This form has been developed to document exceedances present in the modeling results and the reason why those exceedances are occurring. This document in particular pertains to aluminum at evaluation surface water locations SW-002, SW-003, SW-004, SW-004a, SW-004b, SW-005, and SW-006 on the Partridge River and in Colby Lake.

Introduction:

Model results for the Mine Site indicate that the 90th percentile (P90) concentration of aluminum exceeds the surface water standard for aluminum (125 µg/L) at all evaluation locations in the Partridge River and Colby Lake. Also, aluminum concentrations generally increase with distance downstream on the Partridge River. The exceedances and increase in concentrations downstream occur for both the No Action Alternative and Proposed Project.

Aluminum exceedances in the Partridge River and Colby Lake occur between April and November, i.e. during the period when surface runoff contributes proportionately more to river flow than baseflow from groundwater compared to the winter months. Because surface runoff is more likely to exceed the water quality standard for aluminum than baseflow from groundwater, the Partridge River is in turn more likely to exceed the water quality standard for aluminum at times when runoff is contributing proportionately than baseflow more to river flow. The concentration of aluminum increases from evaluation location SW-002 to SW-005 because runoff contributes proportionately more flow to each downstream reach than to the previous reach.

Evaluation:

Surface water evaluation locations for the Mine Site are shown on Figure 1. Exceedances of the aluminum standard occur at all evaluation locations on the Partridge River: SW-002, SW-003, SW-004, SW-004a, SW-004b, SW-005, and SW-006; similar exceedances occur at Colby Lake. Figure 2 through Figure 9 illustrate the highest annual concentration of aluminum at a 10%, 50% and 90% probability at each respective Partridge River evaluation location.

<u>Background Concentration of Aluminum</u>

Concentrations of aluminum in background surface runoff regularly exceed the water quality standard; aluminum in runoff exceeds the water quality standard approximately 20% of the time, as shown on Figure 10. However, aluminum in groundwater almost never exceeds the water quality standard, as shown on Figure 11. In the Partridge River, surface runoff and baseflow from groundwater contribute to overall river flow in proportions such that, under background conditions, the water quality standard is exceeded approximately 10% of the time in the calibrated river model, as shown by the calibration distribution in Figure 12. This is slightly less than what has been observed, where approximately 25% of the surface water monitoring data

used for calibration exceeded the standard (Figure 12, excerpted from *Calibration of the Existing Natural Watershed at the Mine Site*, approved by the Agencies).

Potential Project Sources of Aluminum

Potential sources of aluminum from the Project include the West Pit and the East Pit – Category 2/3 Stockpile. Aluminum concentrations in groundwater flowpaths from each of these sources are described below:

- Aluminum concentrations in groundwater from the West Pit are consistently below 125 µg/L and actually decrease below No Action levels in the long term, as shown on Figure 13.
- Groundwater from the East Pit – Category 2/3 Stockpile does show a "pulse" of aluminum concentration that peaks at about 175 µg/L at the Partridge River between years 25 and 125, however simulated aluminum concentrations are otherwise consistently below 125 µg/L, as shown on Figure 14. Because groundwater from the East Pit – Category 2/3 Stockpile is diluted upon reaching the river, the "pulse" is not discernable at the downstream evaluation locations during periods of higher flow (and therefore higher aluminum concentrations), as shown on Figure 15 (SW-004 is the first surface water evaluation location downstream of the contribution of the East Pit – Category 2/3 Stockpile flowpath). In fact, under Project conditions the annual maximum concentration of aluminum falls below that for No Action condition in the long term at locations downstream of all Mine Site impacts (SW-004a and SW-004b), shown on Figure 5 and Figure 6. This decrease is due to the constant discharge of treated West Pit water from the Mine Site WWTF, which has lower than background aluminum concentrations.

Although the Project does have potential sources of aluminum, model results indicate that the Project does not cause concentrations of aluminum to increase at evaluation locations and will actually cause aluminum concentrations to decrease slightly due to changes in the watershed configuration and the discharge of cleaner-than-background West Pit water.

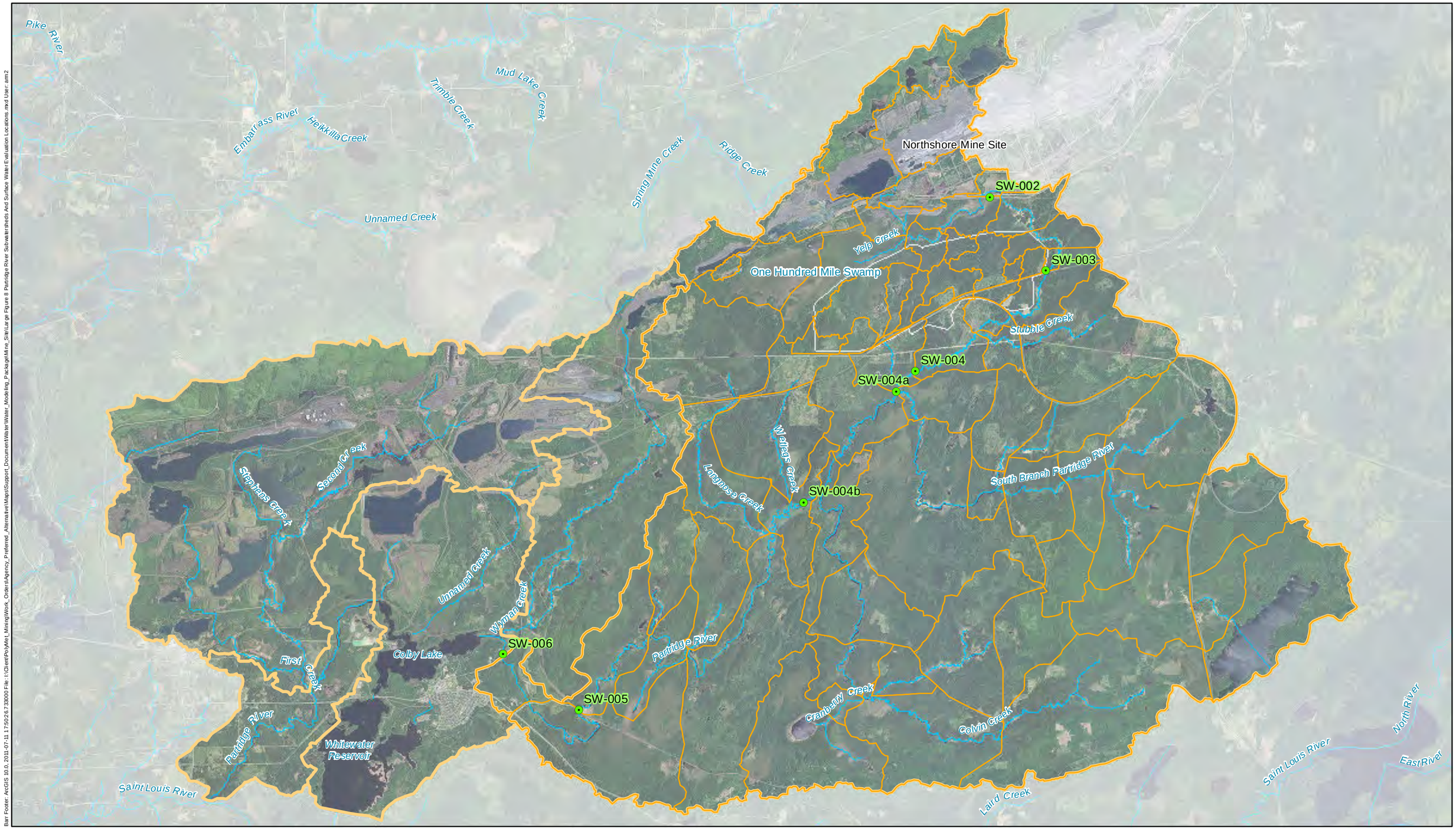
The likelihood of aluminum concentrations being above 125 µg/L in any given month is nearly identical in the No Action and Project models. Figure 16 shows the percent of model runs that are estimated to have at least one month with aluminum concentrations exceeding 125 µg/L at SW-004 for each year of the simulation. The red line shows the total percent of Project model runs estimated to have an exceedance; the blue line shows the percent of model runs where there was an exceedance in the Project Model and no exceedance in the No Action model. Virtually all of the model runs that are estimated to have an exceedance would have had an exceedance even without the Project. For months where natural conditions would not cause an exceedance, there is less than a 10 percent probability that aluminum loading from the Project will result in concentrations rising over 125 µg/L (the maximum value for the blue line in Figure 16 is 1.2%). That is, there is a greater than 90% probability in any month that the Proposed Project does not cause additional exceedances.

Conclusion:

Although the surface water quality standard for aluminum is exceeded, the exceedances are not due to the Project. Rather, they are due to background surface runoff which is naturally high in aluminum.

- Background surface runoff to the Partridge River is estimated to exceed the water quality standard approximately 20% of the time, whereas the groundwater contribution to the river is very unlikely to exceed the standard.
- Although the Project does have potential sources of aluminum, modeling indicates that the Project will not increase aluminum concentrations in the Partridge River and will instead cause aluminum concentrations to decrease slightly.

Figures



Barr Foster: ArcGIS 10.0, 2011-07-11 17:50:26 7:33000 File: I:\Client\PolyMet_Mining\Work_Orders\Agency_Preferred_Alternative\Maps\Support_Document\Water\Water_Modeling_Package\Mine_Site\Large Figure 8 Partridge River Subwatersheds And Surface Water Evaluation Locations.mxd User: am2

- Model Evaluation Locations
- Upper Partridge River Subwatersheds
- Partridge River Watershed
- Mine Site
- Streams/Rivers

1.5 0.75 0 1.5
Miles

Figure 1
PARTRIDGE RIVER SUBWATERSHEDS AND SURFACE WATER EVALUATION LOCATIONS
NorthMet Project
PolyMet Mining Inc.
Hoyt Lakes, MN

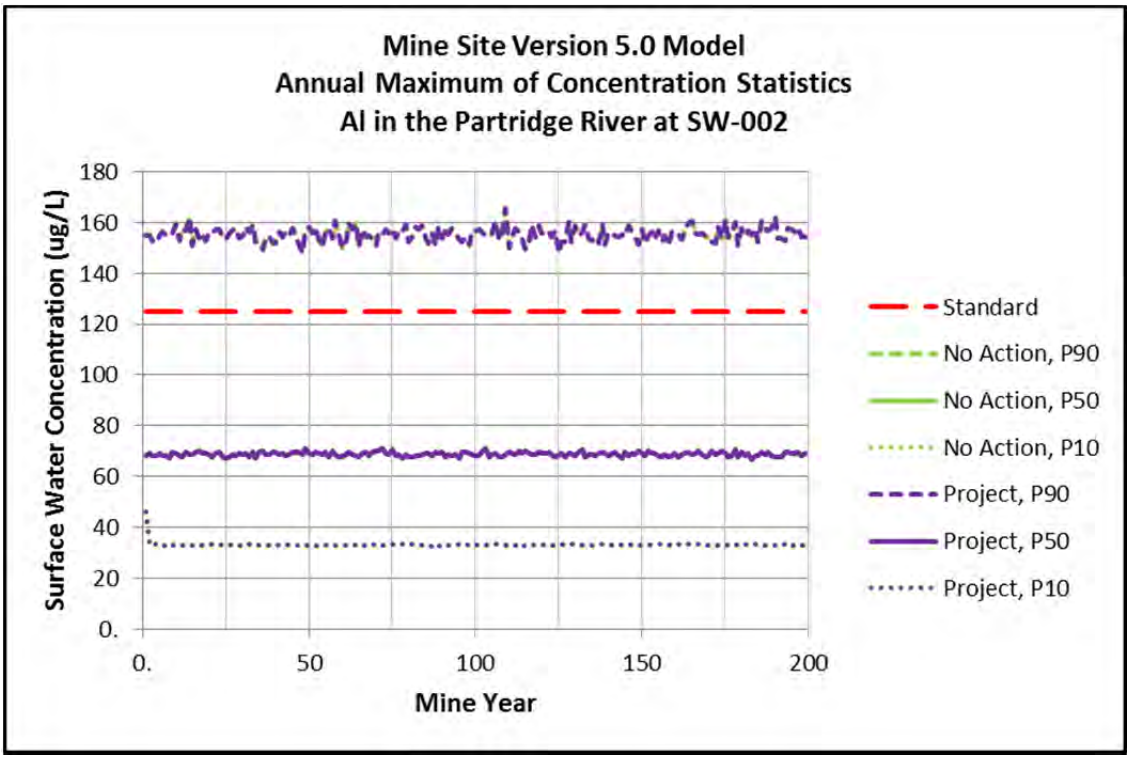


Figure 2 Annual Maximum Aluminum Concentrations at SW-002

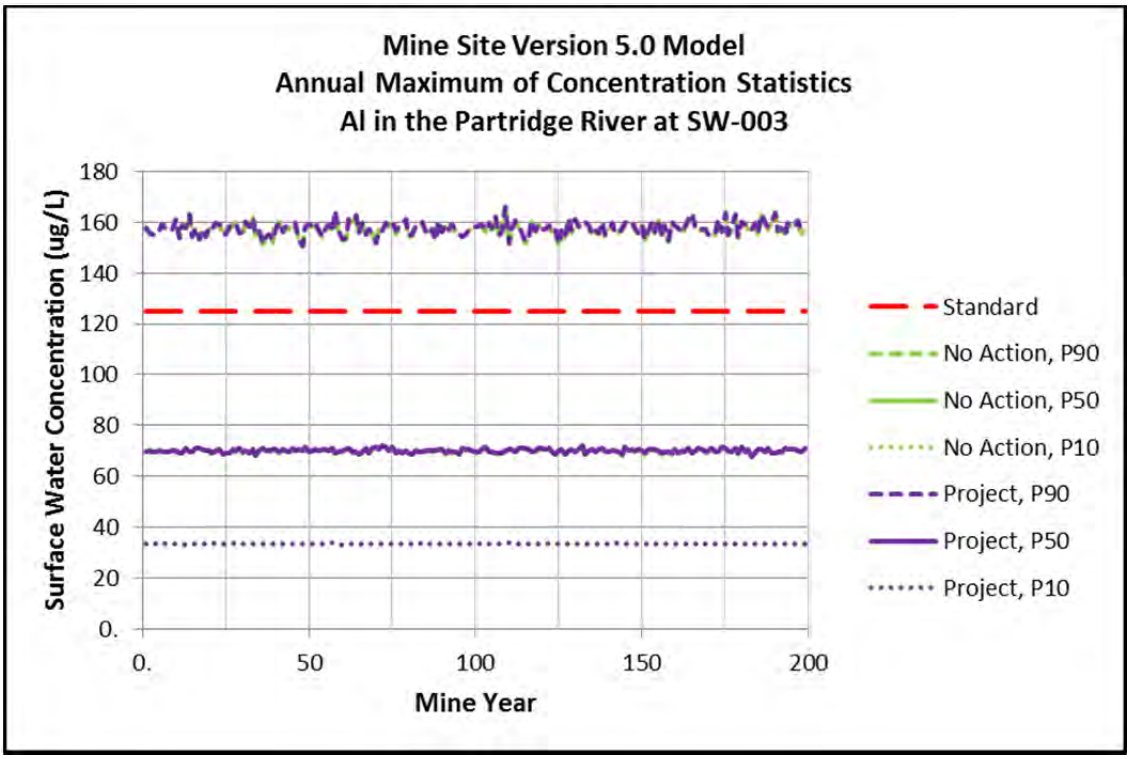


Figure 3 Annual Maximum Aluminum Concentrations at SW-003

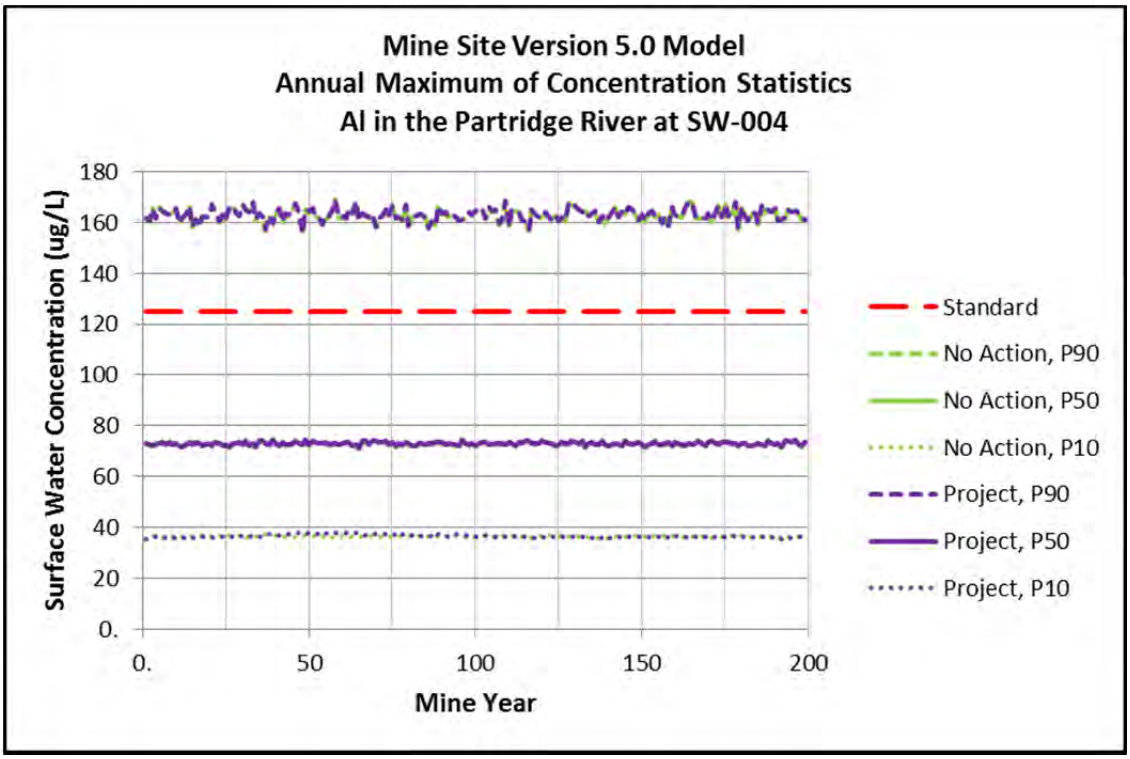


Figure 4 Annual Maximum Aluminum Concentrations at SW-004

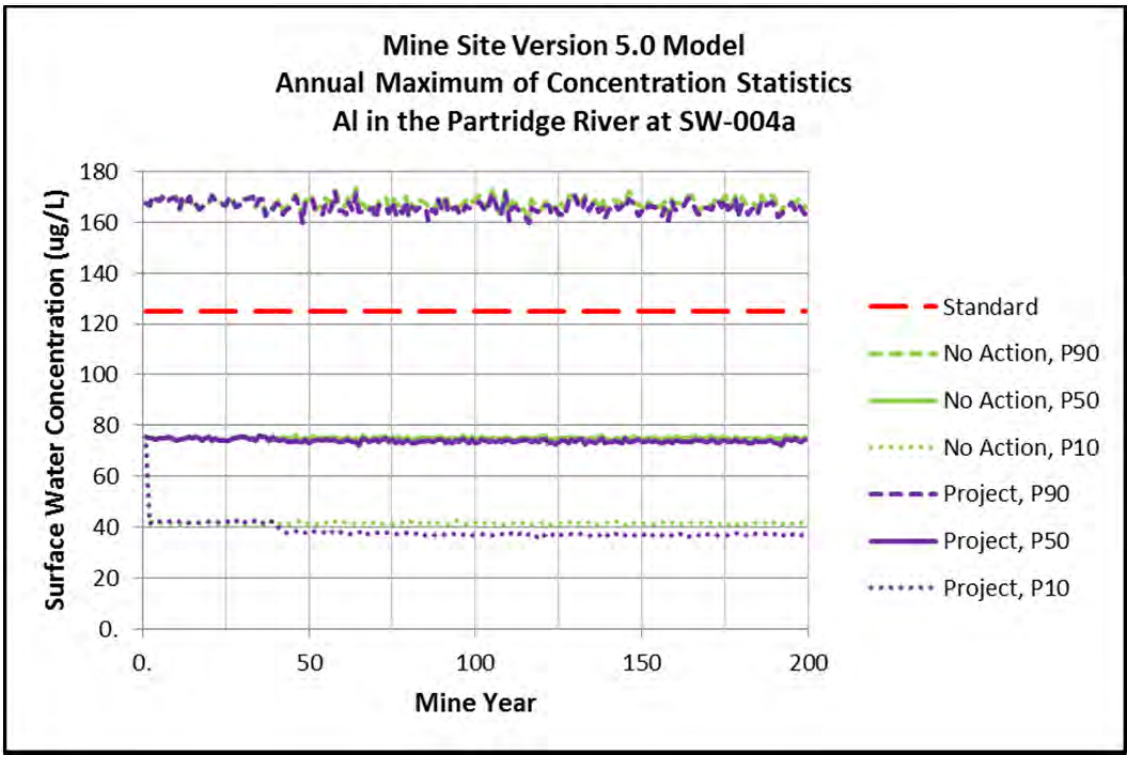


Figure 5 Annual Maximum Aluminum Concentrations at SW-004a

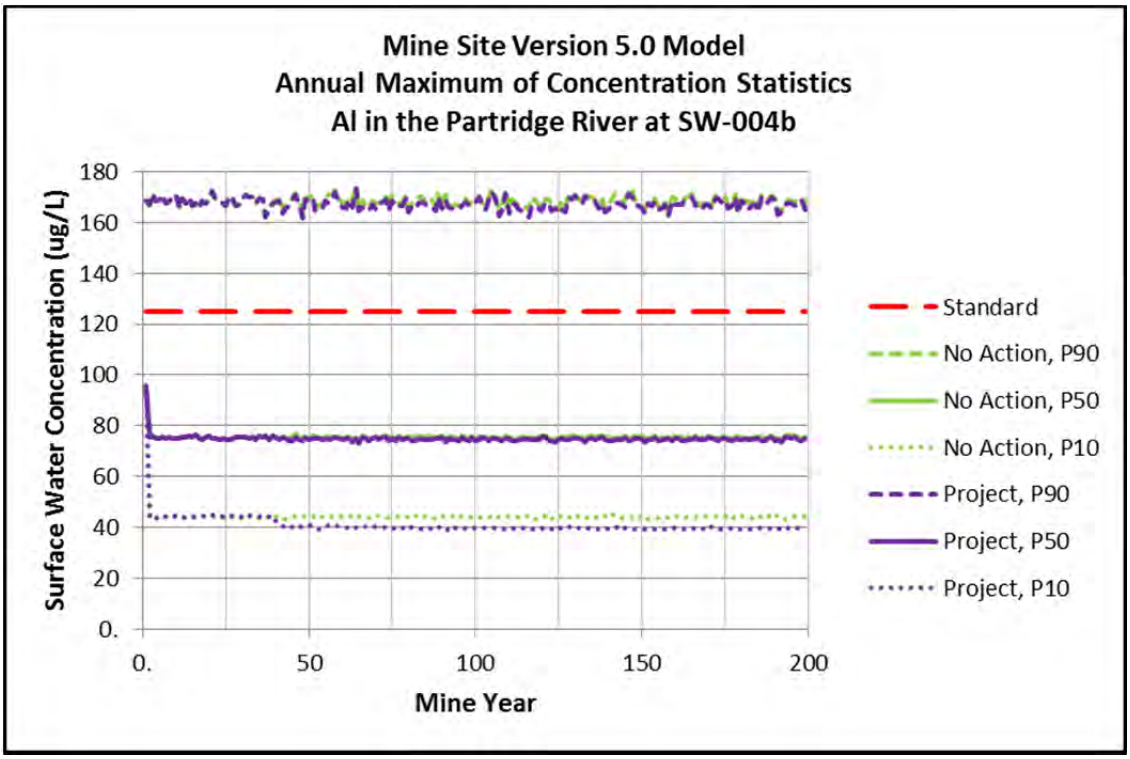


Figure 6 Annual Maximum Aluminum Concentrations at SW-004b

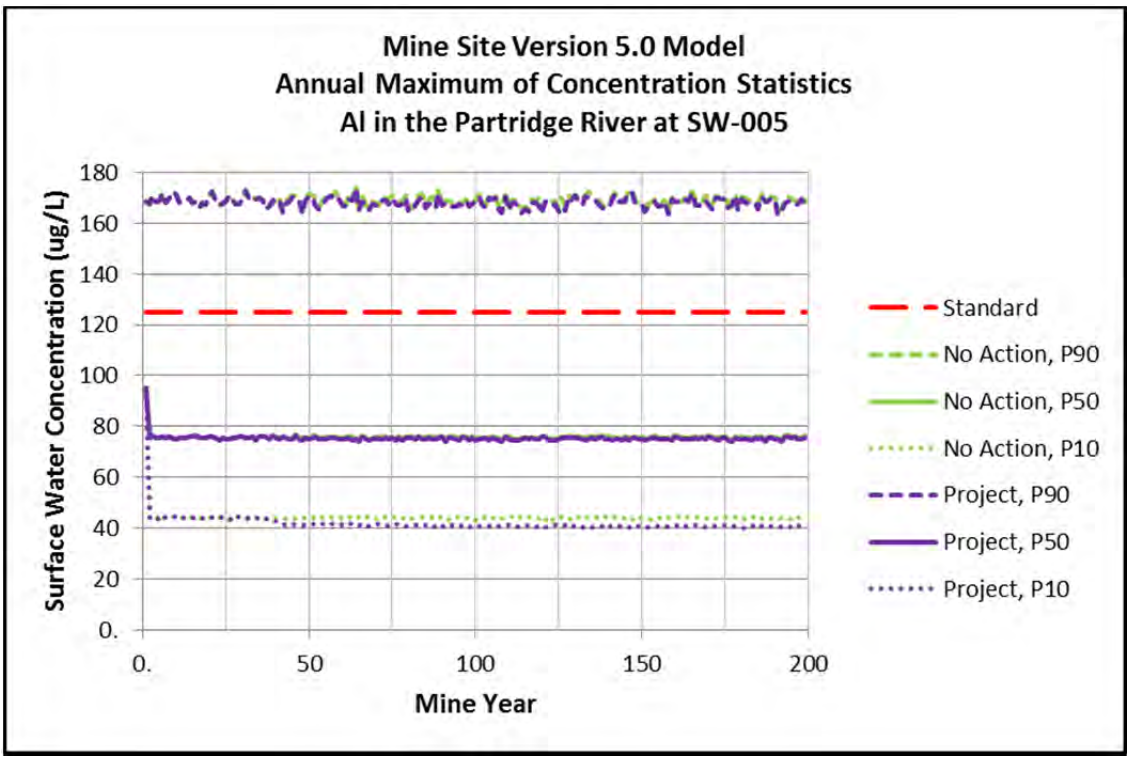


Figure 7 Annual Maximum Aluminum Concentrations at SW-005

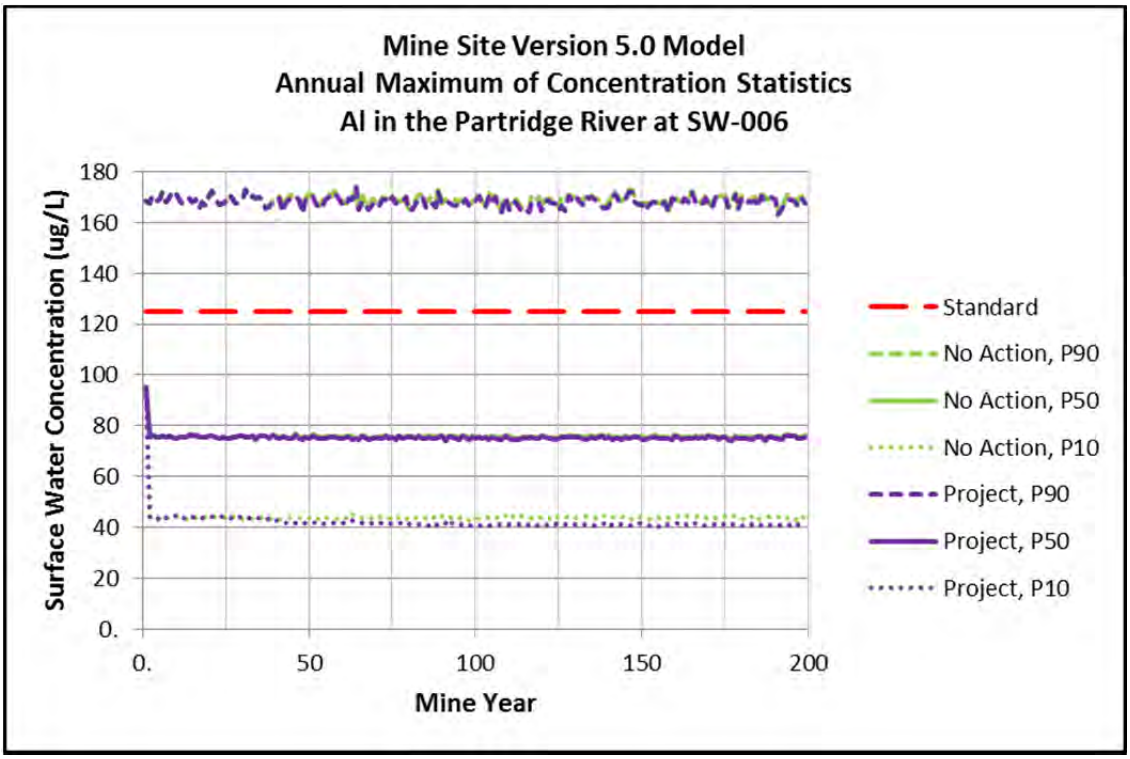


Figure 8 Annual Maximum Aluminum Concentrations at SW-006

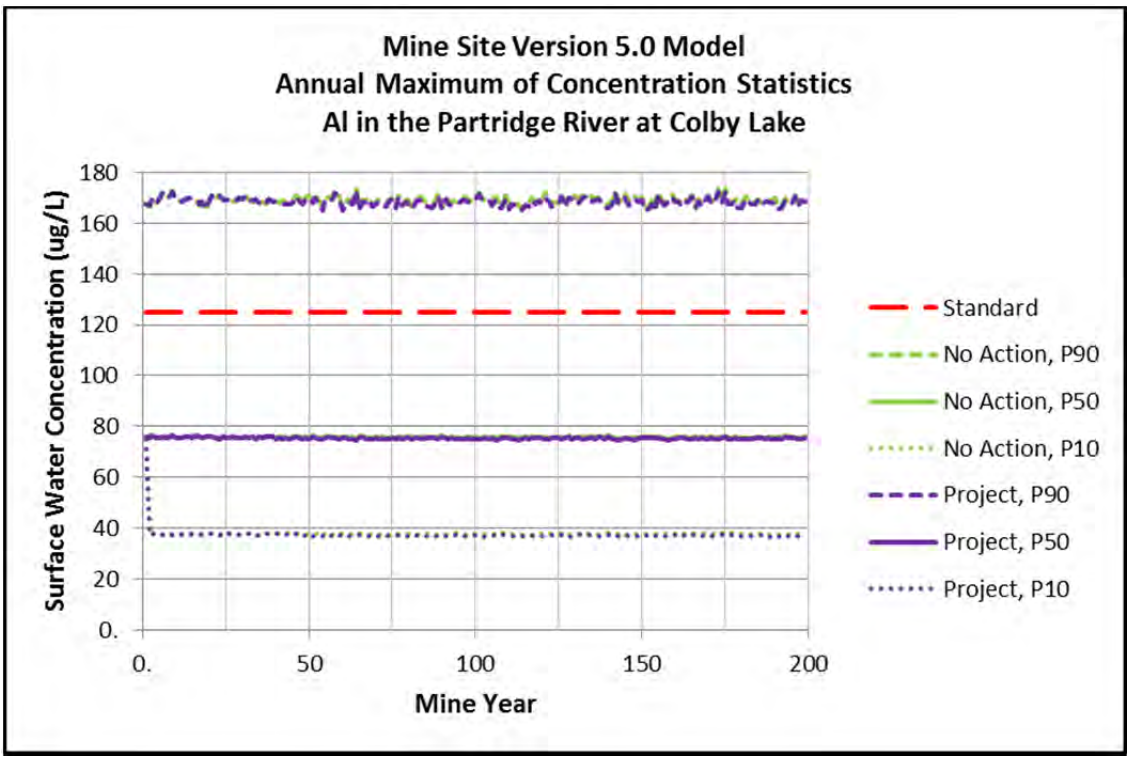


Figure 9 Annual Maximum Aluminum Concentrations at Colby Lake

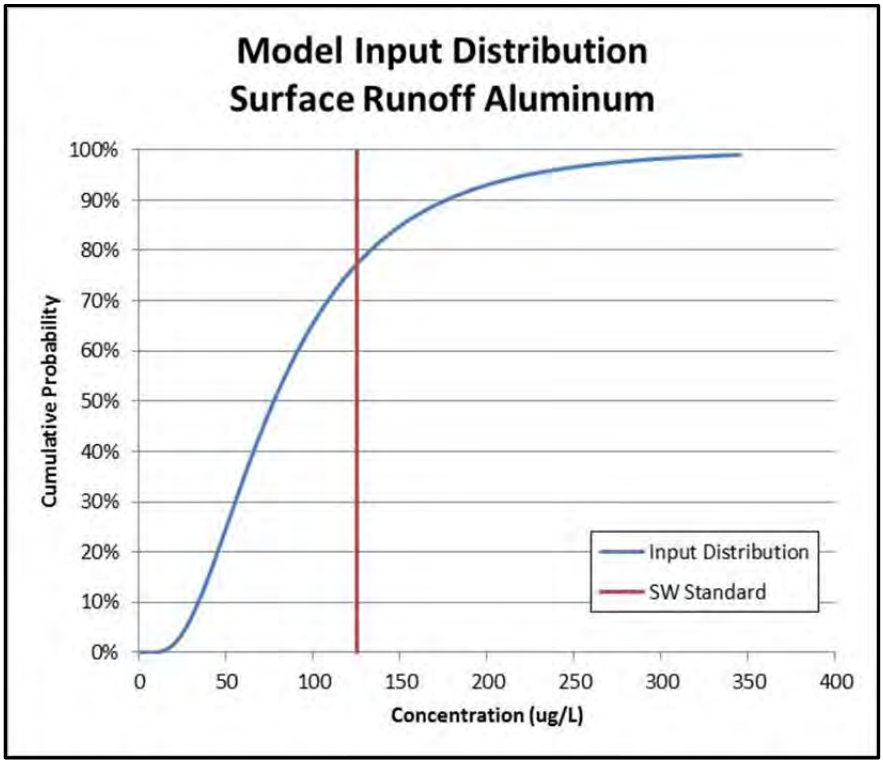


Figure 10 Simulated distribution of aluminum concentrations in surface runoff

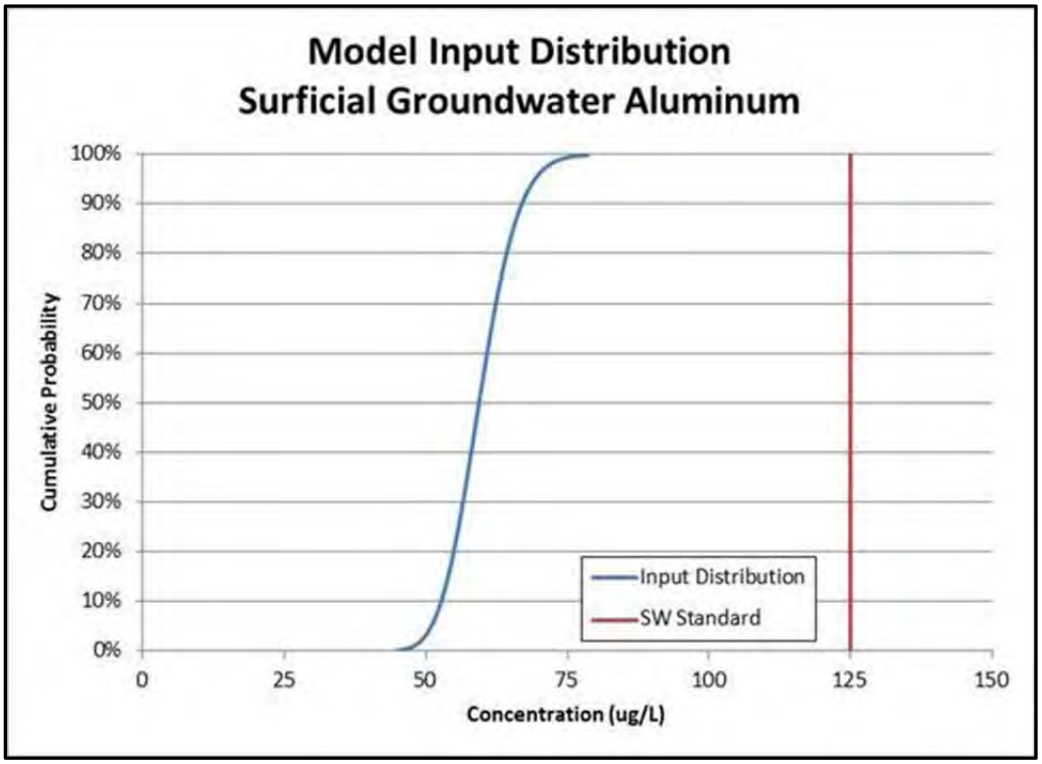


Figure 11 Simulated distribution of aluminum concentrations in groundwater

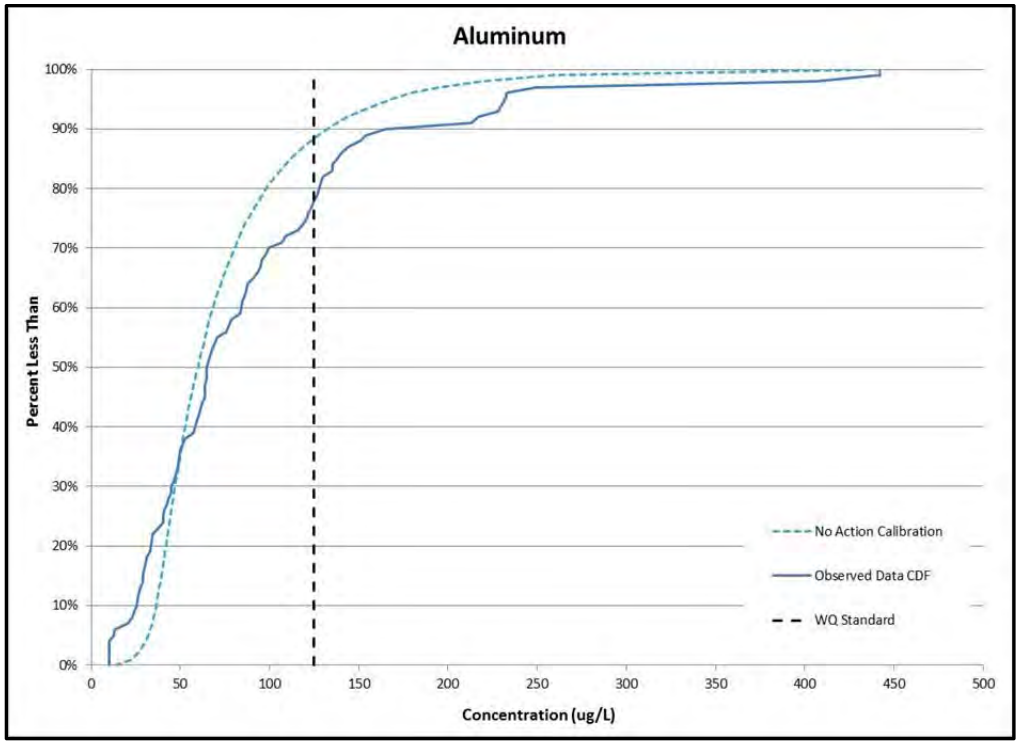


Figure 12 Calibration fit to aluminum concentrations in the Partridge River (from *Calibration of the Existing Natural Watershed at the Mine Site*)

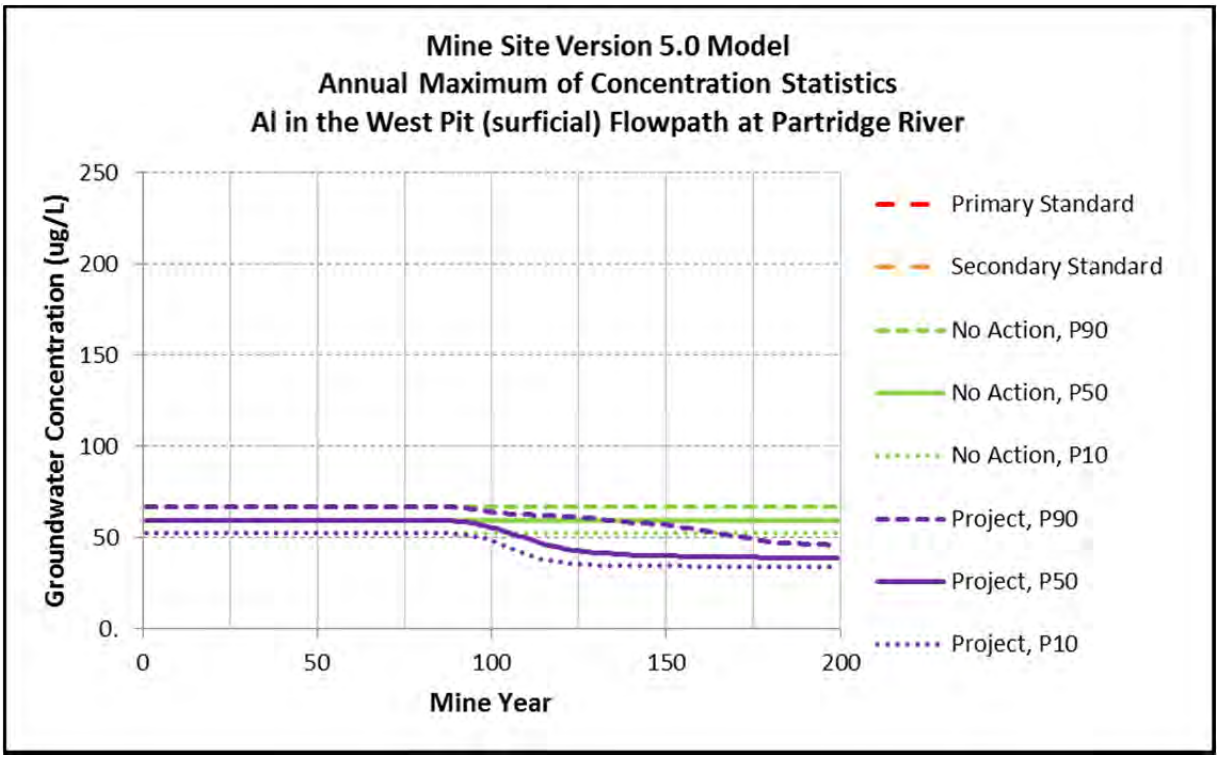


Figure 13 **Annual maximum aluminum concentrations along the groundwater flowpath from the West Pit**

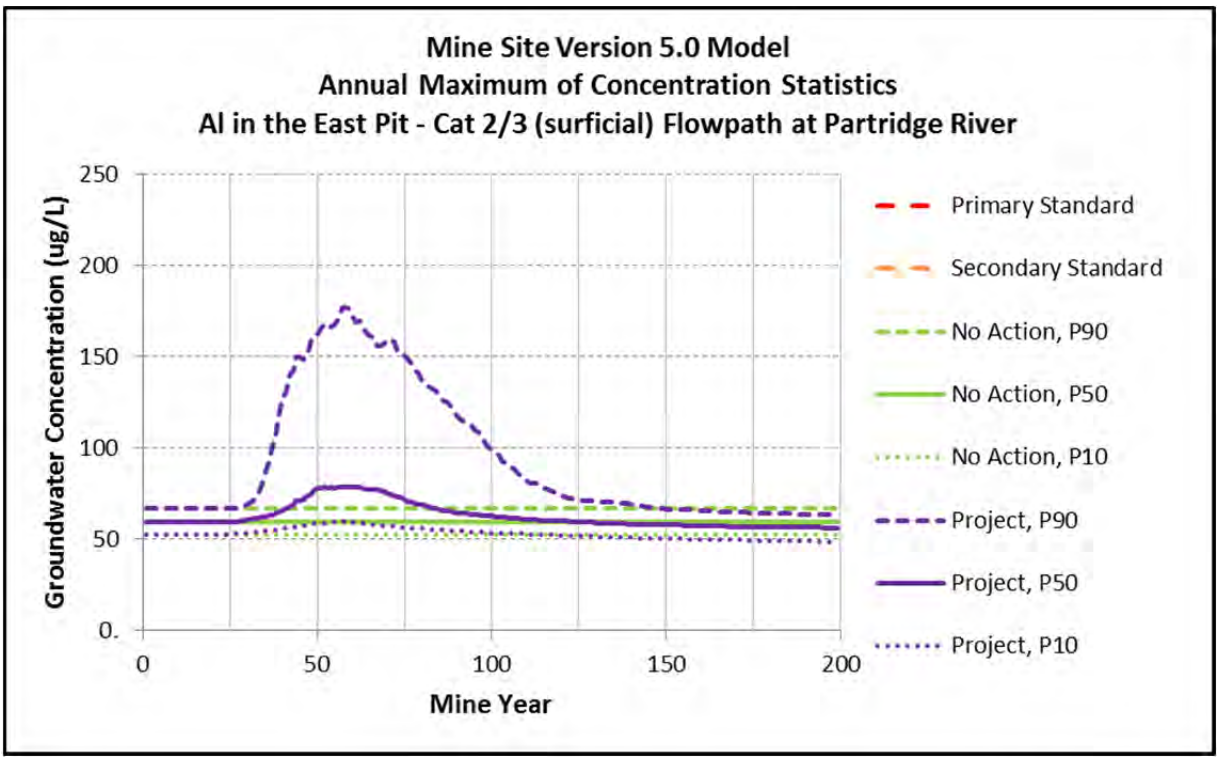


Figure 14 **Annual maximum aluminum concentrations along the groundwater flowpath from the East Pit - Category 2/3 Stockpile**

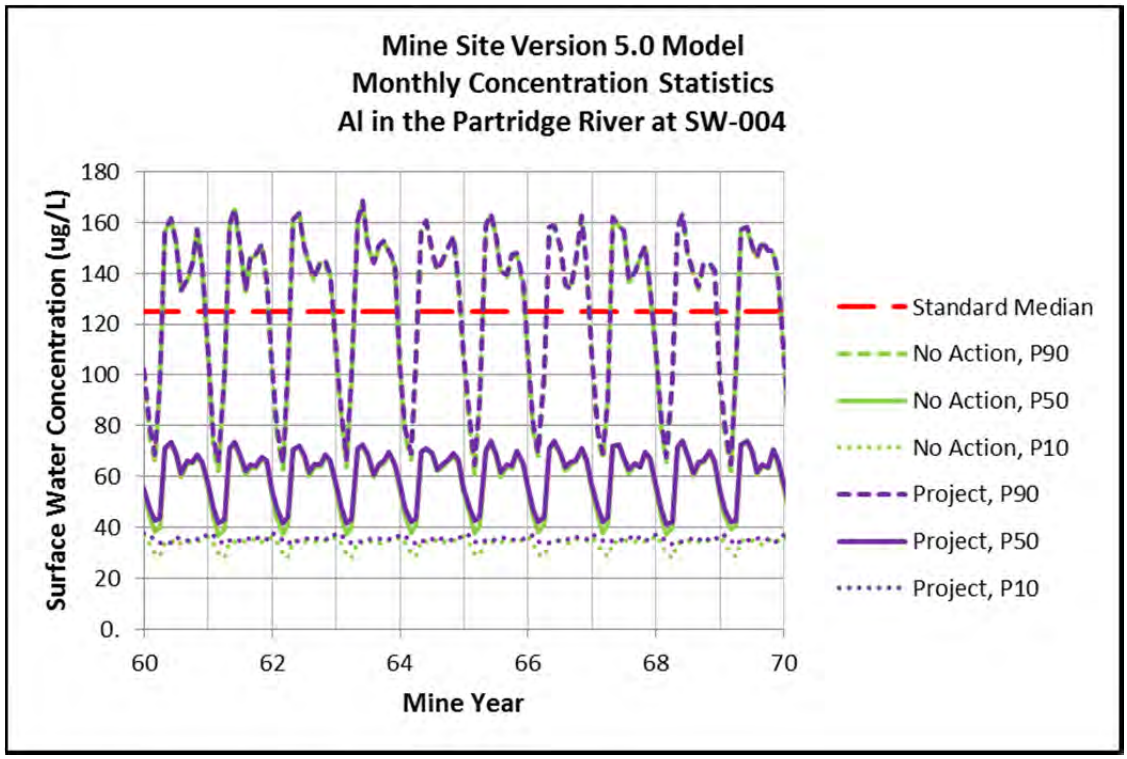


Figure 15 Monthly Aluminum Concentrations at SW-004

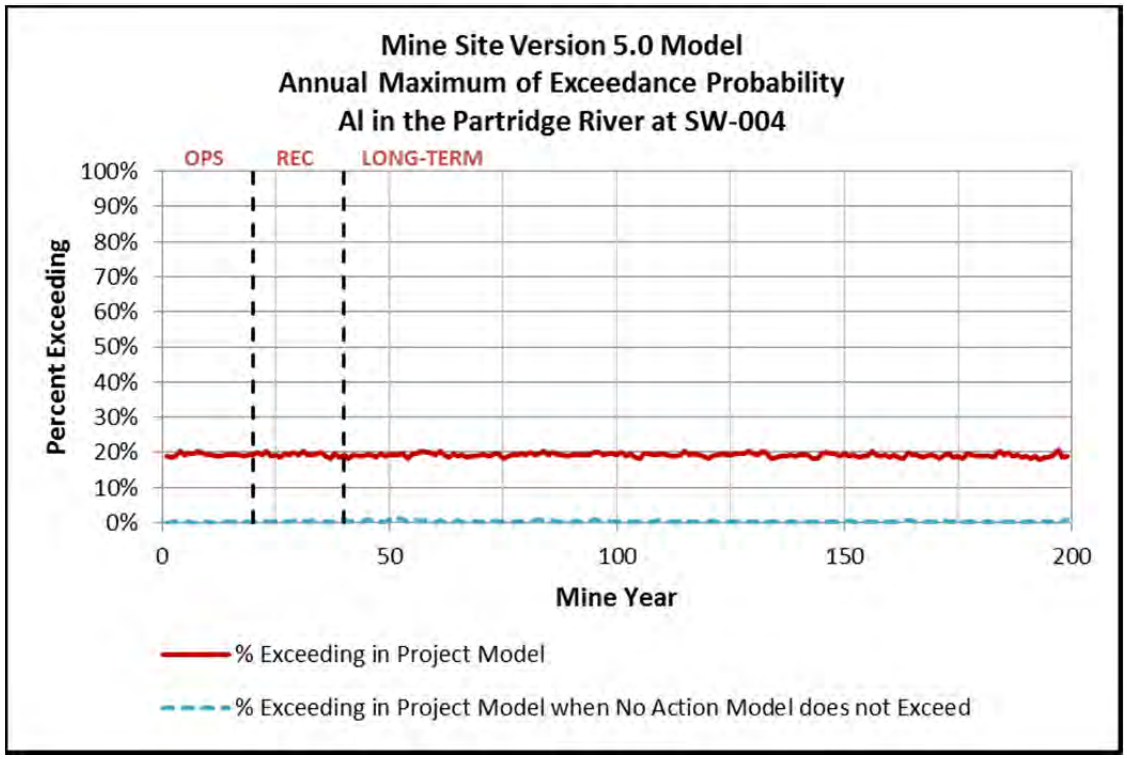


Figure 16 Annual maximum likelihood that aluminum concentration exceeds 125 µg/L at SW-004