DECEMBER 2022

PERFORMANCE MEASURE INFORMATION SHEET

ARROW LAKES RESERVOIR: DUST

SUMMARY

Goal: Minimize dust generation.

Recommended Performance Measure:

Objective / Location	Performance Measure	Description
Dust Control/ Arrow Reservoir	Dust potential hectare-days	Sum of # hectare-days per year that the mapped area is exposed when dust generation potential is highest in the lower elevations (between April 1 and Oct 15). Less is better.

INTRODUCTION

Historically, the generation of air borne dust has been an issue in some locations adjacent to the Arrow Reservoir in periods prior to spring freshet and reservoir filling when high winds can pick up dust from dry, unvegetated areas.

Past research and related works have focused on the Revelstoke Reach (Revelstoke to Shelter Bay). From 1987 to 2008, BC Hydro seeded significant portions of this reach for erosion control and dust abatement. On average, about 2500 acres were treated each year (Boehringer 2010). This was modified annually based on projected water levels, shifts in dust source locations, and the encroachment/establishment of native vegetation on previously seeded areas. In 2008, the treatment program was suspended and photo monitoring of dust activity was implemented at selected locations in the drawdown zone. The decision to suspend the program was driven by a number of assumptions around the state of drawdown zone dust sources at that time. Specifically, it was believed that planting was no longer required at a number of historical treatment areas due to native plant encroachment and establishment into lower elevations. Further, planting for dust control would only be required at a reduced intensity because much of the vegetation in dust control treatment areas was regenerating naturally, leaving smaller areas to be seeded in each subsequent year.

In lieu of treatments, the 2009 and 2010 programs focused on data collection and monitoring activities to increase the understanding of current conditions of remaining dust sources in Revelstoke Reach (Boehringer 2010). An analysis of these data and monitoring programs (Boehringer 2010) recommended that additional field data be collected to assess future treatment needs. At that time, there were limited empirical data on vegetation communities that existed at the lower elevations targeted by the dust control program and factors beyond timing and extent of inundation that may have been influencing the establishment of perennial and/or annual vegetation at these lower limits. Since then, a BC Hydro-commissioned study of bank erosion on the Revelstoke Reach found that bioengineering plantings were difficult to establish due to long duration inundation and rapid fluctuation of water levels due to hydropeaking (Kerr Wood Leidal Associates, 2016).

PAST PERFORMANCE MEASURES

A dust performance measure was not included in the water use planning process because there was an understanding that dust issues would be addressed through BC Hydro's Dust Control Program, which ended in 2008. For the Non-Treaty Storage Agreement Options Assessment in 2010, a performance measure was developed to examine the relative impacts of various scenarios on dust generation potential in Arrow Lakes Reservoir (BC Hydro, 2010). The metric tracked the number of days over the year that the reservoir elevation was below 1410 ft (429.7 m) during the period when dust potential was thought to be highest (March 1 to April 30). This performance measure was also used in the 2013 Columbia River Treaty Review Technical Studies process.

NEW INFORMATION

In 2016, LGL Ltd. completed a dust source assessment for the Revelstoke Reach. This study used recent elevation data to refine dust area mapping from the 1990s. The amount of area designated as 'dust producing' increased by approximately 10% as a result of this study, but the authors acknowledged that results still represent a coarse assessment because of the complex factors that lead to dust production. They recommended a research protocol to better understand how various parts of the Revelstoke Reach contribute dust to the Revelstoke airshed (Hawkes, 2016).

Recently, BC Hydro noted that most of the Revelstoke Reach has been taken over by reed canary grass—an invasive species with low habitat value—so dust potential is lower in this area. Further, the dust-generation window is shorter as snow free to green up is approximately a month but old canary reed grass holds soil in place during that period. Usually, snow is still melting in March and the Revelstoke Reach doesn't dry out until early to mid-April.

The research team discussed this performance measure with a number of local residents including Columbia Basin Regional Advisory Committee and Local Governments Committee members.. The interviewees agreed that dust storms are currently a frequent issue in Burton, with storms coming from Burton Flats, on both sides of the river, and perhaps from as far north as McDonald Creek Provincial Park, though the geography makes this unlikely. They described that the dust requires people to stay in their homes at times. They noted that dust storms do occur infrequently near Revelstoke, Nakusp, Fauquier and Edgewood, however their source, frequency, and impacts are uncertain. The individuals who were interviewed had not been told of problems with dust storms in Beaton.

There is agreement that the performance measure used in the NTSA consultations and the CRT Review Technical Studies does not reflect the complex factors related to dust storms including:

- which unvegetated areas have soil particles that can be picked up and moved by winds;
- when these areas are exposed and are not frozen and the sand is dry enough for the wind to pick up dust particles; and
- when winds are strong enough to transport dust to the communities and are blowing in the direction of the communities.

Revegetation initiatives are one way to reduce dust production. The team was made aware of ATV damage to revegetation initiatives by residents in the Burton area in 2009-2010, which is seen by some to indicate a low concern by some residents for dust storm impacts. BC Hydro has confirmed that there has not been any damage to the new wetland revegetation project in the Burton area.

RECOMMENDED PERFORMANCE MEASURE

Given the frequency and impacts of dust storms in Burton, it is recommended that a performance measure be adopted to measure the number of days that the unvegetated portion of the Burton Flats is exposed, from April to mid-October, reflecting when the area is most likely to be dry enough for dust storms to develop.

To develop the recommended performance measure, the team calculated the amount of exposed "dust-generating area" at various elevations based on mapped dust polygons. These polygons were created from a review of satellite imagery during a low water period and reviewed with local residents who agreed that they accurately represented the problematic area (Figure 2). The revised season was also reviewed with residents.

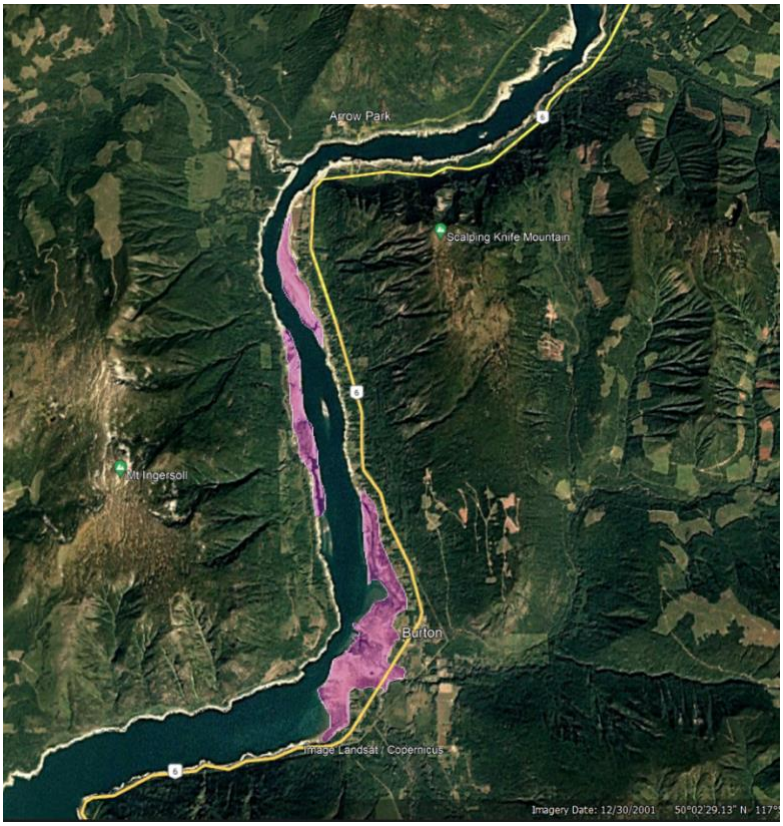

Figure 2: Dust polygons (pink areas) for the Burton Flats

The team recognizes that this approach does not fully account for all of the complex factors related to dust storms that are listed above, however it uses the best available information to account for this important community health and quality of life impact.

The resulting performance measure is summarized in Table 1.

Table 1: Recommended performance measure for Arrow Lakes Reservoir (Burton) dust

Area	Performance Measure	Dates	Critical Elevation Zone
Arrow Reservoir (Mapped areas around Burton)	Dust potential hectare-days (sum of the number of	April 1 – October 15	Area exposed at various elevations as outlined in Table 2 and Figure 1.

	hectares exposed each day over the dust season)		

Table 2: Exposed area at various elevations for mapped dust-generating polygons on Arrow Lakes Reservoir (Burton)

Elevation (m)	Elevation (ft)	Area Exposed (ha)
420	1378.0	676
422	1384.5	659
424	1391.1	640
426	1397.6	618
428	1404.2	592
430	1410.8	562
432	1417.3	529
434	1423.9	494
436	1430.4	459
438	1437.0	349
440	1443.6	250
442	1450.1	195

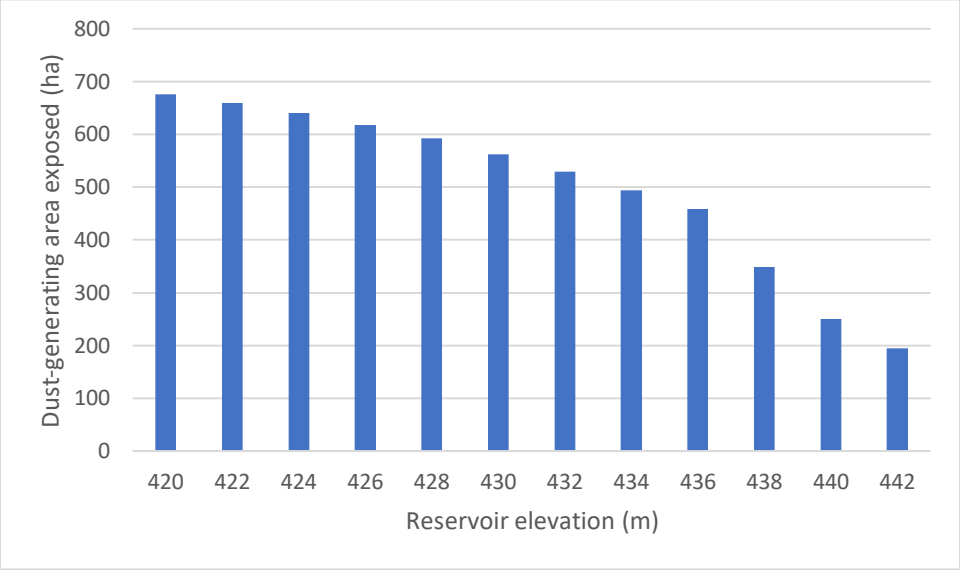

Figure 1: Exposed area at various elevations for mapped dust-generating polygons on Arrow Lakes Reservoir (Burton)

The research team also recommends that residents around Arrow Lakes Reservoir be encouraged to send dated pictures of dust storms, with the location and if possible, the source of the dust, to info@crtlgc.ca to monitor dust storms near populated areas. This information will be considered to refine this performance measure in the future, and potentially to add locations where a more detailed understanding of the source and impacts of dust is currently needed.

Another approach to reducing the uncertainty associated with this PM could be to undertake a study similar to that completed for the Revelstoke Reach in 2016, or using the methodology proposed in this study for dust polygon refinement.

COMPARISON OF PROPOSED PERFORMANCE MEASURE WITH HISTORICAL OPERATIONS

Dust is possible at all reservoir elevations; however, in the area around Burton, the potential dust-generating area exposed is greatest at 436m (1430.4ft) and lower elevations (i.e., down to 420.1m / 1378ft – the base of the reservoir). During the period of 1969-2020 (Figure 3), historical operations exposed potential dust-generating areas at 436m (1430.4ft) and at lower elevations during April through late May in all years, when the reservoir is drawn down to create storage to receive freshet inflows for flood risk management. From June through September in most years the reservoir elevations have been above this level.

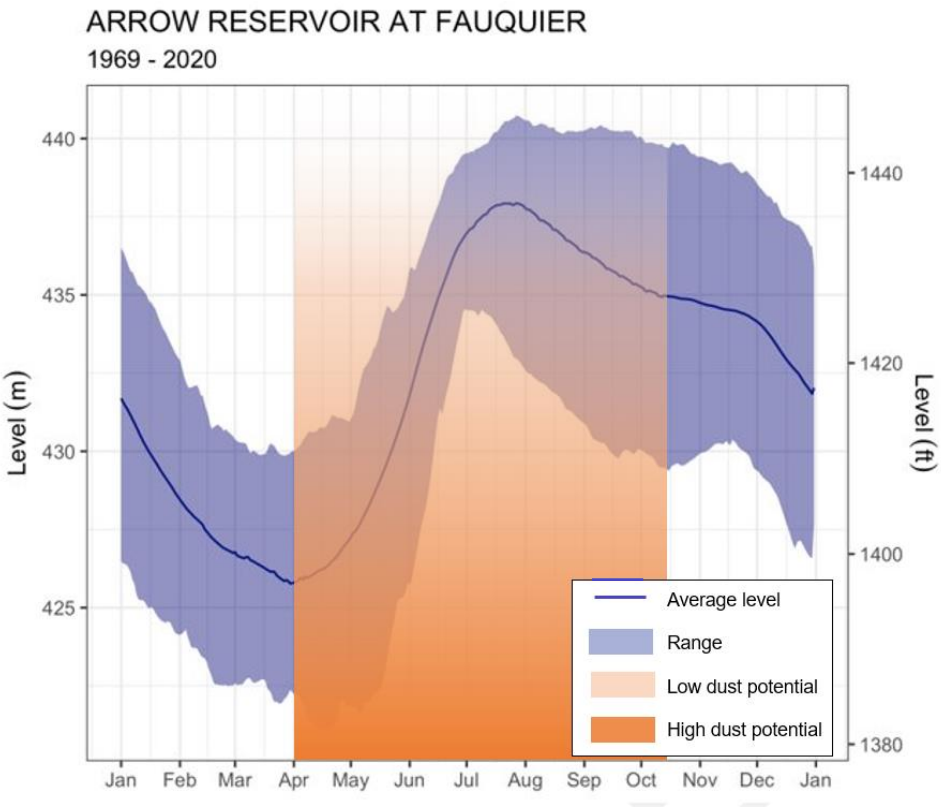

Figure 32: Historic elevations for the Arrow Lakes Reservoir in comparison to dust potential performance measure

CALCULATIONS

1. Assemble the simulated results for Arrow Reservoir elevations.
2. Multiple the number of days between April 1 and October 15 that the reservoir elevation is at or below a given elevation band by the number of dust-generating hectares exposed at the same elevation.
3. Summarize all statistics.

KEY ASSUMPTIONS AND UNCERTAINTIES

- Each scenario is simulated using the same set of system constraints, input assumptions (e.g., load forecasts) and historic basin inflows.

REFERENCES

BC Hydro (2010). Non Treaty Storage Agreement Performance Measure Information Sheet # 18: Arrow Lakes Reservoir Dust. https://www.bchydro.com/content/dam/BCHydro/customer-portal/documents/corporate/community/ntsa/pm-info-sheet-arr-dust.pdf

Boehringer, E. 2010. Upper Arrow Lakes Reservoir (Revelstoke Reach) Dust Control Report 2010. Summary and Assessment of Treatment Data 1987 to 2008. Prepared for BC Hydro, Environment and Social Issues, Castlegar.

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Kerr Wood Leidal Associates Ltd. (2016). Mid-Columbia River Bank Erosion Protection and Monitoring Program. Implementation Year 5 (Final) Report. https://www.bchydro.com/content/dam/BCHydro/customer-portal/documents/corporate/environment-sustainability/water-use-planning/southern-interior/clbworks-35-yr5-2016-04-01.pdf