

TOPIC 5 – WATER MANAGEMENT



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- **Overall Water Management**

- Projected Water Levels in different areas of Kennady Lake
- Projected Water Levels in Area 7 – Discharge to Area 8

- **Water Management and N11 Discharge**

- MVLWB-4 – Additional Discharge Year 4
- NHX-24, 25 – Runoff assumptions from the waste rock piles, mean runoff values
- DFO-4 – Stream D1 – routed around West Mine Rock Pile

- **Downstream Flow Mitigation**

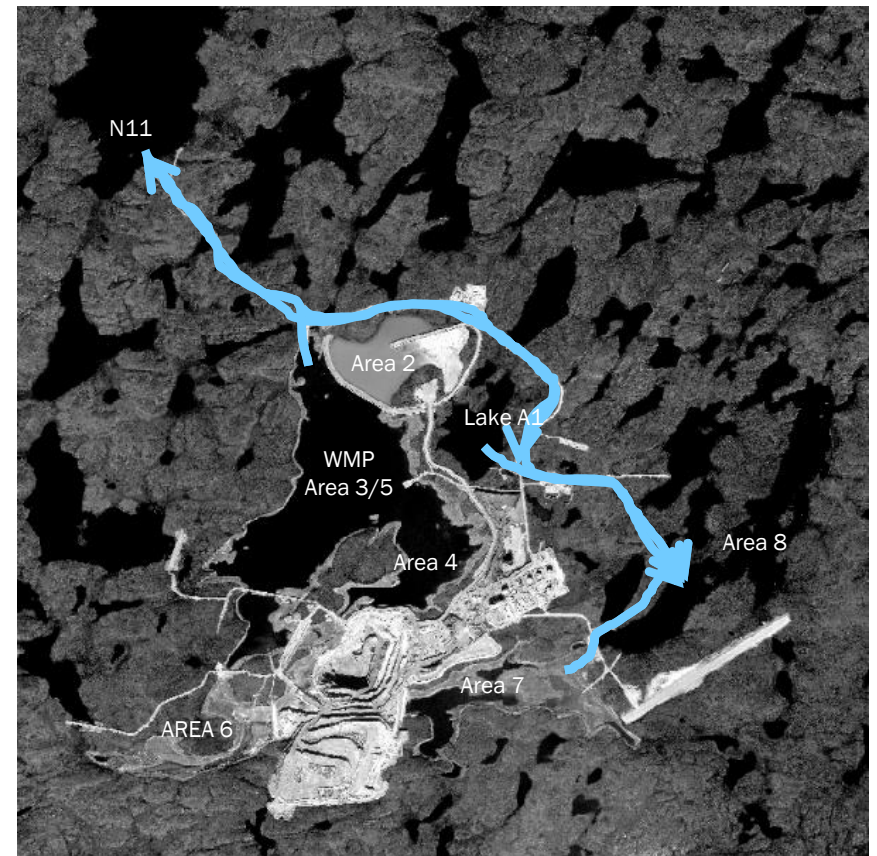
- ENR-31, MVLWB-5, MVLWB-6 – No Discharge from the WMP to Area 8, Flow Mitigation from N11, Area 7 and Lake A1
- ENR-38, ENR-39 – Availability of N11 Discharge Pipe – Annual discharge period versus licensing period
- NHX-1 - Flow augmentation in dry years.
- NHX-26 – Flow mitigation targets, and dry years.

- **Dykes**

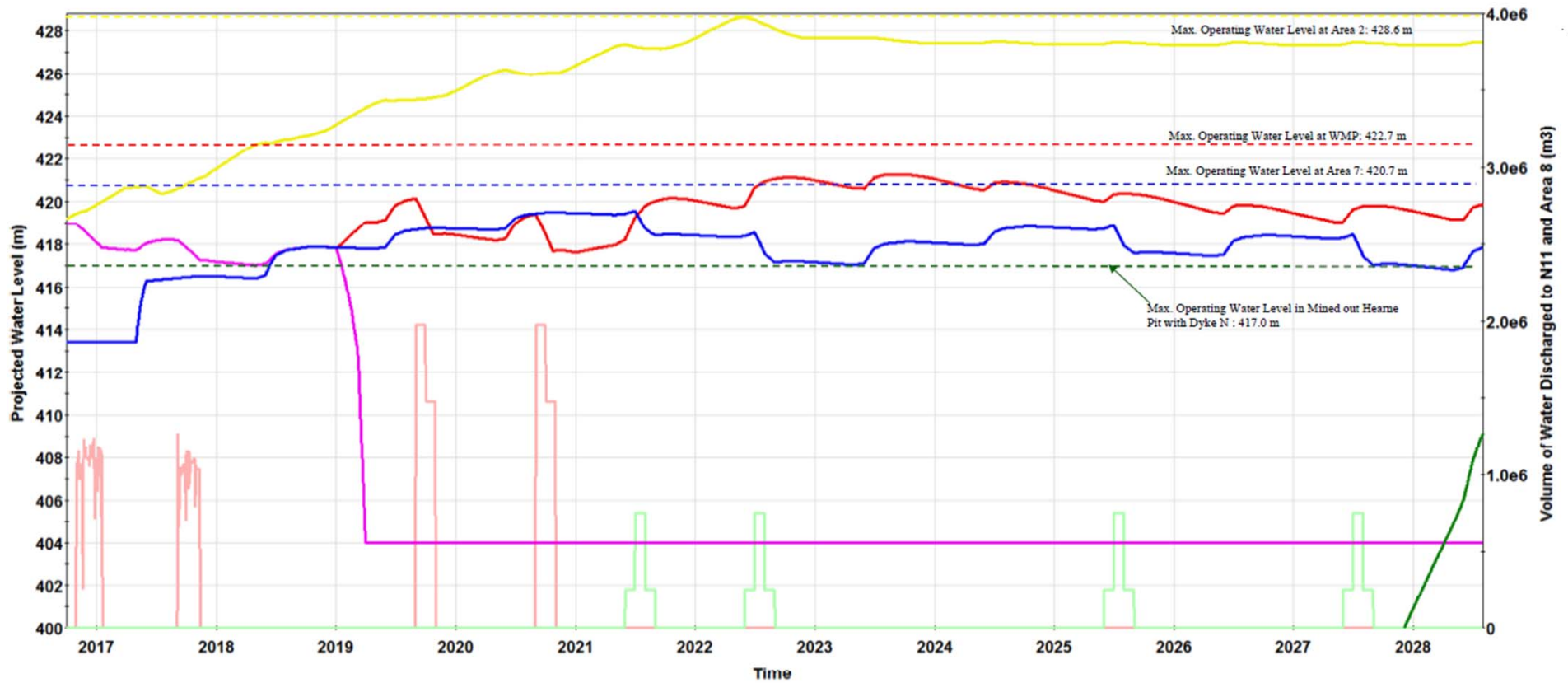
- NHX-28, NHX-29 Dyke Leakage and Lifespan

WATER MANAGEMENT – OPERATIONS

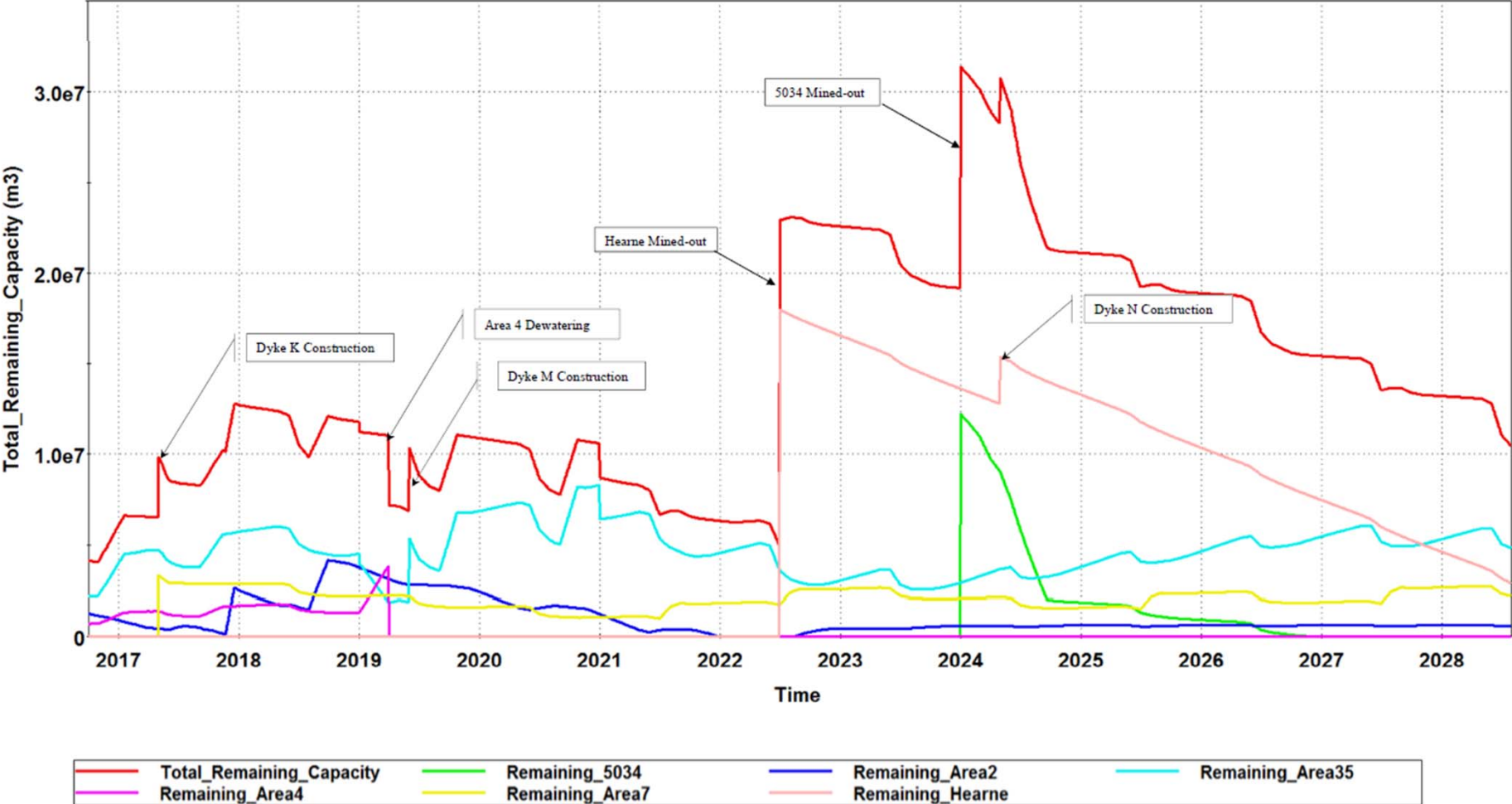
- Discharge water from WMP to Lake N11
 - Current W.L. = Annually for 3 years
 - Amendment = Annually for 4 years
- Pump water from A1 to A8
 - Current W.L. = Annually
- Pump water from Lake N11 to A8
 - Current W.L. = 3 out of 4 years
- Pump Water from A7 to A8
 - Amendment = Periodically



WATER BALANCE SUMMARY



REMAINING STORAGE CAPACITY IN WATER MANAGEMENT SYSTEM



WATER MANAGEMENT – DISCHARGE (MVLWB-4)

- One (1) additional year discharge from WMP to Lake N11, occurs in Year 2020.
- 3.45 Mm³ of water will be discharged to Lake N11 in Year 2020, occurs in September and October.
- Flow Rates will be around 0.75 m³/s, will be adjusted depending on actual pumping operation.



WATER MANAGEMENT – N11 DISCHARGE AND DISCHARGE LINE - ENR–38, ENR-39

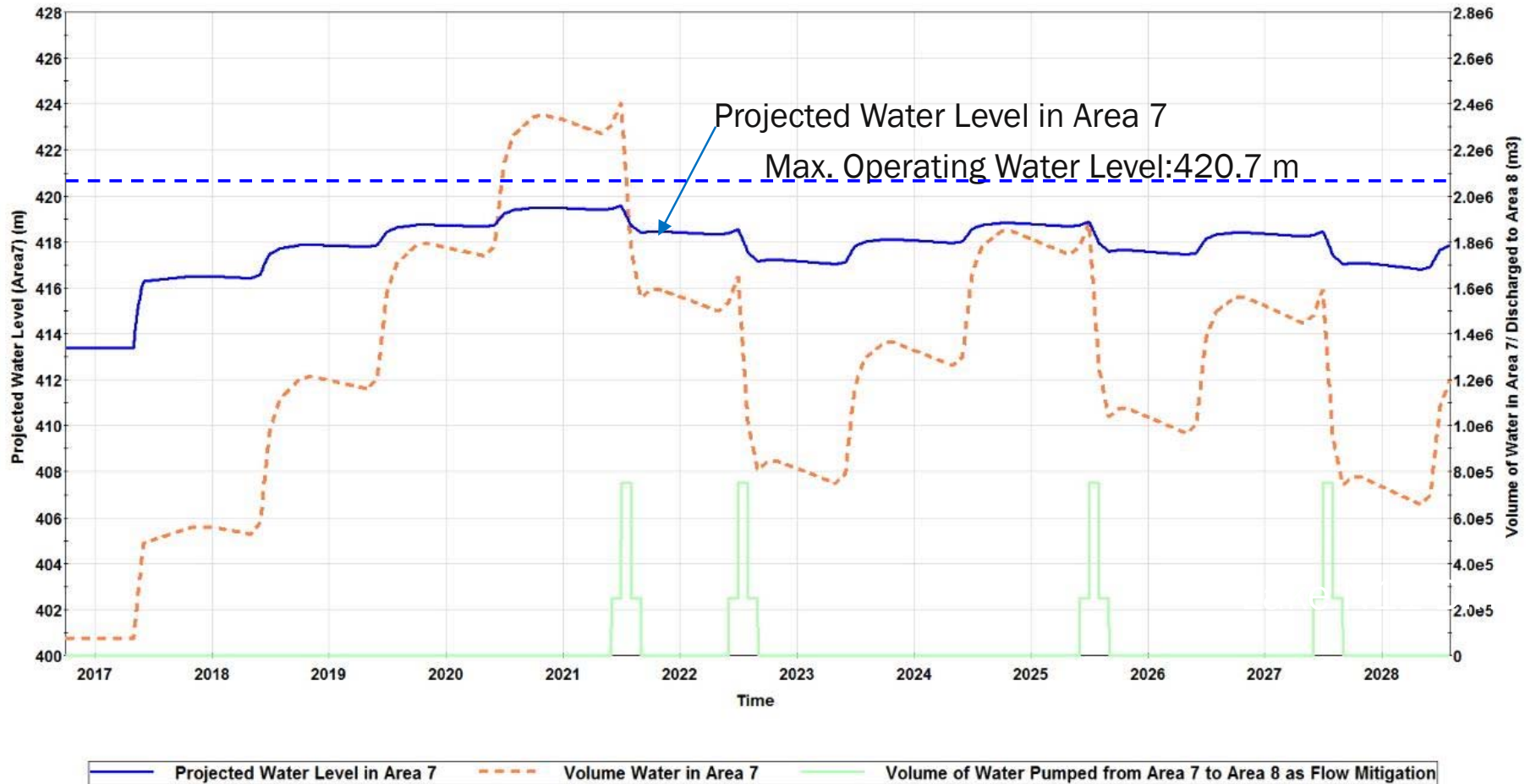
- N11 Pipeline serves two purposes
 - Flow Mitigation N11 to Area 8. June 1, to August 31.
 - WMP discharge to N11. Discharge from the Water Management Pond to Lake N11 is limited to periods when the water quality meets EQC (predicted to be June-November) and when the pipe is available for use (September 1-May 31).
- The anniversary date of the licence is September 24th.
- Discharge is limited to the period between the end of downstream flow mitigation (September 1) to the anniversary date of the licence (September 24). This is an insufficient period of time to discharge the full annual allotment of 3.45 Mm³. Discharge for the following year has to start Sept 25th. Sampling and testing must be done prior to the following year discharge. Two weeks turn around time.
- If the water quality does not meet EQC within the calendar year of 2018 no discharge is allowed. With the spring inflows of freshet in 2019 the water quality could be sufficient for discharge. The entire 3.45 Mm³ would need to be discharged from Sept.1 to Sept. 23, 2019 in order to remain within the terms of the licence and the interpretation of ENR that the water discharge volume is tracked on licence year rather than calendar year.
- It is requested that an annual allotment be allowed to carry over into the subsequent anniversary year of the licence so the discharge could proceed through the fall (over the anniversary date). Alternatively, the calendar year could be used as the water discharge year, consistent with all other aspects of the water licence.

AREA 7 DISCHARGE TO AREA 8 FOR DOWNSTREAM FLOW ENR-31, MVLWB- 5, 6 NHX-1,26

- The proposed amendment does not alter existing downstream Flow Mitigation plans. The source of the water for mitigation proposed to come from N11, Lake A1, and Area 7. No longer from the WMP.
- 1.55 Mm³ of water will be discharged in each planned year (3 out of 4 years), occurs in June, July, and August.
- Flow Rates ranges from 0.1 m³/s to 0.4 m³/s, depending on downstream flow augmentation targets and will be consistent with the flow rates stipulated in the Fisheries Authorization.
- Planned four (4) years discharge from Area 7 to Area 8, occurs in Year 2021, Year 2022, Year 2025, and Year 2027. Actual years will vary depending water levels, and other events.
- Flow mitigation water can not be sourced from N11 with the N11 outflows drop below the 1:5 dry year flows. During these periods water could be sourced from Area 7 or Lake A1. If sufficient volumes do not exist, flow mitigation could be postponed, as 1 in four years when there is no flow mitigation



AREA 7 DISCHARGE TO AREA 8 FOR DOWNSTREAM FLOW

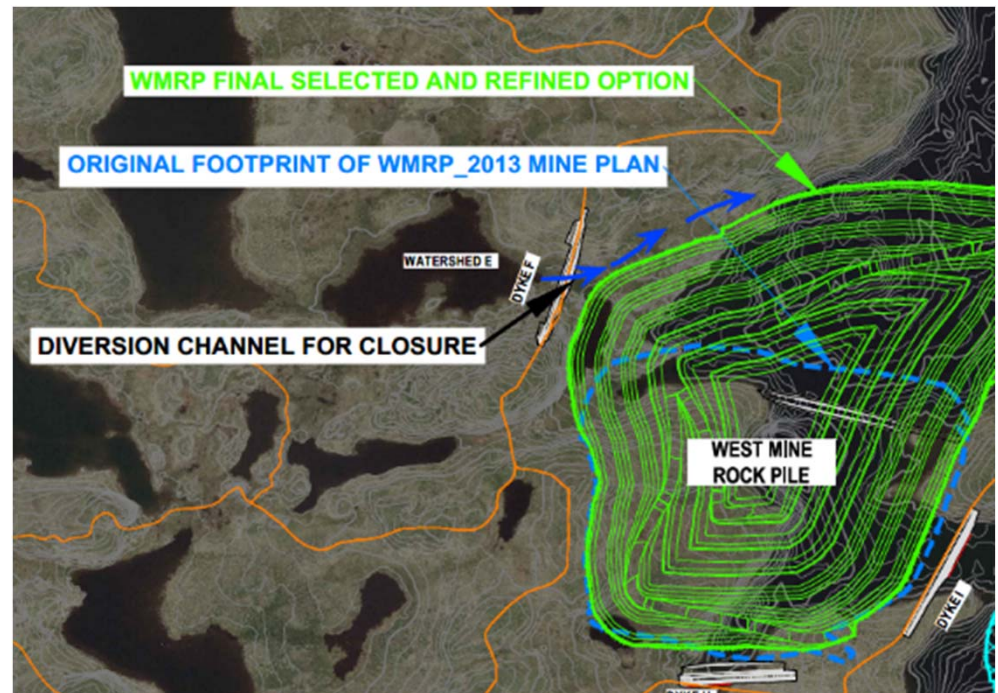


WATER MANAGEMENT – RUN-OFF - NHX 24, 25

- Run-off Values based on mean values, as oppose to median values. Mean values provide a better indication of the long term storage in the WMP and long-term water quality projections.
- Reduced Run-off (105 mm/year) from mine rock piles during pile construction. This accounts for wetting of country rock due to precipitation falling on the mine rock pile during construction. Increase in moisture content in the mine rock pile confirmed from work at other northern mine sites.

WATER MANAGEMENT – D1 DIVERSION - DFO-4

- Diversion D1 required at closure to reconnect D watershed to Kennady Lake. Details of diversion channel will be developed in final closure plan.



WATER MANAGEMENT –DYKE LINER LIFESPAN – DYKE LEAKAGE (NHX – 28, 29)

- Dykes around the Fine Pk Area 2 – Two seepage control measures
 - Natural Till – 7 m wide
 - HDPE Geomembrane.
- Area 2 Fine PK operated for 6 years. Post Closure – area graded to minimize open water in area.
- HDPE Geomembrane Liners – similar to used at most landfills lined with synthetic liners over the past 30 years. Liner lifespan a function of exposure and chemistry of waste. The GK liners are buried with no exposure to aggressive chemicals. The lifespan of HDPE liners in this condition is longer than the current in usage today (i.e. plus 30 years). Expected be much longer than this based on lab testing to evaluate the depletion of the antioxidants in the liner.
- Dyke L intended to allow seepage towards the WMP.
- Dykes A1 and D intended to retain fine PK and water. If seepage is observed from these dykes seepage to be collected and returned to Area 2. Seepage could be collected in ponds, and ditches, or wells. Seepage could be reduce by the use of thermosyphons, or grouting if there are unfrozen conditions. Fine PK against the dyke could also reduce seepage. The solution depends on the situation encountered.