

8.0 EFFECTS OF THE ENVIRONMENT ON THE PROJECT

8.1 Background

The Federal Environmental Impact Statement (EIS) Guidelines (Appendix B-1) require that Rainy River Resources (RRR) consider how local environmental conditions and natural hazards could adversely affect the Rainy River Project (RRP), and how this could result in impacts to the environment (CEA Agency 2012).

Five potential effects the environment could have on the RRP have been identified to be assessed based on guidance provided from regulatory agencies and experience with other mine environmental assessments:

- Water supply availability;
- Increased minewater volumes;
- Natural hazards;
- Climate change; and
- New Species at Risk designations.

8.2 Water Supply Availability

There are two water supply scenarios to be considered from the perspective of effects of the environment on the project: insufficient water and excess water. Local runoff conditions are highly variable from year to year, as described in Sections 5.3.1 and 5.6.2. Consequently there is a very real probability of there being either too little water, or excess water at the RRP site, in any given year.

Insufficient water supply could:

- Cause a temporary shutdown or scaling back of process plant operations, if there is insufficient water for process water demands; and
- Alter the proposed treated water discharge timing, if low flows occur in the Pinewood River (the receiving watercourse for discharge from the RRP) during the planned period for excess water discharge, such that there would be reduced assimilative capacity in the river. This could potentially cause a greater portion of the treated water intended for a fall discharge to be held over for release during the following spring freshet.

Similarly, during years of increased precipitation, there would be much more runoff entering the system from local catchments, which would lead to a need for increased water storage capacity, and increased discharges of treated water to the environment.

To alleviate concerns over either too much or too little water supply, the RRP water management system has been designed to provide a large reservoir capacity that will accommodate year to year variations in runoff (water supply) conditions. The tailings management area has a large internal water holding capacity. In addition, the water management pond has a capacity of 6.64 Mm³. Additional contingency storage capacity will be available in the mine rock pond and to a much lesser extent in the water discharge pond (Table 4-5). The site water management system is also highly flexible in its ability to treat and release treated water, in order to manage any excess water brought in to the system (Section 4.12; Appendix W-1).

8.2.1 Insufficient Water

The concern for too little water is most acute for process plant start-up and initial operations, when a sufficient inventory of water will be needed to guarantee an uninterrupted process plant water source, especially through the first winter of process plant operations. To support process plant start-up, a minimum system water inventory of 2 to 3 Mm³ will be required for the ice-free, open water period, and a minimum water inventory of 5 Mm³ will be required leading into the winter months (Section 4.12). A larger water inventory is required to support winter operations as there will be no new runoff inputs to the system during the winter months, and because a substantial portion of the water inventory will be lost to ice formation on the ponds. As a result, it will be necessary to build an initial water inventory in the water management pond, principally from water taken from local site catchments and the Pinewood River (Appendix W-1). Table 4-3 shows water availability from the Pinewood River during annualized, average and varying low flow conditions.

The principal concern for consistent water supply availability is the potential for two low flow years to occur in succession, resulting in a limited water supply within the Pinewood River. From an engineering perspective water taking from the Pinewood River could continue during low flow years, so long as such taking did not exceed 20% of the spring flow and 15% of the flow during the remainder of the open water period. To provide for such a condition, it has been conservatively assumed that two back to back 5th percentile years could potentially be encountered during 2016 and 2017, when the initial process plant water inventory is being generated and leading into early phase operations, and that ore processing would not commence until after the 2016 spring freshet. Historical flow records for the Pinewood River indicate that the likelihood of encountering back to back 5th percentile or more extreme years is extremely low. However, a more extreme low flow condition than two back to back 5th percentile low flow years was encountered during 1987 and 1988, so there is still some risk (Table 5-20). An approximate 25,000 m³/d pumping capacity would be required to draw the proposed taking of 20% of the Pinewood River flow during the maximum flow month of April under a 5th percentile annualized condition.

Once RRR is past the process plant start-up and early phase production, there is opportunity to build a greater system water inventory, the risk of an insufficient water inventory to support milling operations greatly diminishes.

If for any reason water inventory conditions were insufficient to support process plant start-up and operation through the first winter period, the available options would be to:

- Collect or otherwise obtain additional water from another source;
- Delay the start of milling until such time as a sufficient water inventory could be developed; or
- Temporarily scale back milling operations, particularly in the late winter.

The alternative of delaying process plant start-up or temporarily scaling back process plant operations (likely in the late winter of 2017) would be a hardship for the RRP.

The other aspect of low water conditions is related to receiving water (the Pinewood River) natural assimilative capacity and potential environmental impacts. To optimize final effluent quality, it is planned that in-plant effluent treatment for cyanide destruction and heavy metal precipitation would be followed by extended effluent aging internal to the tailings management area (primarily within the tailings management area pond) and in the water management pond (Section 4.12). Minewater will also contain residual ammonia from explosives use that would require extended aging prior to release to the environment. The most potentially problematic case for RRP effluent management involving low water conditions, would be the circumstance whereby a larger than normal water inventory was built up in the system due to high runoff conditions leading up to a fall discharge, but where the autumn is exceedingly dry such that the Pinewood River would have limited, if any, natural assimilative capacity. This concern would apply mainly to the pipeline discharge to the Pinewood River, as opposed to discharge through the constructed wetland, as the pipeline discharge lacks the wetland polishing step. In such a circumstance the quality of the discharge water would have to be exceptionally good, or effluent discharge would have to be held over until the following spring as it could not rely on a mixing ratio with the Pinewood River to meet discharge limits.

Table 8-1 shows the assimilative capacity potential of the Pinewood River downstream of the McCallum Creek outlet as the proposed final effluent discharge location, for an adjusted watershed area of 186 km², under annualized average and low (5th percentile) and high (95th percentile) flow conditions. The natural 207 km² watershed area of the Pinewood River, at this point, has been adjusted to a nominal value of 186 km² recognizing that a site catchment area of approximately 21 km² would potentially be removed from the system by site developments. Therefore, during an exceptionally low flow autumn condition, the assimilative capacity of the Pinewood River would only allow for an approximate 1.53 Mm³ effluent

discharge at a nominal one to one effluent to receiver mixing ratio. Under such circumstances the fall effluent discharge may have to be held over until the following spring.

The RRP process plant effluent is expected to contain very low concentrations of residual metals; lower than virtually all other gold operations with which AMEC is familiar. It is therefore possible to achieve an exceptionally high quality final effluent for this operation. In the circumstance where high runoff conditions were encountered leading up to a dry autumn, the excess accumulated runoff would help to improve overall effluent quality. At the same time, the tailings management area design capacity is such that it would also be possible to easily hold over the intended autumn effluent discharge until the following spring. Limited receiver assimilative capacity is therefore a readily manageable condition as described further in Appendix W-1.

8.2.2 Excess Water

The RRP water inventory storage capacity would evolve over time, especially during preparation for process plant start-up and during early phase operations. The intent is that the water storage capacity of the water management pond would be developed to hold approximately 6 Mm³ of water mid-2016. If the water management pond is filled to capacity or near capacity, pumping of fresh water from the Pinewood River for start-up would be terminated or reduced (Appendix W-1).

Once process plant operations commence, water inventory holding capacity will be available within the tailings management area pond, the water management pond and the mine rock pond. Water within the system will be managed, with any excess treated water discharged to the environment. Final effluent would preferentially be discharged to the environment through the constructed wetland to optimize final effluent quality and to maintain Pinewood River flows. All final effluent from the water management pond that is not discharged through the constructed wetland would be discharged by pipeline to the Pinewood River at McCallum Creek (Appendix W-1).

Table 8-2 shows the potential for accumulating excess runoff in the system.

The excess accumulated water generated for year 2 of operations for the more extreme 95th percentile runoff condition is 5.0 Mm³ and 7.4 Mm³ for year 15 of operations. These values compare with a Pinewood River assimilative flow capacity of approximately 11.7 Mm³ for the 5th percentile low flow condition (Table 8-2). The data suggest that a minimum 1:1 mixing ratio (i.e., greater than 1 part river water to 1 part final effluent) would be available for the extreme condition (95th percentile wet runoff year was followed by a 5th percentile dry runoff year).

There are two ways this condition could be managed:

- Provide increased storage within the system inventory to manage the condition; and
- Discharge excess effluent during wet years so as not to accumulate such a large system water inventory.

Both strategies may be used to manage the system water inventory within acceptable limits. The condition of excess runoff in extreme wet years can therefore be effectively managed without causing a malfunction or additional environmental effects.

8.3 Increased Mine Water Volumes

Minewater results from the combined inputs of direct precipitation, surface runoff and groundwater inflow to the mine workings. Minewater is proposed to be discharged to the mine rock pond for use in processing, or to the tailings management area pond if there is excess water beyond that which can be used immediately for processing, or stored in the mine rock pond for future processing (Figures 4-9 and 4-10). Minewater directed to the tailings management area will be stored as part of the system water inventory for subsequent use in processing, with any excess water to be aged for eventual, seasonal release to the environment.

If groundwater flow into the open pit were to be substantively greater than that anticipated by the groundwater modelling (base case annual averaged value of 3,400 m³/d; Section 4.5), then there may or may not be a greater excess of system water inventory requiring discharge to the environment in any given year depending on runoff conditions. Additional pumping systems would be installed if needed to maintain a safe working environment, and there would be no affect on pit wall stability.

A sensitivity analysis was carried out as part of groundwater modelling to determine the potential range of groundwater inflows into the open pit. The results of this sensitivity analysis showed that the annualized groundwater inflow to the open pit could potentially range from 2,900 to 3,900 m³/d.

The current tailings management area water management plan provides for seasonal effluent discharge to the environment. Increased minewater production would potentially increase the rate and/or period of seasonal excess effluent release, but not by a large amount and not beyond the design capacity of the system. There is a high degree of confidence in the groundwater model prediction, and it is extremely unlikely that groundwater production numbers will appreciably exceed the conservative upper limit model result.

In regards to increased groundwater flow into the underground mine, if such increased flow was to occur, grouting efforts to restrict minewater inflow would be increased, along with increased underground pumping capacity.

Increased minewater production can therefore readily be handled by the proposed water management system. It does not pose a safety hazard and will not cause an additional malfunction or environmental effect.

8.4 Natural Hazards

Natural hazards which could potentially affect the RRP given its geographic location include: earthquakes, extreme floods and natural fires (Section 8.4); as well as climate change (Section 8.5). Other items identified in the EIS Guidelines as potential events (landslides and avalanches) are not credible events for the RRP.

8.4.1 Earthquakes

The RRP is situated in a low risk seismic zone (Adams and Halchuk 2008). Nevertheless, the tailings management area dams have been designed to withstand the maximum credible earthquake according to the *Lakes and Rivers Improvement Act* (MNR 2011), which is utilized in Ontario. The Ministry of Natural Resources (MNR 2011) requirements are essentially equivalent to the Canadian Dam Association (2007) requirements.

More specifically, the tailings management area dams have been designed to exceed the prescribed short term, long term and pseudo-static minimum factor of safety (Section 4.8).

To ensure that calculated factors of safety are maintained through the construction process, the tailings management area dam construction (initial construction and subsequent dam raises) are required to be, and will be, completed under the supervision of a qualified geotechnical engineer. The risk of a tailings dam failure resulting from an earthquake was taken into consideration in the dam designs, and in the manner in which the dams will be constructed.

As a result, there is no expected environmental effect resulting from seismic events.

8.4.2 Extreme Floods

Extreme floods have the potential to cause structural failure of tailings dams and dam structures, and to flood site facilities, principally the open pit. To protect the tailings dams against the risk of extreme floods, the tailings dams have been designed to contain the environmental design flood and the spillways will be designed to pass the probable maximum flood. The probable maximum flood is the flood that may be expected from the most severe combination of critical meteorological and hydrologic conditions that are reasonably possible in a particular drainage area.

The tailings management area is designed to include dam spillway(s) to pass extreme floods without affecting dam stability. The spillways also have the potential to become activated for short periods of time depending on the timing of the precipitation event and dam raises, for return period precipitation events exceeding 100 years, which is less stringent than the probable maximum flood design criteria that would apply at the completion of the differing dam stages. Other site area ponds will be designed with spillways capable of passing the environmental design flood. If the spillways were to become activated under extreme flood conditions, there would be no perceived effect on the Pinewood River as the river flows during such conditions would be capable of providing maximum assimilative capacity.

The RRP has been designed such that the open pit will not be flooded by the overtopping of the banks of the Pinewood River or West Creek. Flood routing studies conducted by AMEC (2012i) show that the 100-year flood would result in the Pinewood River cresting adjacent to the open pit at an elevation ranging from 347 to 349 masl. A berm will be constructed between the open pit and the river to ensure that such a river cresting would not enter the pit or affect the overburden pit slope stability (Figure 4.1).

The West Creek diversion has been designed to pass the 100-year rainfall event. The pit perimeter road has been designed to help ensure that any larger storm event would not enter the pit despite any backing up of the creek.

Any water which did enter the pit through direct precipitation or overland flooding (via West Creek) would be pumped out over a period of several days. During any such period the process plant feed would derive from the ore stockpile so as not to disrupt milling operations. There is also the potential that mining could continue to occur above the flooded pit level.

Extreme flood events are not expected to affect the RRP except as discussed above, and no resulting environmental effects are expected. This would be similarly true of floods of higher probability, such as the 5-year or 10-year floods which represent less extreme events.

8.4.3 Natural Fires

Forest fires are part of the natural regeneration cycle of the Agassiz Clay Plain Ecoregion where the RRP is situated, with forest fire cycles ranging between 63 and 210 years (Crins et al. 2009). Any terrestrial habitat losses resulting from fire damage will allow for natural succession ecological processes which occur throughout the region.

Project components most vulnerable to a natural fire would potentially include the process plant and the 230 kV transmission line. Fire suppression systems will be constructed to protect key buildings and help ensure the safety of personnel. Multiple highway / road accesses are available to evacuate people from site if needed.

The process plant and other RRP buildings will also be generally protected from natural fires as a result of their position between the tailings management area, open pit and stockpiles. The primary exposure area of the process plant and outbuilding complex to natural fire would be to the northeast. Much of the terrain in this direction consists of exposed rock outcrop, open fields, wetlands and patchy forest, the combination which would limit the progression of natural fires. Should it be determined in the future that additional fire break is required, appropriate approvals will be obtained from the MNR.

Much of the transmission line also passes through exposed rock terrain, which would help to limit the risk of line damage by fire. The transmission line, nevertheless, remains as the most vulnerable RRP component to fire. If portions of the transmission line were to be damaged by fire, those portions of the line would need to be repaired. Until such time, processing and associated operations would cease due to a lack of power. A small set of contingency transmission line poles may be stored at site to facilitate expeditious line repair in the event of fire damage to the line. The existing electrical distribution system at the RRP will still be available to provide limited power to support critical functions, such as pumps, at the site in addition to emergency diesel generators.

While natural fires may have an effect on the RRP, they are not expected to result in an additional environmental effect, such as causing a malfunction or accident.

8.5 Climate Change

Various climate change assessments have been developed for northwestern Ontario (Colombo et. al 2007; IEESC 2012; Racey 2004). Virtually all of these assessments predict an increase in temperature, stable to increasing precipitation, more episodic precipitation, and an increased risk of natural fires. The primary means by which climate change has the potential to affect the RRP is through the RRP water balance both during operations and at closure, and to a lesser extent, affect the risk from natural fires.

Colombo et. al (2007) predicted changes to Ontario winter and summer temperatures and precipitation based on application of the Canadian Coupled Global Circulation Model for both the A2 and B2 scenarios, with the A2 scenario being the more extreme scenario (greenhouse gas levels reaching a value of 1,320 ppm by volume by 2100), and the B2 scenario (greenhouse gas levels reaching a value of 915 ppm by volume by 2100) being less extreme. Under the more extreme A2 scenario, these authors predicted that by the year 2100, average summer and winter temperatures for the RRP area would increase by about 4 to 5°C, and that warm season precipitation rates would remain about the same as they are currently, but that cold season precipitation rates would increase by about 10%. In the nearer term (2011 to 2040) they predicted that warm season precipitation rates would increase by from 0 to 10%, and that cold season precipitation rates would remain unchanged.

The more recent study (IEESC 2012) study predicts a near-term median (50% probability) average temperature increase for the region of from 2.3 to 2.5°C (2020 to 2049), and a longer-term median average temperature increase of 5.3 to 5.8°C (2070 to 2099) and hence increased evaporation. These authors predict an average annual short and long term median precipitation increase for the region of from 3.8 to 6.6%.

There is consequently a trade-off in the prediction of temperature and precipitation increases which would tend to balance runoff conditions; with increased temperatures leading to reduced runoff, and increased (and more episodic) precipitation leading to increased runoff.

Actual long term runoff data for the region are available from the Rainy River, Manitou Rapids Water Survey of Canada station (Station 05PC018) which has operated since 1929. The station is regulated and has a contributing watershed area of 50,200 km². Annual runoff data for this station are plotted in Figure 8-1. Year to year runoff rates are variable, but there is an overall upward trend of increasing runoff with time. If the pre-1940 data are excluded, the trend is virtually flat.

It would therefore appear on balance that runoff regimes in the region are likely to remain close to their current levels, with a high degree of year-to-year variability. Water balance determinations which have been used in the design the RRP water management system and closure strategy (include flooding of the open pit), are unlikely to change during the life of the RRP, and are unlikely to change appreciably over the longer-term, within the accuracy of predictive models. It would therefore be possible to continue to maintain a water cover over the deposited tailings as proposed to prevent the development of acid rock drainage (ARD) conditions. Results of humidity cell testing suggest that the lag time to ARD in these materials is approximately 27 to 40 years. Periodic short term exposures of portions of the tailings solids to the atmosphere during operations (should this occur) would therefore be unlikely to be problematic. The contingency measure, if ever needed, would be to augment the tailings management area water cover by pumping water from the flooded open pit to the tailings management area after closure as part of ongoing site maintenance.

The potential for increased occurrences of forest fires has implications primarily for the transmission line as indicated in Section 8.4.3; but any such implications due to climate change would be minor because of the comparatively short term duration of the RRP relative to climate change scenarios.

8.5.1 Projected Climate Change Effects on the Water Balance

RRR was requested in comments received on the draft EA Report (Version 2) to further consider seasonal and annual, temperature and precipitation projections from a number of climate change models for a range of emission scenarios; and to provide discussion of projected changes on water balance, particularly on the water cover for the TMA to prevent acid mine drainage in the post-closure period.

Projections were made for thirty-year average values representing the estimated future conditions in 2020, 2050 and 2080. Estimates were developed for these three future periods and for the 5th, 25th, 50th, 75th and 95th non-exceedance percentile values across the ensemble of General Circulation Model projections of future climate (Appendix W-2). These percentile values reflect the differences in projections of future climate conditions across the climate models and are a conservative means of addressing uncertainty. It uses the extremes in the distribution of results to represent minimum bounds of possible future conditions. In this approach, the 5th and 95th percentile values would be used to characterize the lower and upper bounds of the possible changes in the annual water balance. The projected change in climate in conditions is determined for each climate projection by comparing the climate condition during the overlap period from the climate condition at some future point in time, and applying that projected change to historical conditions (Figures 8-2 and 8-3).

Table 8-3 provides an estimate of the net effect of climate change on the annual water balance at the site. From this assessment, it is clear that the overall effect of climate change across the complete ensemble of climate change projections on the RRP site will be a net increase in the overall water balance of between 20 mm and 190 mm annually. Climate change is therefore predicted to improve the ability to maintain a water cover over the tailings in the longer term.

8.6 New Species at Risk Designations

Species at Risk (SAR) Net Benefit permits are required from the Province of Ontario for species that are considered Endangered or Threatened. As of the preparation of this Environmental Assessment (EA) Report, MNR has confirmed that SAR Net Benefit permits will be required for Eastern Whip-poor-will and Bobolink, and that a SAR Net Benefit permit may be required for Barn Swallow depending whether or not any existing structures supporting barn swallows are demolished as part of mine development. Currently, there are no such plans to demolish barns or similar structures during the construction phase; however, it is expected that these structures may be demolished during operations, in order that they do not pose a public safety hazard, assuming that there is no longer term use envisaged.

Three fish were captured (and released) by AMEC and MNR in the lower reaches of the Pinewood River approximately 27 km downstream of the RRP open pit. If the Federal designation of Lake Sturgeon changed to afford them protection under the *Species at Risk Act* and it was determined that the RRP has an effect on Lake Sturgeon habitat, it could result in additional approval requirements.

The SAR-related concern to the RRP is the rapidly changing status (conservation designation) of SAR species and the long timelines required to obtain SAR Net Benefit permits from the Province. If additional SAR species, such as those currently listed as being of Special Concern or currently unlisted, were suddenly to become listed as Threatened, and if these Threatened

species were likely to be adversely affected by planned project developments, then additional, presently unplanned SAR Net Benefit permits could be required.

8.7 Ice Jams

The EIS Guidelines listed ice jams as potential natural hazards. There have been certain instances of flooding in the region in the past (for example, the Town of Rainy River was subject to an ice jam related flood threat in 1997), in part related to heavy regional precipitation and management of International waters. The only potential for concern for ice jams for the RRP would be ice jams on the Pinewood River that could affect the integrity and function of the pit protection berm. An ice inspection and contingency plan will be developed to ensure that ice jams would not cause the Pinewood River to overflow the pit protection berm.

The tailings management area will not be subject to ice jam effects as it will have insufficient wind fetch to generate an ice jam either during operations or at closure.

Table 8-1: Available Pinewood River Seasonal Flows for Effluent Assimilative Capacity

Flow Condition	Period		
	April to May (m ³)	October to November (m ³)	Total (m ³)
Mean	17,744,390	4,542,809	22,287,199
5th Percentile	5,969,047	1,528,159	7,497,206
95th Percentile	35,893,461	9,189,222	45,082,683

Note: functional watershed for assimilation is 186 km² (= 207 km² - 21 km²)

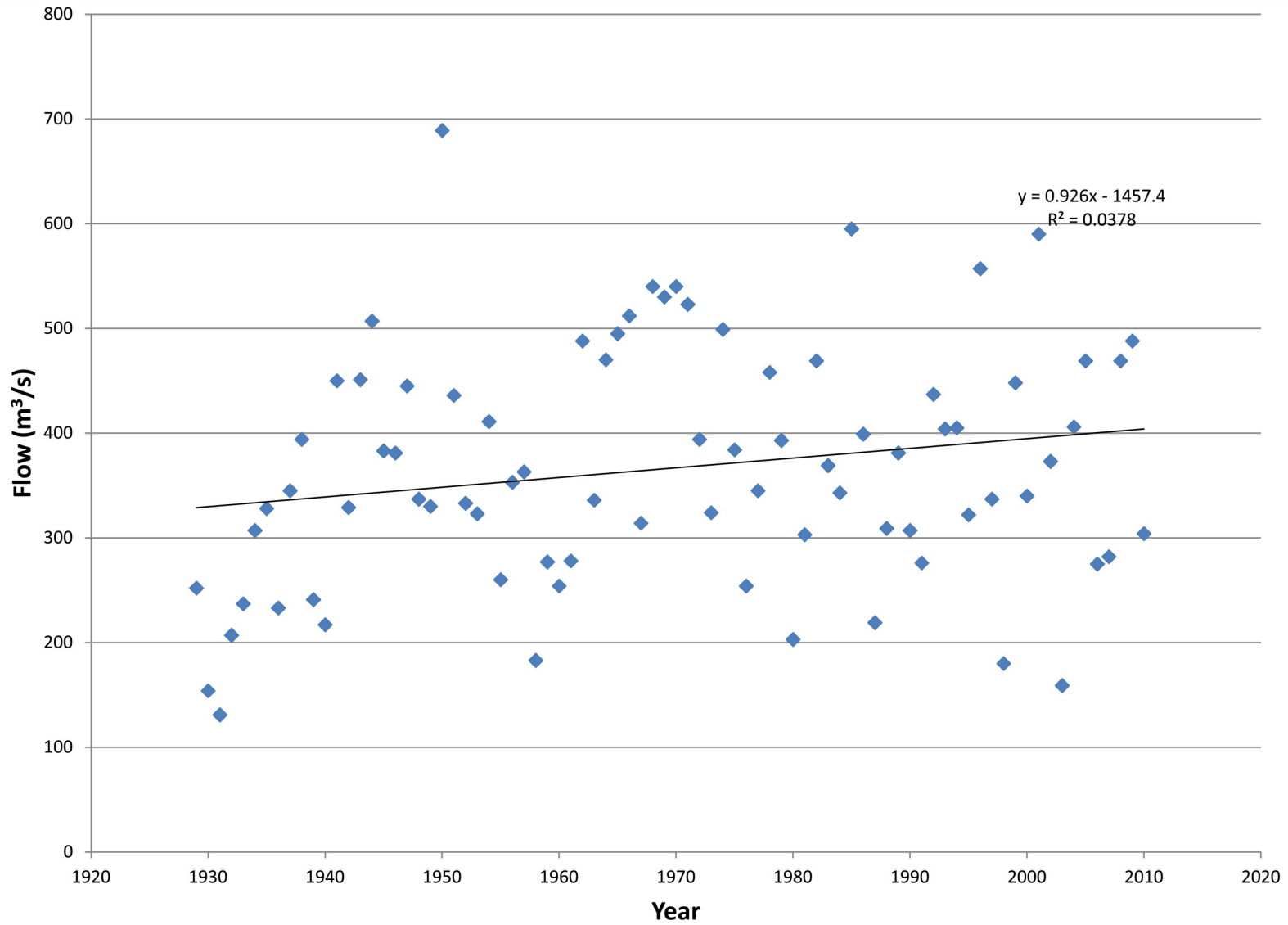
Table 8-2: Potential for Accumulated Runoff under varying Runoff Conditions

Runoff Condition	Runoff (mm)	Runoff Volume (m ³)	Mine Water (m ³)	Tailings Void Losses (m ³)	Process Plant Losses (m ³)	Dust Suppression Losses (m ³)	Net Surplus (m ³)	Pinewood River Flows at McCallum Creek – 186 km ² (Apr - Nov) (m ³)
Year 2								
Average	213	4,473,000	1,241,000	2,590,000	146,000	260,000	2,718,000	34,893,799
5th Percentile	93	1,953,000	1,241,000	2,590,000	146,000	260,000	198,000	11,737,949
95th Percentile	322	6,762,000	1,241,000	2,590,000	146,000	260,000	5,007,000	70,583,392
Year 15								
Average	285	5,985,000	1,241,000	2,590,000	146,000	260,000	4,230,000	34,893,799
5th Percentile	117	2,457,000	1,241,000	2,590,000	146,000	260,000	702,000	11,737,949
95th Percentile	438	9,198,000	1,241,000	2,590,000	146,000	260,000	7,443,000	70,583,392

Table 8-3: Adjustments to the Annual Net Water Balance based on Climate Change Projections

Non-exceedance Percentile	2020 (mm)	2050 (mm)	2080 (mm)
5	55	48	20
25	83	78	69
50	100	110	100
75	120	130	140
95	150	170	190

Note: data shows a net overall increase in the water balance under all scenarios



LEGEND

◆ Manitou Rapids, Water Survey of Canada Station 05PC018

NOTES:

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RAINY RIVER PROJECT

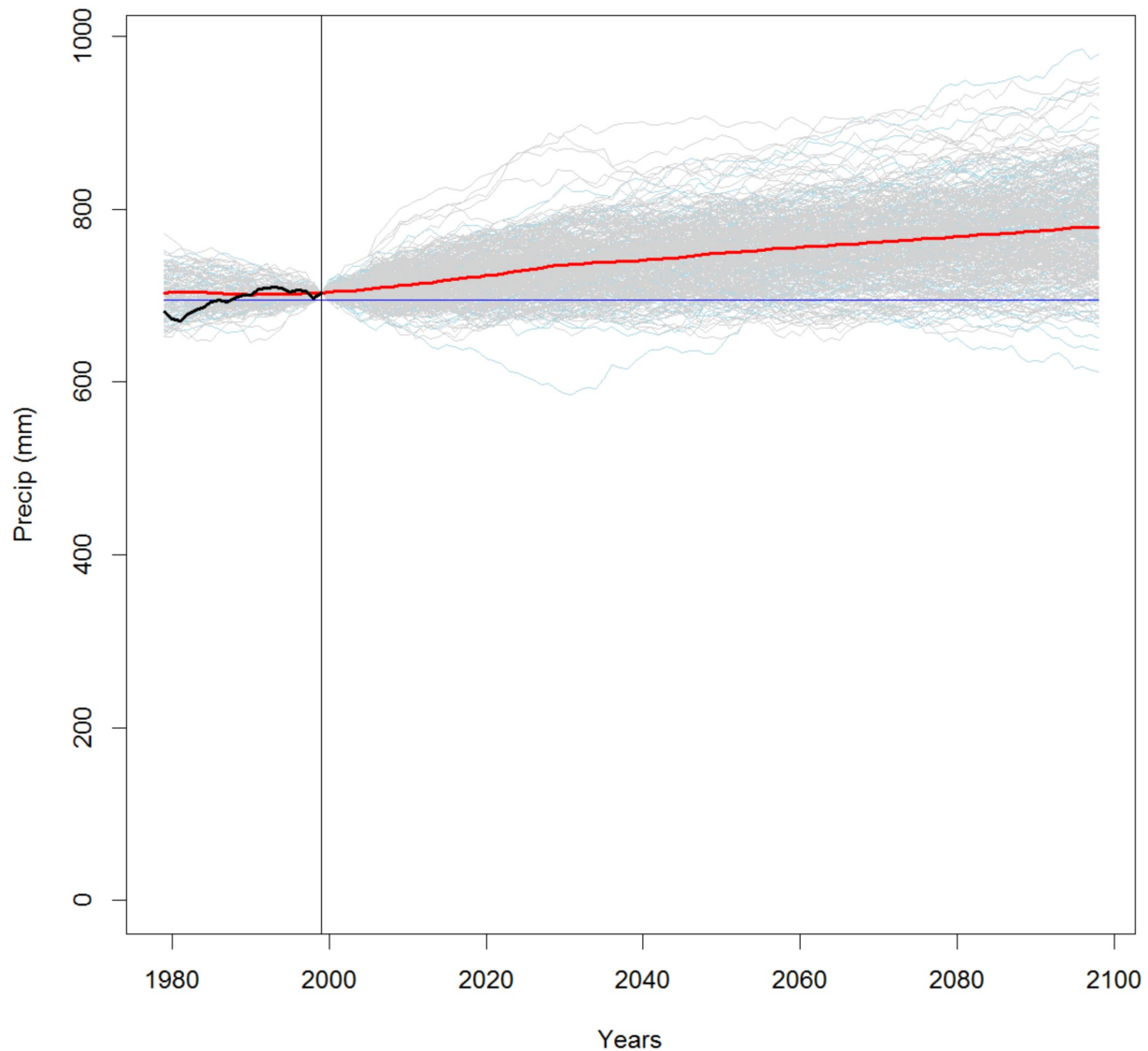
**Rainy River
Mean Annual Flows**

PROJECT N°: TC111504

FIGURE: 8-1

SCALE:

DATE: October 2013



LEGEND

- Historical Mean
- Projected Mean

NOTES:
 - Annual average precipitation (mm) InvDist weighted average.



RAINY RIVER PROJECT

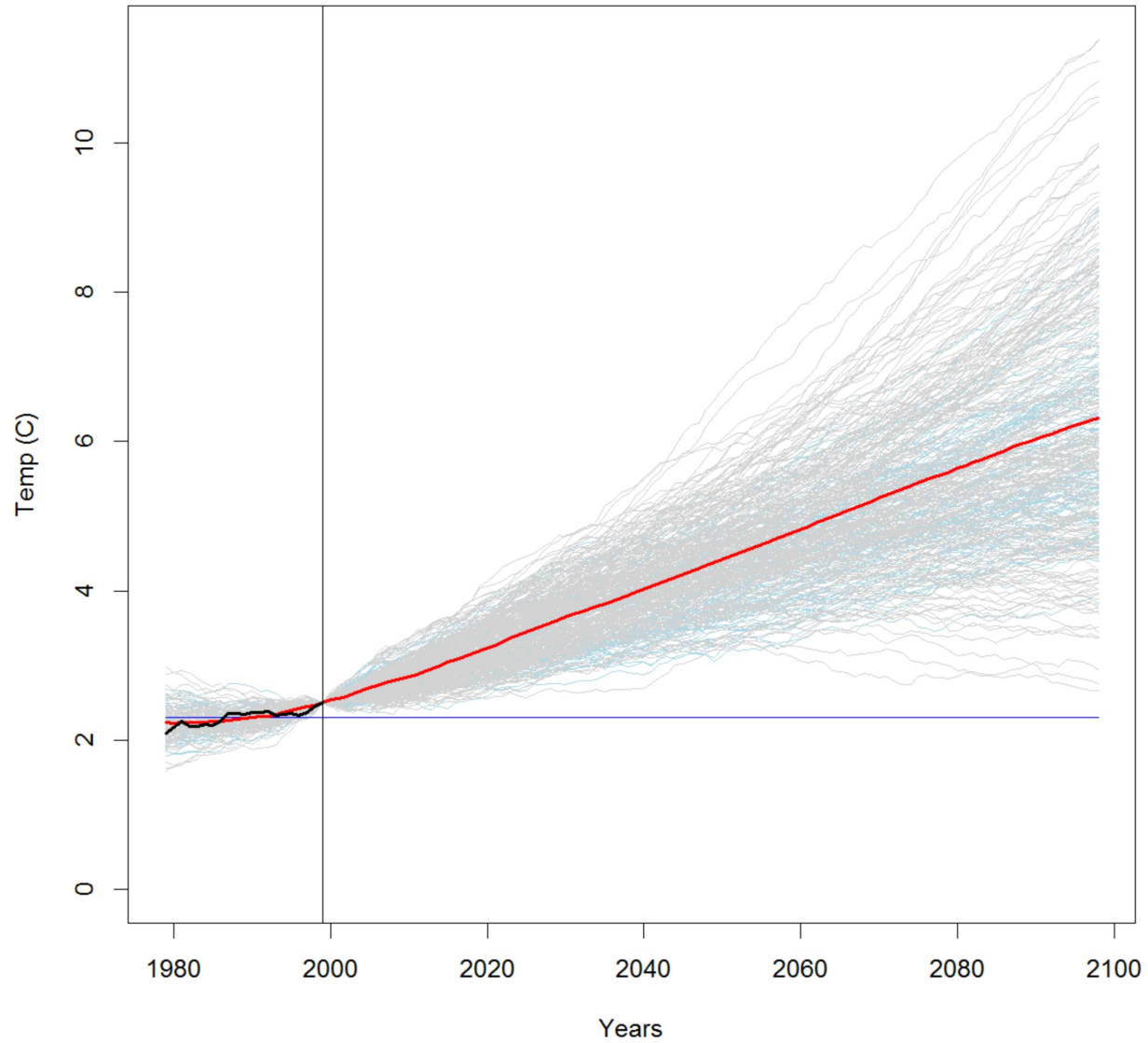
Projected Precipitation at the Rainy River Project Site

PROJECT N°: TC111504

FIGURE: 8-2

SCALE:

DATE: October 2013



LEGEND

- Historical Mean
- Projected Mean

NOTES:
 - Annual average temperature (C) InvDist weighted average.



RAINY RIVER PROJECT

Projected Temperature at the Rainy River Project Site

PROJECT N°: TC111504	FIGURE: 8-3
SCALE:	DATE: October 2013

