Peace Project Water Use Plan

WILLISTON TARGETED DEBRIS MANAGEMENT

Implementation Year 12

Reference: GMSWORKS-22

Study Period: 2020

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CHU CHO ENVIRONMENTAL

CHU CHO INDUSTRIES

GMSWORKS#22 – Final Report

2020

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GMSWORKS#22 – Final Report: 2020

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Chu Cho Environmental has prepared this report using sound technical and professional judgment based on our extensive expertise and experience in developing and conducting works of this nature. We have identified and developed this report in order to provide clear and concise information regarding the debris management works completed during the 2020 season.

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1 Introduction

This report documents the annual operations of the GMSWORKS#22 debris management program. This report provides detail on the scope of work completed during the spring, summer and fall months including the methodologies, timing and cost of the work. Specifically, this report identifies the equipment used, work locations, the total volume of debris managed and the cost per cubic meter to complete the management. This report will also provide descriptions of the archaeological and environmental work that was completed during each stage of operations. GMSWORKS#22 is managed and implemented by Chu Cho Industries LP with environmental services being provided by Chu Cho Environmental LLP.

1.1 Overview of Activities

In general, debris management activities included:

- Accessing numerous beaches via truck, crew boat and barge,
- Removing debris from the shores of these beaches using a rock truck, excavator and bulldozer,
- Piling the debris at the high-water mark for removal or burning,
- Communication with local stakeholders (Finlay river outfitters) regarding the extent to which they require/desire debris management in their high use areas,
- Managing amphibians that would be potentially disturbed by moving the debris,
- Managing other environmental issues,
- Managing archaeological and other heritage concerns, and;
- Conducting spill prevention and response measures.

1.2 Summary of Measurements

The following Table 1 provides a summary of parameters that describe the program in 2020:

Table 1: Key Parameters Describing 2020 Program

Number of Beaches	Total Volume Piled	Total Number of Piles	Avg. Cost per Pile	*Avg. Cost per Cubic Meter
6	143,790.38 m^3	310	$2,634.96	$5.68

*Avg. Cost per Cubic Meter is calculated as Total Cost per each beach divided by # of piles in that same beach. Then taking the $/ pile cost and dividing that by the total cubic meters of the beach.

1.3 Before and After Debris Management Pictures

The following series of images show several beaches before and after debris management.

Figure 1: Bevel Beach before debris management, July 27, 2020.

Figure 2: Bevel Beach after debris management, July 27, 2020.

Figure 3: Davis South Beach before debris management, August 23, 2020.

Figure 4: Davis South Beach after debris management, August 23, 2020.

Figure 5: Debris piles on Ospika Beach, August 18, 2020.

Figure 6: Davis North Beach after debris management, August 24,2020.

Figure 7: Debris piling at Tsay Keh Beach, September 17, 2020.

Figure 8: Debris piling at Tsay Keh Beach, September 19, 2020

Figure 9: Debris piling at Van Somers Beach, September 22, 2020.

Figure 10: Debris piling at Van Somers Beach, September 23, 2020.

2 Work Locations and Volume of Debris Managed

In 2020, all work was completed in the Finlay Arm of the Williston Reservoir. Debris removal occurred along 6 beaches in this zone, with work focused on piling the debris above the high-water mark. In some locations piling above the high-water mark was not feasible due to standing timber. Piles within the high-water mark are scheduled to be burned winter of 2021. Chu Cho Industries LP (CCI) developed an Operational Work Plan (OWP) that was revised throughout the season in response to changing water levels and beach accessibility. The OWP describes the order in which beaches are to be managed and the equipment that will be used. The OWP also outlines the environmental and archaeological issues that must be managed at each location.

There were sustained high water levels for the 2020 season. This resulted in difficulty accessing beaches, increased erosion control measures and a delay to the start of work.

2.1 Work Locations

The following table details the 6 locations where CCI conducted debris management activities in 2020. The beach names provided in Table 2 are the most commonly used colloquial names.

Table 2: GMSWORKS#22 Work Locations 2020

Location	Equipment Used	Days on Site	Notes
Bevel Beach	2 Excavators, 1 Rock Truck (Volvo A20), 1 Cat DH6 Dozer, Crew Boat, ATV, Boom Logs, and Barge/Tugboat.	4	
Ospika Beach	2 Excavators, 1 Rock Truck (Volvo A20), 1 Cat DH6 Dozer, Crew Boat, ATV, Boom Logs, and Barge/Tugboat.	23	Beach Sections B1-B4
Bruin/Collins Beach	2 Excavators, 1 Rock Truck (Volvo A20), 1 Cat DH6 Dozer, Crew Boat, ATV, Boom Logs, and Barge/Tugboat.	9	
Davis North Beach	2 Excavators, 1 Rock Truck (Volvo A20), 1 Cat DH6 Dozer, Crew Boat, ATV, Boom Logs, and Barge/Tugboat.	3	
Tsay Keh Beach	2 Excavators, 1 Rock Truck (Volvo A20), 1 Cat DH6 Dozer, Crew Boat, ATV, Boom Logs, and Barge/Tugboat.	6	
Van Somers Beach	2 Excavators, 1 Rock Truck (Volvo A20), 1 Cat DH6 Dozer, Crew Boat, ATV, Boom Logs, and Barge/Tugboat.	9	

The following series of images shows an overview of work locations for typical beaches within the Finlay Arm of the reservoir. Figure 11 shows an excavator and rock truck piling debris on Corless Beach. Figure 12 shows two excavators and a dozer piling debris on Stromquist Beach.

Figure 11: Debris piling by excavator and rock truck on Corless Beach.

Figure 12: Stromquist Beach during debris management.

2.2 Volume of Debris Managed

The debris tends to accumulate along the shoreline of the reservoir. Debris is piled using excavators fitted with a rotating grabber or a bucket and a thumb. The rotating grabber can circle through 360 degrees and can open and shut to grab and move debris, the bucket and thumb are similar but cannot rotate through 360 degrees. Once the excavators create a sufficiently large pile, a D6 Cat fitted with a rake blade pushes the stray debris towards the center of the pile to pack it tight in order that it burns with greater intensity. This process is simple, proven efficient and was replicated along the shoreline.

After the management of each beach was complete, two technicians visited the beach in order to count and measure the debris piles. The technicians independently counted and measured the piles in order to minimize bias and ensure that the numbers are accurate.

Debris piles are inherently misshapen, porous, and dissimilar. Our team consulted a number of industry professionals as well as primary research sources in search for the best methodology for measuring debris piles and calculating an accurate assessment of the volume of debris contained within. Typically, the technician measuring the debris would envision the pile as a geometric shape to calculate the volume and then use a porosity factor to estimate the actual volume. The shape of the debris varies greatly, depending on the size and homogeneity of the debris. Porosity is a disputed factor amongst professionals who regularly measure debris pile volumes. Porosity factors that practitioners commonly used in debris pile volume estimation ranged from 20% to 39%.

For this project, we have reasoned that estimating the debris piles as rectangular prisms is sufficiently accurate. In order to estimate porosity, we have chosen 25%, which is a rough average of the most commonly used numbers. This is consistent with the recommendations provided by the independent contractor that BC Hydro hired for the project in 2016 (P.Comm J. Kostyshyn, 2017). A technician would measure the Length, width and height dimensions of 5 piles on a given beach. The total volume would be calculated ($V = L \bullet W \bullet H$). Then the average of the five volumes would be calculated ($V_1 + V_2 + V_3 + V_4 + V_5 / 5) = V_{AVG}$. Then V_{AVG} would be multiplied by 75% or (100% - 25%). $V_{AVG} * 0.75 = V_{FINAL}$.

In 2020, CCI created 310 piles of debris on the beaches of the Finlay Arm of the Williston Reservoir. Piles ranged in size from 240 m^3 to 1220 m^3, the average being approximately 470 m^3. Larger piles were created on flatter wider beaches where conditions allowed the equipment operators to efficiently pile the debris. Smaller piles were created in areas where there was little beach to work with and where the high-water mark was a concern. In general, larger piles are burned more efficiently.

Table 3 provides the number of piles and volume of debris collected on each beach in 2020:

Table 3: Volume of Debris Managed in 2020

Location	Number of Piles	Volume of Debris (m^3)
Bevel Beach	39	10,215
Ospika Beach	80	67,761
Bruin/Collins Beach	52	12,480
Davis North Beach	13	15,912
Tsay Keh Beach	40	11,880
Van Somers Beach	86	25,542
TOTALS	**310**	**143,790**

2.3 Estimated Costs

Table 4 provides an estimate of the average cost per beach to manage the debris. The costs are highly variable across beaches and depend on the size of the beach, the density of the debris, the access and the precariousness of the operations (i.e., how close to water, how steep the beach gradient, etc.). The costs presented in the following table were derived using the value on each invoice and the debris pile counts conducted by CCI. The average cost per pile was $2,634.96 and the average cost per cubic meter was $5.68.

These values are similar to 2019 where the average cost per pile was $2,674 over 4 beaches. The similarities in cost could be attributed to the high-water levels reducing beach areas to narrow beaches compared to low-water years of expansive beach. The narrow beaches concentrate the debris, requiring less movement of the machinery to pile debris. From 2019 and 2020, there was a significant difference in the average cost per cubic meter from $9.01 to $5.68 which could be attributed due to beach configurations, when high water level was reached, use of rock truck, etc.

Table 4: Debris management cost estimate per beach in 2020.

Location	Total Cost/Beach	Cost/Debris Pile	Cost/Cubic Meter
Bevel Beach	$66,204.43	$1,697.55	$6.48
Ospika Beach	$409,347.27	$5,116.84	$6.04
Bruin/Collins Beach	$134,661.05	$2,589.64	$10.79
Davis North Beach	$55,033.87	$4,233.37	$3.46
Tsay Keh Beach	$66,351.49	$1,658.79	$5.59
Van Somers Beach	$85,238.01	$991.14	$3.34
Total/Average	**$816,836.12**	**$2,634.96**	**$5.68**

3 Environmental Management

3.1 Environmental Issues

Chu Cho Environmental provided environmental monitoring services for GMSWORKS#22. The Environmental Management Plan specifies procedures for ensuring that potential environmental issues that might arise due to debris program operations are minimized. This includes standard items such as spill prevention and management and a detailed procedure for amphibian management.

The amphibian management plan is based on avoidance through surveying and flagging no work zones. The avoidance-based plan is meant to reduce the potential harm to amphibians and to avoid all handling. Prior to conducting debris removal, each beach is surveyed for amphibians and reptiles. On a typical beach there may be 5 – 10 zones where amphibians are either found or where there is good amphibian habitat.

Few frogs and tadpoles were found during the environmental monitor walk through prior to machines. When they are found, a 30 m no work zone is flagged in order to protect the amphibians and or reptiles. In addition to amphibians, other reptiles and wildlife are observed regularly. These include garter snakes, grizzly bears, black bears, moose, elk, wolves and other small carnivores. Figure 13 shows an example of a zone flagged for no-work where an amphibian was discovered.

Figure 13: Pink flagging indicates discovery of an amphibian and marks a no-work zone.

3.2 Spill Prevention and Management

Spill prevention and management is an ongoing process that CCI takes seriously and goes to great lengths to ensure that there are zero spills to ground. Good spill prevention management is rooted in good equipment management through maintenance and regular checks. All equipment is inspected before, during and after each shift to ensure that hydraulic lines and other potential leak points are all secure. The vehicle inspections are completed using a standard form, which is stored in the field office for the program. Regular maintenance occurs before during and after each crew shift. The following sequence of images shows some examples of good spill prevention management. During the 2020 season, there were no major fluid spills and 3 small non-reportable spills to ground that were cleaned up by CCI. There were no spills to watercourses or the reservoir. Figure 14 and Figure 15 show the fuel bowser located along the shore away from the reservoir and outfitted with a large spill kit for use while refueling as well as repairs. Figure 16 shows the spill kits being used during field-based repairs of the equipment.

Figure 14: Fuel bowser with large spill kit.

Figure 15: Refueling away from water with a spill kit next to refueling.

Figure 16: Managing and replacing leaking hoses with the spill kit.

4 Archaeological Management and Chance Finds

4.1 Archaeological Procedures

The archaeological monitor uses a GPS loaded with archaeological site data that were supplied by Millennia Archaeology. The GPS helps the monitor identify areas that are marked as no work zones as well as areas where artifact collection has occurred or where artifacts have been identified but not collected. Figure 17 shows an example of the daily notes of the archaeology monitor detailing the beach and if there were any artifacts.

Prior to commencing work on any beach, the archaeological monitor has a quick debrief with the management crews to help identify no work zones or areas of potential concern. The archaeological monitoring works ahead of the debris crews to conduct searching and investigation activities to clear the area for work. The debris management work is conducted under the archaeological site alteration permit SAP 2016-0363 that was approved on October 31, 2016 and is valid to December 31, 2021.

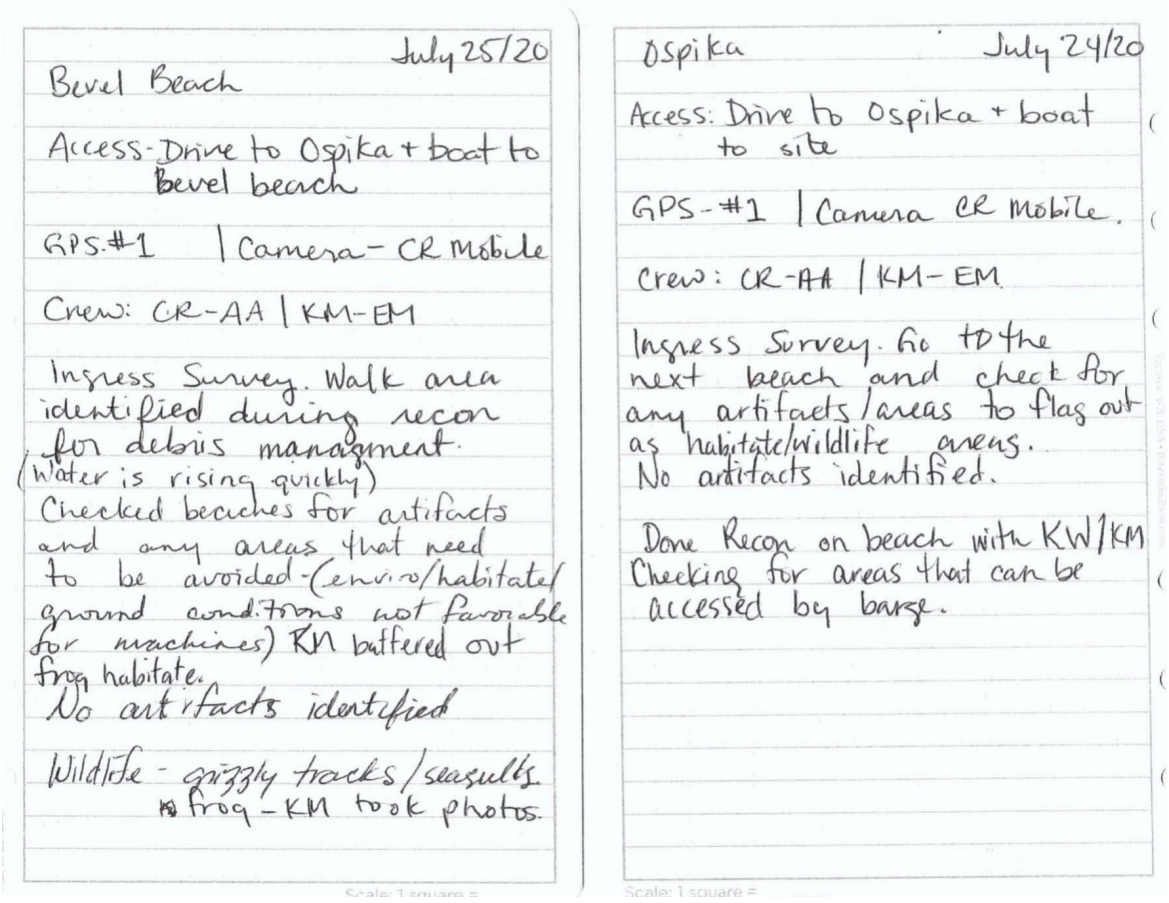

Figure 17: Example of daily notes from the archaeological monitor.

5 Debris Pile Burning

Debris pile burning was not completed during the winter of 2019/2020, due to a shortage of people as a result of an internal restructuring at CCI. Debris piles are piled high on the beach above flooding levels and not burned.

In the event of pile burning, each beach is assessed according to substrate type, road beach access, and nearby water sources, such as creeks and reservoir. At each beach, creeks close to piles were identified as a water source for fire suppression in the event the reservoir is low and further away from the piles above high water. Roads to beaches and along the beaches are located between piles and the adjacent forest to create a fire guard behind the piles.

Prior to burning, burn registration is applied for through the Provincial Wildfire Reporting Center/ Burn Registration BC Wildfire Service of the Forest Lands and Natural Resource Operations and Rural Development provincial branch.

6 Conclusions

The GMSWORKS#22 Debris Management Program piled 143,790.38 m^3 of debris in 310 piles at an average cost of $5.68 per cubic meter. Generally, the 2020 season was successful and CCI is well prepared to initiate the 2021 program in June 2021.

During the reconnaissance flight in July 2020, it was identified that there are still numerous areas where debris accumulations exist in both the Parsnip and Finlay arms of the reservoir (Figure 18). Table 5 is the edited and updated table from the Operational Work Plan 2020 as reconnaissance flight identified beaches with accumulated debris. The beaches not completed in 2020 will be reassessed in Spring 2021 for debris accumulation and management potential.

The biggest factor to increased debris cleanup is reservoir levels. When debris starts in early June, the water level is starting to rise, which starts to re-float debris (that hasn't been piled) as well it reduces the amount of beach available to be managed.

Table 5: Edited and updated Operational Work Plan table from Spring 2020 indicating beaches completed in 2020 as bold and italicised.

Beach Name	Location	Opportunity and Management Required	Days of Effort	Access	Priority Level
TKD Foreshore and Finlay Plug	***13.5km Finlay FSR***	***High water is re-rafting debris, and it is accumulating in the TKD foreshore area as well as the mouth of the Finlay. When the conditions permit CCI will target this area as it can lead to highly efficient debris removal.***	***5 - 25***	***Road***	***Very High***
Van Somer to Chowika – "North of Chowika"	***87.5km Davis FSR***	***Large accumulations along the steep bank area. Good opportunity to move these concentrations while water levels are elevated. The rock truck was utilized to move this debris into flatter central locations to pile.***	***10 - 20***	***Road***	***High***
Ospika	***0km Davis FSR***	***There are several very large embayments that present efficient opportunities for debris management.***	***20***	***Road***	***High***
Davis south	***42km on the Davis FSR***	***There is debris but management is difficult due to beach conditions. Difficult due to narrow beach and difficult access as need to travel through Finlay River Outfitters property. Presents a good opportunity to restack and further clean the beach.***	***5***	***Road***	***Moderate***

Bruin and Collins	***32 km on the Davis FSR***	***Minimal management required. Old piles could be re-stacked for future burning to further clean the area. Some large concentrations on northern reach of the beach. These old piles were restacked in 2020. Bruin beach is slated to be burnt in winter of 2021. Collins Beach will not be burnt due to organic material. The piles at Collins Beach are located outside the high water mark so will not re-float. At present, there are no plans to move piles to another beach to be burned.***	***-***	***Road***	***Low***
Upper Ruby Red	92km Davis FSR	Mouth of Finlay Adjacent to TKD village. Previously unmanaged, high concentrations and good access.	10	Road	High
Raspberry Harbour to South of Coreless	10km Chunamon FSR	Numerous embayments and high elevation beach areas with sizeable debris concentrations.	20 - 25	Road and Barge	High
West Side South of Billy's Bay	90km on the Chunamon FSR	New previously un-managed area. Very steep ground but the low reservoir level makes operating in this area feasible. Also new cut blocks along the shores of the reservoir create options for access. With rafting debris there is good opportunity for the bag and tag method.	5	Barge and Road	Medium/High
Factor Ross South to Stromquist Point	80km south to 65km on the Chunamon FSR.	New cutblocks provide access to previously unmanaged debris sections along this shore. The barge can be used to move the equipment and debris can be moved off the shore away from the steep banks. The bag and tag method would be used here as well.	10 – 15	Barge and road	Medium/High
Frank Creek	85km Chunamon	This area is good for management during high water conditions as the debris can be easily moved into the water and log-boomed to higher ground.	15	Road and Barge	Moderate
North Coreless to Pete Toy Area	54km on the Chunamon FSR south to 45km	Many standing piles in this area that were not burned during the previous season. There is new debris here as well primarily in creek embayments and along previously unmanaged sections of the shore.	10	Barge	Moderate
Areas in Parsnip Arm	Parsnip Arm	There are many areas in the Parsnip Arm which have not been managed for 8+ years. In the past Manson, Strandberg and areas south of Finlay Forks have been identified as having cost effective debris concentrations. This includes areas such as Strandberg, Manson, Dastiaga Creek and south of the Blackwater. When the	40+	Road and Barge	Moderate – high water makes management here difficult.

		water is low in 2021 there could be excellent opportunity here to gather debris in these areas.			
North of Middle Creek	65km on the Davis FSR north to 70km.	New cut blocks will provide access to this previously difficult to access area. The wood can be stacked and removed from the beach so that it is not re-rafted during full pools. There are significant accumulations in this area.	10+	Road and Barge	Low – inaccessible due to high water in 2020.
Chowika North	75km on the Davis FSR	Old piles can be cleaned up for future burning.	2	Barge and road	Low

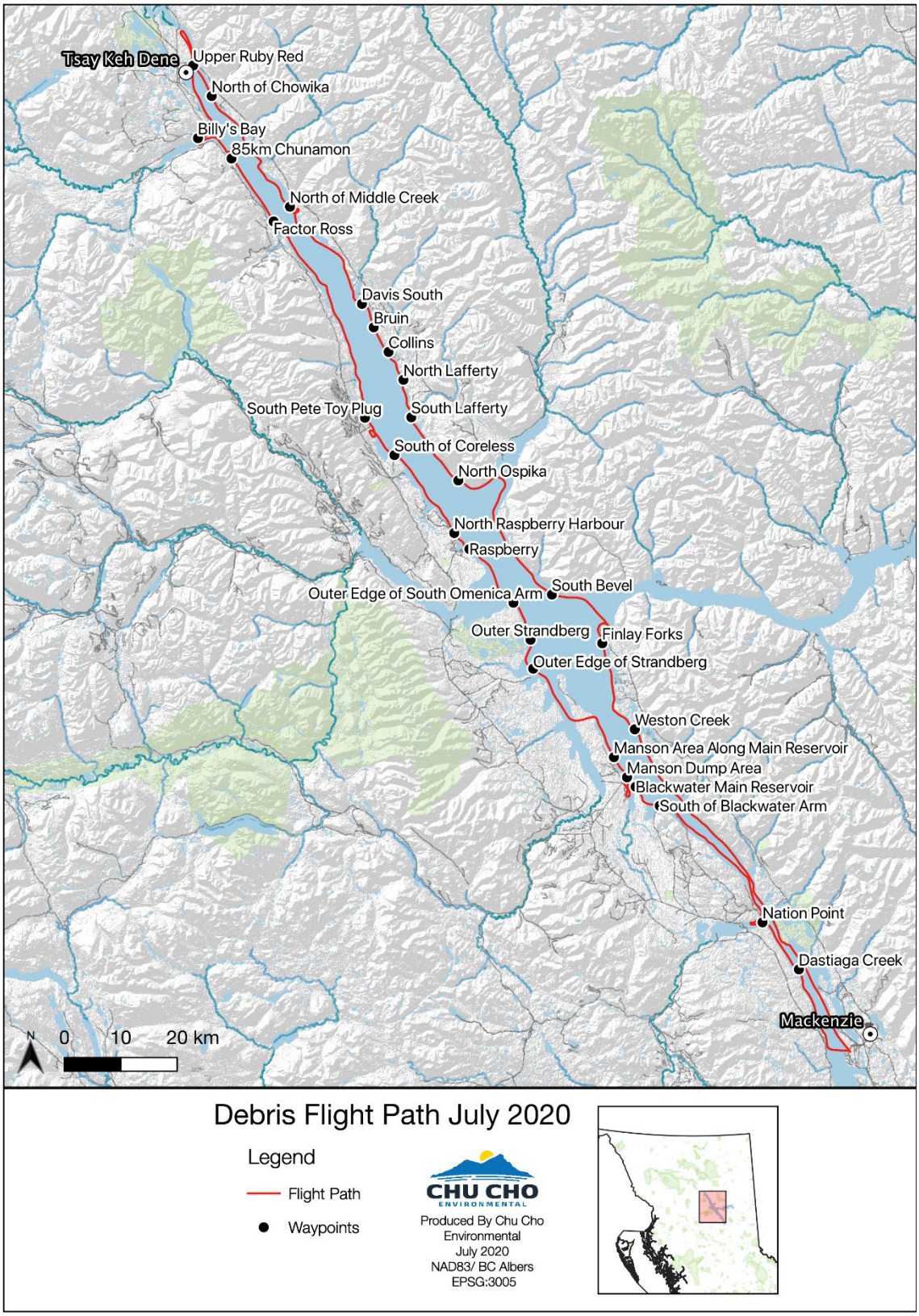

Figure 18: Flight path and identified potential debris operating zones along the Finlay Arm of the Williston Reservoir, July 2020.