared by M.Griffin, February 23, 2022, 18 p.

4. Emerman, Steven H., Malach Consulting, "Prediction of Seepage from the Clay Tailings Filter Stack (CTFS) at the Lithium Nevada Thacker Pass Mine, Northern Nevada," Report prepared for Great Basin Resource Watch Submitted on April 7, 2022, Revised on April 11, 2022

5. NDEP (Nevada Division of Environmental Protection), 2022c. Response to comments received during the publiccomment period for Lithium Nevada Corporation's Thacker PassProject: Bureau of Mining Regulation and Reclamation: WPCP NEV2020104, February 25, 2022, 158 p.

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1. Variation of the Geotechnical Water Content was Needed but Not Done

A key aspect of the seepage analysis that was not explored properly is the geotechnical water content (100 weight of water / weight of dry solids). Small changes in the geotechnical water content can result in large changes in the seepage rate. As is shown in Dr. Emerman's analysis in Figures 18a through 18d, the seepage can vary from tens to thousands of gallons per minute (gpm). For example, at the target geotechnical water content (46%) in the non-structural zone, seepage rates ranged (depending on specific gravity) from 10 gpm for a residual geotechnical water content of 19% to 19 gpm for a residual volumetric water content of 0.066, and at the maximum allowed geotechnical water content in the non-structural zone (58%), seepage rates ranged (depending on specific gravity) from 2297 gpm and a residualvolumetric water content of 0.066 to 9215 gpm for a residual geotechnical water content of 19%. Clearly, it is important to understand the effect on seepage rate from geotechnical water content.

According to NDEP (2022c)[6], "A range of moisture contents was not analyzed because the clay tailings are required to be dried, stacked at near optimal moisture content [the target geotechnical water content of 46%], and compacted by the approved engineered design, thus the materials are unsaturated upon placement and are not anticipated to produce any meaningful seepage." The above quote is inconsistent with the Fact Sheet accompanying the permit that allows tailings with geotechnical water contents in the range 40-52% in the structural zone and tailings with geotechnical water contents in the range 34-58% in the non-structural zone (NDEP, 2022b). Since LNC has the authorization to fill the structural zone entirely with tailings with geotechnical water content of 52% and to fill the non-structural zone entirely with tailings with geotechnical water content of 58%, the target geotechnical water content of 46% is completely irrelevant, and the seepage analysis should have been carried out at the limits of authorization, not at the target.

6. Piteau Associates, 2021a. Clay Tailings Filter Stack (CTFS) unsaturated flow modeling:Technical Memorandum from T. Cluff (Piteau Associates) to T. Grandy and C. Clark(Lithium Nevada Corporation), File—3898 TM21-01, January 26, 2021, 15 p.

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Piteau (2021a-b)[7] explained the choice of using 46% geotechnical water content by writing "It should be noted that clay tailings will be dried and stacked at near optimum moisture content, thus the materials are unsaturated upon placement and are not anticipated to produce any meaningful seepage. The purpose of this exercise is to validate the concept." As explained above, the "optimum moisture content" has no relevance to seepage prediction and the software should have been run at the maximum allowed geotechnical water contents.

The analysis by Piteau only ran their analysis for the target geotechnical water content of 46%, and Newfields only used 49.1%. There was no analysis that addressed variations in the geotechnical water content in either case despite the sensitivity of the seepage rate on this parameter. Furthermore, as discussed in more detail below, achieving the target geotechnical water content is not assured since it has never been done consistently for the type of tailings anticipated for the Thacker Pass mine. In addition, the NDEP permit allows for the geotechnical water content to be as high as 52% for the structural zone and 58% in the non-structural zone. Therefore, it is necessary to perform the seepage analysis with meaningful variation in the geotechnical water content to have any understanding of the range of seepage possible and therefore the design of the tailing facility and potential for the tailings facility to violate the "zero-discharge" requirement.

In fact, NDEP did recognize the deficiency in the analysis regarding moisture content by including the following item in the permit:

> By 10 July 2022 (within 120 days of the effective date of the Permit), the Permittee shall submit for review and approval an additional sensitivity analysis analyzing the effect of moisture content on seepage rates from the Clay Tailings Storage Facility to specify an allowable operating range for tailings placement." (Part I.B.8)

But the agency arbitrarily allowed the permit to go forward knowing that the analysis was incomplete and could potentially affect the design specifications of the CTFS facility. Furthermore, there will be no public notification of the additional sensitivity analysis, and what if this additional analysis shows that the seepage rate is much higher and consistent with the result of Dr. Emerman? In what way will the CTFS design need to be changed? What will be the

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7. Piteau, 2021b. Clay Tailings Filter Stack (CTFS) unsaturated flow modeling revision1: Technical Memorandum from T. Cluff (Piteau) to T. Grandy and C. Clark(Lithium Nevada Corporation), File—3898 TM21-01, September 21, 2021, 30 p.

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plan for increased seepage? NDEP was premature in its issuance of the permit and the agency should have known this.

2. The value of the Specific Gravity of the Tailings is not Clarified.

The specific gravity of the tailings is a critical parameter, since it is needed to translate from the volumetric water content to the geotechical water content. Newfields reported reported on three measurements (3.12, 3.20, 3.28) and one assumption (2.93) about tailings specific gravity without ever clarifying which is the correct value. Piteau in its analysis never stated which value they used for their seepage analysis. Documents from Piteau and LNC there is reference to the volumetric water content, and without the tailings specific gravity, so it is not possible to know what is the geotechnical water contentant. This leaves another uncertainty to the CTFS seepage analysis. Therefore, the tailings specific gravity is vital to knowing whether the project is adhering to geotechnical water content stated in the permit.

Correct estimation of the seepage rate will also depend on the tailings specific gravity. For example, at the maximum geotechnical water content of 58%, the difference between 2297 gpm (specific gravity 2.93) and 9215 gpm (specific gravity 3.28) is in fact significant. Consider a facility that is designed to handle seepage maximum of 2300 gpm, but has to handle an excess of 9,000 gpm. This could be a disaster resulting in water pollution escaping into the environment in violation of Nevada regulations.

3. The Analysis did not Consider Variation of Combinations of Parameters as Needed

The sensitivity analysis that Piteau did conduct showed great sensitivity to input parameters. Sensitivity analyses included the use of the input parameters for the silt loam from the HYDRUS database, the assumption of no transpiration, the reduction of potential evapotranspiration by 15%, and the use of only a 12-inch cover layer of growth media (without the underlying waste rock) (see Fig. 10C, Emerman). The variation in predicted steady-state seepage rates is over two orders of magnitude (as high as 2.42 gpm) emphasizing that the calculation is strongly dependent upon the choice of input parameters and conditions. All four sensitivity analyses considered alternative conditions separately, but not in combination.

Piteau (2021b) updated the preceding calculation only by considering two additional sensitivity analyses. Although the properties of an additional tailings sample (composite salt /

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clay tailings) were considered (see Fig. 11A, Emerman), they were not used to update any of the input parameters (see Fig. 10b, Emerman). The additional sensitivity analyses were the use of only the growth media and waste rock with no underlying tailings (cover only) and doubling the mean annual precipitation. The steady-state seepage was still 0.02 gpm for the base case (see Fig. 11b, Emerman). The variation in predicted steady-state seepage rates now ranged over three order of magnitude (up to 12.7 gpm for doubling the annual precipitation and 15.2 gpm for cover only), which further emphasizes that the calculation is strongly dependent upon the choice of input parameters and conditions (see Fig. 11b, Emerman). As in Piteau (2021a), all six sensitivity analyses considered alternative conditions separately, but not in combination, so that there was no way to assess the interactions among input parameters and conditions. It is clear from Dr. Emerson's analysis how critical is the variation of multiple parameters in order to capture the reasonable range of seepage. The combined variation in the seepage rate from the target geotechnical water content (46%) and a specific gravity of 2.93 to a geotechnical water content of 52 % (maximum for structural zone) and a specific gravity of 3.28 is from 10 gpm to 410 gpm. NDEP should have required analysis of multiple combinations of parameters to obtain a reasonably maximum seepage rate that would need to be managed at the CTFS facility.

These results of Piteau (2021a,b) should have been an alert that more analysis is needed and variation of the geotechncial water content and specific gravity is necessary as well as variation of combinations of paramenters. NDEP should have recognized this need for a robust sensitivity analysis to fully capture the range of seepage for the CTFS. According to NDEP, "In the sensitivity analysis, all conditions are held steady, then one parameter is varied at a time to determine its impact potential. By varying multiple parameters concurrently, there would be no way to determine which variable resulted in a change to the model outcome" (NDEP, 2022c, p41). However, often the greatest variation in predictions results from the interaction between input parameters. Thus, the *standard practice* that NDEP should be aware of and which is required in sensitivity analyses is to vary input parameters both separately and in combination in order to show a more realistic range in predictions.

4. <u>Piteau Analysis Failed to Include Tailing Consolidation</u>

The Piteau analysis ignores the critical process of consolidation of the tailings, the process

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by which the underlying tailings are further compacted by the overlying tailings, so that unsaturated tailings could potentially be resaturated. As Dr. Emerman explains:

> A key issue is that although filtered tailings may be unsaturated when deposited in the tailings storage facility, it is still necessary to prevent resaturation of the tailings in order to prevent future liquefaction. The problem is particularly acute since the target geotechnical water content for maximum compaction is typically only a few percentage points less than the saturated geotechnical water content. The pore spaces between the tailing particles can become resaturated simply by consolidation under the weight of additional overlying tailings, which reduces the volume of pores so that they become filled with water (Klohn Crippen Berger, 2017)[8]. In fact, it is not unusual for the lower one-third to one-half of a filtered tailings stack to be saturated, and the stability analysis for the CTFS was based on the assumption that the water table would be one-half of the height of the CTFS (NewFields, 2020; see Fig. 7)[9].

5. Piteau's Key Conclusion is Incorrect

Piteau (2021a) calculated negligible seepage during the first 1000 years after closure. According to Piteau (2021a), "Seepage related to the drainage of in-situ water content during the first 1,000 years of emplacement was zero. Water content at the bottom of the CTFS was simulated to slowly increase as a result of unsaturated gravity drainage … However, pore water along the bottom of the CTFS will remain in tension with clay material until water content reaches field saturation conditions to overcome capillary tension and freely seep into the collection system." The additional implication is that no seepage would occur during operation because the base of the CTFS would not become saturated until well after closure. The above discussion by Piteau(2021b) is not correct because drainage from the CTFS will occur as long as the volumetric water content of the base of the stack exceeds the field capacity. Thus, the conceptual understanding by Piteau is incorrect and inconsistent with basic principles of soil physics - gravity is acting on soil water even if the pores are unsaturated. Capillary forces are acting to retain the water within pores, but for volumetric water contents that exceed the field capacity, gravitational forces will dominate over capillary forces. Thus, even an unsaturated soil will drain until the volumetric water content has dropped to the field capacity (see Fig. 3,

8.Klohn Crippen Berger, 2017. Study of tailings management technologies: Report to Mining Association of Canada and Mine Environment Neutral Drainage (MEND) Program, MEND Report 2.50.1, 164 p. Available online at: http://mendnedem.org/wp-content/uploads/2.50.1Tailings_Management_TechnologiesL.pdf

9.NewFields, 2020. Attachment J—Thacker Pass Project—Engineering Design Report—ClayTailings Filter Stack, Waste Rock Storage Facilities, Coarse Gangue Stockpile, Mine Facilities & Process Plant—Stormwater Management: Prepared for Lithium Nevada Corp., Revision 0, NewFields Project No. 475.0385.000, April 2, 2020, 1388 p.

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Emerman). The inability of Piteau (2021b) to predict drainage for unsaturated conditions within the CTFS casts doubt on their correct use of the HYDRUS software.

In the case of the CTFS, for a residual volumetric water content of 0.066 (which was assumed by Piteau (2021a-b); see Fig. 10b, Emerman), geotechnical field capacities were calculated as 47.5%, 44.6%, 43.5%, and 42.4% for tailings specific gravities of 2.93, 3.12, 3.20 and 3.28 respectively - all of which appeared in Newfields documentation. Therefore, even the target geotechnical water content (46%) would exceed the field capacity, except for the lowest tailings specific gravity (2.93). On that basis, the use of HYDRUS should have predicted seepage from the base of the CTFS long before the base became saturated. The fact that the use of HYDRUS by Piteau (2021a-b) produced results consistent with their conceptual misunderstanding and inconsistent with soil physics casts doubt upon their correct use of the software.

In response to public comments that the free 1-D version of the HYDRUS software was not used correctly and, moreover, could not be used to simulate horizontal cracking that could convey water from the interior to the outside of the CTFS, NDEP (2022c) replied, "Hydrus 1D is listed on the BMRR [Bureau of Mining Regulation and Reclamation] guidance document titled 'LISTING OF ACCEPTED CODES FOR GROUNDWATER AND GEOCHEMICAL MODELING AT MINE SITES' and is the preferred draindown model in analyzing draindown from tailings impoundments." The above response is disturbing because, although the 1-D version of HYDRUS is free, it has no provisions for taking into account tailings consolidation, which is probably the most important effect. Since the base of the CTFS will likely be saturated even during operation, the incorrect statement by Piteau (2021a-b) that "pore water along the bottom of the CTFS will remain in tension with clay material until water content reaches field saturation conditions" is completely irrelevant. Therefore, it is more likely that seepage will be continuous throughout operation and closure until the CTFS has drained to its field capacity. In summary the analysis by Piteau (2021a-b) should be regarded as both incorrect and irrelevant.

6. Seepage Analysis Reports Lack Transparency

The analysis provided to NDEP and the public by Piteau does not adequately clarify numerous aspects of the seepage analysis to allow for an independent analyst to reproduce the

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reported results. Piteau (2021a) used the HYDRUS software to calculate the seepage rate from the CTFS only after closure after 10 years of operation, corresponding to the first phase of the mining project and the only phase that has received a permit. After closure, the filtered tailings stack would be covered by a 12-inch layer of growth medium underlain by a 12-inch layer of waste rock. The analysis provided to NDEP and the public by Piteau lacks sufficient detail to reproduce the calculations performed requiring a number of assumptions. The parameter Φsat is presumably the saturated volumetric water content (equivalent to the porosity), not the saturated geotechnical water content (see Fig. 10a, Emerman). The hydraulic conductivity is presumably the saturated hydraulic conductivity, although that is not stated (see Fig. 10a, Emerman). Other parameters such as α and *N* presumably correspond to the van Genuchten model for the soil water characteristic curve, although this was never stated (see Fig. 10b, Emerman). For the sensitivity analysis, Piteau (2021a) substituted the equivalent input parameters for a silt loam available in the HYDRUS database. It is unclear why a silt loam was chosen, since the textural classes of the first two samples (see Fig. 10a, Emerman) considered by Piteau (2021a) are sandy clay loams, while the textural class of the third sample (see Fig. 10a, Emerman) is clay (USDA-NRCS, 2022)[10]. NDEP should have required Piteau to fully justify their results with complete transparency in all aspects of their analysis including all input parameters and conditions, so that the public could download the free software and attempt to reproduce their results. NDEP also could not conduct an independent assessment, and why the agency did not require the necessary information to do this is unclear. It is the responsibility of the agency to ensure that the analysis provided to the state of Nevada reflects the best available science and is defensible. The ability for independent assessment is vital to this goal.

7. Newfields Analysis is Incomplete

The seepage analysis by Newfields (2020, 2021[11]) is more accurate than that of Piteau

10. USDA-NRCS (United States Department of Agriculture – Natural Resources Conservation Service), 2022. Soil Texture Calculator. Available online at: https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/survey/?cid=nrcs142p2_054167

11. NewFields, 2021. Seepage calculation: Memo from J. Schonlau (NewFields) to M. Griffin (NDEP), November 8, 2021, 2 p.

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(2021a-b) because only the analysis by Newfields took into account the key feature of tailings consolidation. However, Newfields did not vary key parameters such as the geotechnical water content and did not extend the analysis through post closure, so the Newfields analysis also does not provide the range of seepage that is reasonably expected during operations and closure. No document from NewFields (2020, 2021) has explained how the calculation was carried out, how or whether meteorological variables (such as precipitation and evaporation) were taken into account, why a geotechnical water content of 49.1% was chosen, or clarifies whether the calculation applies to the operation or closure phase. In addition, no document reconciles the contradiction between 74 gpm as the "estimated average seepage flow rate" (NewFields, 2021; see Fig. 9) and as the "maximum seepage rate" in the preceding quote (NewFields, 2020).

NDEP seemed to accept both analyses (Piteau and Newfields) despite their inconsistencies, using the seepage rate of 74 gpm for the design of the seepage collection system during operations, and then using the negligible drainage during the first 1,000 years and 0.02 gpm after 1,000 years. In response to public comments, NDEP (2022c) indicated that it regarded the analysis by Piteau (2021a-b) as superior, despite the fact that only the seepage analysis by NewFields (2020, 2021) took tailings consolidation into account. In response to a question regarding the source of 74 gpm as a criterion for the reclaim pond, NDEP (2022c) wrote, "The calculation [of 74 gpm by NewFields] was not originally provided as it was essentially superseded by the 21 September Piteau Model [Piteau, 2021b] … The 74 gpm … included several conservative factors including a higher permeability … Since this original calculation, a more refined seepage analysis was completed by Piteau." In other words, NDEP (2022c) decided that the analysis by Piteau (2021a-b) was superior because the analysis by NewFields (2020, 2021) was too conservative in that it included a higher permeability (hydraulic conductivity). NDEP never endeavored to resolve this discrepancy and arbitrarily used both analysis to move the permit forward.

Instead of requiring a robust analysis with variation of all significant parameters for both during operations and post closure NDEP simply accepted the inaccurate and incomplete analysis provided. Ultimately, neither LNC, the public, nor the agency really knows what to expect at the CTFS, especially given that the analyses done by Newfields and Piteau did not bracket the

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conditions of the permit. All of the Piteau calculations were run at 46% geotechnical water content and Newfields at 49.1%. NDEP should have required that the analysis encompass the range of 34% to 52% and 40% to 58% for the structural and non-structural zone, respectively, *as allowed in the permit.*

Despite the incorrect use of the software and inaccurate conceptualization, and lack of including tailings consolidation, NDEP still relied on the Piteau results that calculated no seepage for 1000 years after closure, and a long-term steady-state seepage of 0.02 gpm. However, Piteau gave no indication as to when the steady-state seepage would occur. Furthermore, this result was determined under the most optimal conditions, which are unlikely to occur.

D. Final decision was clearly erroneous as the agency cannot ensure closure due to an inadequate mine plan.

It is necessary to have a sense of the seepage rate versus time to know how long and to what extent management of the tailings facility will be required. The plan of operations for the mine provides for managing seepage from the tailings during mine operations by sending the seepage to the processing facility. This is a recognition that seepage is likely during operations. Seepage will continue throughout closure and continue for a yet to be estimated time, and according to Newfields analysis a minimum of 109 years. The conclusion that seepage will not occur for 1000 years is not correct and should not have played a role in permitting decisions. Further, there is a conflict in the seepage analysis of Newfields and Piteau that needed to be resolved. The agency seems to choose numbers from both analyses without justification, assuming that both are correct. The agency and the public need to be provided a best estimate of the rate of seepage over time including the associated seepage toxicity. There is no reliable data on this aspect of the tailings facility, and therefore the timeline for long-term management is unknowable.

Credible data and analysis exist that the design specifications of the tailings facility including the seepage management has a reasonable probability of inadequacy. Newfields calculated an expected seepage of 74 gpm during operations, assuming a tailings geotechnical water content of 49.1%. However, analysis of geotechnical water content conducted by LNC and outside Vendor 1 at the drying temperature assumed in the permit show that the geotechnical

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water content ranges 47.1-86.7% and 54.2-69.0% respectively. Even at the lower end of these geotechnical water content ranges they are above the target geotechnical water content of 46% that was assumed in the seepage analysis by Piteau.

GBRW contracted with Dr. Steven Emerman, an expert on tailings and well qualified to critique the analyses of Newfields and Piteau, to conduct the analysis that should have been done to get a sense of the range of the seepage from the CTFS both during operation and after closure. Given the lack of sufficient detail in both the Newfields and the Piteau reports, it was impossible to duplicate those calculations. Dr. Emerman completely rejected the analysis of Piteau based on the lack of consideration of tailings consolidation and results inconsistent with basic soil physics, and took as a starting point the analysis of Newfields. He essentially assumed for this exercise that the results of Newfields of a seepage rate of 74 gpm at the conditions of 49.1% geotechnical water content and a hydraulic conductivity of 1 x 10_{-6} cm/s that was used by Newfields was correct. He then calibrated a standard model to the result of 74 gpm and extrapolated to various geotechnical water contents, specific gravities that were discussed in existing documentation, and two residual water contents also discussed in documentation.Dr. Emerman's seepage results are set forth in pages 47-48 of his report, in sum: "Seepage rates during operation were calculated to be in the range of tens to thousands of gallons per minute, depending upon the initial (at the time of placement in the CTFS) geotechnical water content and residual geotechnical water content of the tailings, and to a lesser degree upon the tailings specific gravity (see Figs. 18a-d)" In addition, Emerman concludes that the "time for the CTFS todrain to field capacity after closure ranged from a few years (within the planned reclamation period) to over a century, depending upon the geotechnical water content and tailings specific gravity, and to a lesser degree upon the residual water content (see Figs. 20a-d). Finally, the average seepage ratesfrom the CTFS during the time between closure and drainage to field capacity ranged from tens to thousands of gallons per minute, depending upon the geotechnical water content at the time of closure, the tailings specific gravity, and the residual water content (see Figs. 21a-d). Given these results and since the Water Pollution Control Permit allows all filtered tailings to be emplaced at the maximum geotechnical water content, a reclaim pond that can accommodate a seepage rate of only 74 gpm is entirely inadequate.

Nevada regulation (NAC 445A.446) states, "Permanent closure is complete when the requirements contained in NAC 445A.429, 445A.430 and 445A.431 have been achieved." NAC 445A.429 requires that, "The holder of the permit must institute appropriate procedures to ensure that all mined areas do not release contaminants that have the potential to degrade the waters of the State." NDEP should have required the analysis that GBRW had performed by Dr. Emerman to "ensure" that the CTFS facility is designed so that there will be no release of contaminants, and contingency plans can be in place in the event of failure. It is also unclear how long toxic seepage will need to be managed at the site. Analysis of conditions at the site and the plan to manage toxic drainage continues to be inadequate.

Dr. Emerman also examined the water addition rate to the tailings facility, and determined that the seepage rate may be greater than the water addition rate under certain conditions. For those conditions the seepage would occur in a pulsed fashion but still likely to exceed the design capacity of the CTFS seepage capture system. (Emerman, p. 48)

It should also be noted that Dr. Emerman's analysis assumes that the tailings cover works perfectly, so any failure of the cover system would produce even greater seepage. There are other parameters varied in the Piteau analysis that could be expected to increase seepage rates. It also is possible that the tailings could be at or above the saturation level at which point flow in the tailings would be governed by saturated or even oversaturated and not unsaturated flow. Therefore, the seepage rate could be considerably larger than the rates calculated by Dr. Emerman and way beyond the design capacity of the CTFS facility.

Ultimately, there is considerable uncertainly in the expected seepage rate for the CTFS for both the periods of operation and post closure. Neither LNC nor NDEP really know what to expect, and neither does the public who is to be protected by the permit. Analyses like that conducted by Dr. Emerman should have been required by NDEP to capture the range of seepage rate, a sense of the uncertainty, and define CTFS design specifications that would ensure a "zero-discharge" facility as required by Nevada regulations.

The analysis of CFTS integrity is also incomplete, and given the high water content of the tailings the potential liquefaction and catastrophic failure exists. Although filtered tailings may be unsaturated when deposited in the tailings storage facility, it is still necessary to prevent

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resaturation of the tailings in order to prevent future liquefaction. NDEP should have required additional analysis to understand if the conditions are possible for liquefaction, and ensure that the tailings facility design will avoid this kind of failure.

E. **The agency is imposing unverifiable requirements in the permit.**

The 46 % target geotechnical water content for the tailings has not been demonstrated to be achievable and should not be in the permit. The design of the CTFS and management of seepage hinges upon the seepage analysis of Newfields and Piteau, both of which have been shown to be either incorrect or inadequate. Those analyses assume a specific geotechnical water content for the tailings with Piteau using 46% and Newfields using 49.1%. The NDEP permit also requires (Part I.G. 11. and 12.) that the moisture content of the tailings "shall not exceed" 46% for both structural and nonstructural zones. However, the NDEP fact sheet that accompanied the permit does allow for a deviation The material placed in the structural zone must have the moisture content required to achieve

structural stability (46± 6 percent) and must be compacted at 95% of Modified Maximum Dry Density (MMDD) as determined by ASTM D1557 resulting in a permeability of approximately 10-7cm/sec. If placed in the nonstructural zone, the material must have a moisture content of 46± 12 percent and compacted at 85 percent of MMDD as determined by ASTM D1557 resulting in a permeability of approximately 10-6 cm/sec. (NDEP Fact Sheet, p12)

The filtered tailings received by Newfields (2020) from LNC for testing purposes had geotechnical water contents of 59.3% for tailings without salt and 60.9% for tailings with salt (Fig. 13, Emerman). LNC (2021a-b) has reported on 93 tests of filtration of clay tailings for which the average solids content has been 60.8%, corresponding to a geotechnical water content of 64.6% (Id, Fig. 14). The above measurements of geotechnical water contents for filtered tailings were far higher than the target geotechnical water content (46%), the maximum geotechnical water content for tailings allowed in the structural zone (52%), and even the maximum geotechnical water content for tailings allowed in the non-structural zone (58%).

Taking a close look at the statistics of the experiments reveals a wide range of uncertainty.

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According to LNC (2021a-b)[12],[13] "On average, filter cakes are measured to contain 61% solids, with the 95% confidence interval ranging to 60% to 61.5% solids." The above confidence interval refers to the confidence that the measured mean is the true mean, that is, there is 95% confidence that the true mean is the range 60.0-61.5% solids content (corresponding to geotechnical water contents of 62.6-66.7%) (Fig. 14, Emerman). Based on the standard deviation of the measurements (3.6% solids content), 95% of samples (the mean plus or minus two standard deviations) fall in the range 53.6-68.0% solids content (corresponding to geotechnical water contents of 47.1-86.7%), a considerable range that still does not include the target geotechnical water content (46%) (Id.).

Unidentified Vendor 1 carried out 11 tests of filtration of clay tailings for which the average solids content was 62.0% (LNC, 2021a-b), corresponding to a geotechnical water content of 61.3%, which is again far higher than the target geotechnical water content (46%), the maximum geotechnical water content for tailings allowed in the structural zone (52%), and even the maximum geotechnical water content for tailings allowed in the non-structural zone (58%) (see Fig. 15A, Emerman). Based on the standard deviation of the measurements (1.4% solids content), 95% of samples (the mean plus or minus two standard deviations) fall in the range 59.2-64.8% solids content (corresponding to geotechnical water contents of 54.2-69.0%), which is again a considerable range that still does not include the target geotechnical water content (46%) (see Fig. 15A, Emerman).

Unidentified Vendor 2 carried out 21 tests of filtration of clay tailings for which the average solids content was 68.7% (LNC, 2021a-b), corresponding to a geotechnical water content of 45.7%, which is nearly equal to the target geotechnical water content (46%) (see Fig. 15b, Emerman). Based on the standard deviation of the measurements (2.6% solids content), 95% of samples (the mean plus or minus two standard deviations) fall in the range 63.5-73.8% solids content (corresponding to geotechnical water contents of 35.5-57.5%) (see Fig. 15b,

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12. LNC, 2021a. Filterability of LNC neutralized clay slurry: Prepared by R.M. Ravenelle, June 14, 2021, 9 p.

13. LNC, 2021b. Filterability of LNC neutralized clay slurry v2: Prepared by R.M. Ravenelle, August 4, 2021, 12 p

Emerman). There has been no explanation as to how Vendor 2 was able to achieve results superior to those of Vendor 1, since both "vendors were able to achieve higher squeeze pressures in their testing," as opposed to the pilot scale filter press at LNC that "operates at a squeeze pressure of 200 psig [200 psi above atmospheric pressure]" (LNC, 2021a-b).

There is no defensible reason to accept the results of unidentified Vendor 2 over Vendor 1 and LNC's own in-house analysis. LNC (2021a-b) attempted to address the discrepancies in drying temperatures by contracting an engineering services company to measure the geotechnical water contents of samples obtained from filter presses at the LNC facility by drying the samples at a range of temperatures. As expected, it was found that drying temperatures lower than the standard (105-110 C) resulted in lower measured geotechnical water contents or higher solids contents (see Fig. 16, Emerman). According to LNC (2021a-b), "The hypothesis is that two forms of water are in the clay; structural water which is bound in the crystal structure of the material, and free water which is representative of moisture on particle surfaces and in pores … It was concluded that 45 C be used as the reference temperature, as it is thought to better represent free water rather than structural water … Thus, it is likely that the 'real' percent solids of filter cakes [see Fig. 14, Emerson] are closer to 70% solids [geotechnical water content of 42.9%]." The above argument is apparently justified in a "Confidential" document entitled "Clay Tailings Filter Stack Design Review Summary Report" (see Fig. 17, Emerman). In fact, out of the seven references in LNC (2021b), four are labeled "Confidential," which at the discretion of LNC as the owner of those reports. Therefore, the public has no way to evaluate the efficacy of the proposed hypothesis, and without data and analysis, the hypothesis is indefensible.

The Fact Sheet (NDEP, 2022b) that accompanies the Water Pollution Control Permit does not explicitly state the drying temperature that should be used for measurement of the geotechnical water content. However, the Fact Sheet does state that "the material placed in the structural zone must have the moisture content required to achieve structural stability (46± 6 percent) and must be compacted at 95% of Modified Maximum Dry Density (MMDD) as determined by ASTM D1557 … If placed in the nonstructural zone, the material must have a moisture content of 46± 2 percent and compacted at 85 percent of MMDD as determined by ASTM D1557" (NDEP, 2022b). The procedure ASTM D1557 requires the use of a

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"thermostatically controlled oven, capable of maintaining a uniform temperature of 230± 9 F (110± 5 C) throughout the drying chamber"(ASTM, 2012)[14]. In other words, the target geotechnical water content of 46% (geotechnical water content at which maximum compaction can be achieved) was determined based on geotechnical water contents that were obtained by oven-drying the tailings samples at 110 C (see Figs. 8a-b, Emerman). Therefore, the proposed explanation by LNC and results for tailings using a drying temperature of 60$_{o}$C or 45$_{o}$C is irrelevant since the required geotechnical water content of 46% is based on the ASTM D1557, procedure that uses a drying temperature of 110 ± 5 C, and cited in the NDEP Fact Sheet, LNC has, thus far, been unable to produce filtered clay tailings with geotechnical water contents even close to the target geotechnical water content of 46% (see Fig. 14, Emerman). The target geotechnical water content of 46% comes from the measurements by NewFields that maximum compaction could be achieved at that water content. NDEP should not issue a permit until LNC demonstrates that they can consistently achieve that water content

NDEP has at least recognized the nonexistence of the first technology in allowing the production of relatively wet tailings from the filter presses as long as the tailings undergo sufficient air-drying before compaction and storage in the CTFS. According to the Water Pollution Control Permit, "The tailings will be dewatered to approximately 61 percent dry basis (geotechnical) moisture content prior to being conveyed to the temporary tailings stockpile located in Cell 0 of the facility. From the stockpile, the material is hauled and placed in either the structural or nonstructural zone in a 12-inch thick lift and scarified to dry to the allowable moisture content" (NDEP, 2022a). However, LNC has not provided any field applicable data on the drying procedure, which leaves questions about how long it will take ,how will the geotechnical water content be varified before the tailings are transferred to the CTFS, and ultimately with this procedure work. LNC has not consistently met the above required geotechnical water content coming from the filter presses (61%) and has produced a mean geotechnical water content that is considerably higher (64.6%). There is no technology for

14. ASTM International, 2012. Standard test methods for laboratory compaction characteristics of soil using modified effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3)): Designation D1557-12, 14 p. Available online at: https://www.academia.edu/31144172/Standard_Test_Methods_for? email_work_card=abstract-read-more

producing wet tailings from the filter presses and then air-drying them in the field to the target geotechnical water content.

CONCLUSION:

In conclusion, based upon the foregoing, Appellant GBRW respectfully requests that the permit be withdrawn and remanded to the agency to obtain the necessary data and analyses to ensure protection of the waters of the State.

Respectfully submitted this 22nd day of April, 2022.

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