

# **MICROPLASTICS IN YUKON FRESHWATER**

# 2021-2022 SAMPLING REPORT



# **FINAL**

April 2022

Prepared for:

Yukon Government -

**Water Resources Branch** 



# **CORE GEOSCIENCE SERVICES INC.**

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## **EXECUTIVE SUMMARY**

This study represents Phase 2 of a microplastics (MP) pilot sampling program initiated in March 2021 by Yukon Government Water Resources Branch and Core Geoscience Services. It incorporates recommendations from Phase 1 and has for objectives to test and evaluate the proposed sampling methodology (1L grab samples with several replicates), and to investigate MP concentrations along the Yukon River (upstream and downstream of communities).

Two rounds of sampling were completed (September 2021 and January 2022) and five 1L grab samples were collected at each of the five sampling sites along the Yukon River: Tagish, Marsh Lake, just upstream of the Takhini River confluence, Carmacks and Dawson, in addition to QA/QC samples. Samples were sent to ALS Cincinnati for analysis by fluorescent tagging and microscopy static image analysis. Results for total particle count and particle size distribution were compared using ANOVA or non-parametric statistical tests.

As was found during the March 2021 Phase 1 pilot study (CoreGeo, 2021), MP particles were present in all blanks. Different types of blanks were collected during this Phase 2 investigation to try to identify potential sources of blank contamination. Given that no significant difference was found between the total MP particle count means of the various blanks, except for Blank6 (held for 30 days prior to analysis), it can be hypothesized that the main source of contamination is from the deionized water itself (where the deionization process may not be entirely successful at removing MP particles) or blank preparation process in the lab (rather than from the sampling bottles, sample handling, or air deposition during sampling). Interpreting field results when blanks are non-zero can be challenging. There is no standard practice for interpreting such data. No correction accounting for non-zero blanks have therefore been applied to the field results as part of the current study.

Results from September 2021 and January 2022 both show a significantly higher total particle count at Tagish, suggesting a local source. Elevated results at Takhini in January 2022 also indicate a possible temporally isolated source. Other locations do not show a significant difference with the blanks or between sites.

September 2021 results at Dawson show a greater proportion of small particle size, which could indicate a source far upstream (e.g. Whitehorse), allowing for deposition and degradation of larger particles by the time they reach Dawson. The total MP count did not, however, point to an obvious source upstream, although there would have been significant dilution as the Yukon River flow increases moving downstream. January 2022 results at Tagish show a larger percentage of larger particles, consistent with the hypothesis of a local source.

Total particle count was higher in January at Marsh Lake, Tagish and Takhini compared to September, and January samples had a higher percentage of larger particles in January at Dawson and Tagish. The fact that January samples were collected under ice could have resulted in lower particle count if atmospheric deposition was an important source, however this was not the case. Smaller particles



are expected to be more readily transported via atmospheric circulation and the fact that some sites saw less smaller particles in the water samples in the winter could be consistent with that hypothesis, but more evidence is needed to understand this process.

## It is recommended that next steps include:

- Continue seasonal monitoring the Yukon River for microplastics during open water and under ice cover to further document the presence or absence of microplastics and particle size distribution to characterize existing conditions.
- Continue to use a sample size of 5 replicates per sites for future sampling events in 1 litre HDPE bottles (blanks collected in glass jars didn't return a lower MP count).
- Sample water from potential MP sources in communities (e.g., water treatment plant discharge, storm sewers, snow dump runoff), as well as the Yukon River immediately upstream and immediately downstream of source discharge points.
- Sample the southern lakes water and sediment, and precipitation and glacier fed tributaries to the southern lakes.
- Send some samples/subsambles to be analyzed using Raman, IFT-IR spectroscopy, or (py-GC-MS) to confirm reliable MP identification using fluorescent tagging and microscopy.
- Work with laboratories to conduct further research on blank contamination, including the
  effects of sample agitation prior to analysis, rigorous analysis and characterization of
  laboratory deionized water, and development of a LOD and LOQ.
- Work with the MP research community and laboratories towards the development of a standardized MP reporting unit (i.e., mass or volume/unit volume).
- Work with laboratories to better understand particle size distribution (i.e., through additional size categories), and how particle such as filaments are classified in terms of size.
- Investigate for potential sources of microplastics near or upstream of the Tagish and Takhini sampling location to explain the higher particle counts at these locations.
- Sample atmospheric deposition (dustfall) for microplastics to better understand contribution from atmospheric transport.



## **LIST OF ACRONYMS**

ANOVA Analysis of Variance AS Analytical Sensitivity

FB Field Blank

HDPE High Density Polyethylene

IFT-IR Indirect Fourier Transform - Infrared Spectroscopy

L Liter

LOD Limit of Detection

LOQ Limit of Quantification

MP Microplastic(s)

MPP/L Microplastic Particles per Liter
QA/QC Quality Assurance Quality Control

RCL Replicate Control Limit
RWL Replicate Warning Limit
SOP Standard Operating Protocol
T Non-zero duplicates/replicates
UTM Universal Transverse Mercator

V Variance

WRB Water Resources Branch (Yukon Government)

YG Yukon Government



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#### 1 Introduction

Microplastics (MP) in water and aquatic ecosystems are a growing concern for which there are little data, especially within freshwater systems. Currently, there are no standardized protocols for MP sampling (other than for microbeads) and quantification in Canada. Yukon Government's - Water Resources Branch (WRB) has been spearheading MP investigations in freshwater systems, within the Yukon Territory and has retained Core Geoscience Services Inc. (CoreGeo) to support the initiative.

#### 1.1 BACKGROUND

A literature review and the first phase of a microplastics (MP) pilot sampling program were conducted by WRB and CoreGeo in 2021 (CoreGeo, 2021). The first phase of the study was designed based on findings from a state of science review. Samples were collected from the Yukon River in March 2021 using two different methods (grab samples through sieves; and filter samples using a submersible pump) and sent to three different labs using different analytical methods (microscopy particle count, low level particle size analysis, and elemental composition analysis). Quality assurance/quality control (QA/QC) samples were also collected (trip blanks, field blanks, method blanks, and positive controls).

Both sampling methods presented challenges, particularly for winter sampling. Apart from trying to prevent water from freezing in the sieves or filters, one of the biggest challenges was to prevent contamination, as MP are ubiquitous in the environment (Smith and Rochman, 2021). MP were found in the blanks and in the control samples, despite numerous precautions to prevent contamination. Another challenge was with laboratory analyses and differentiating MP from other particles. There is currently no standard analytical method, and results from different labs are difficult to compare. Microscopy appeared to be the most suitable laboratory technique to obtain MP-specific particle count and size distribution. Fluorescent tagging conducted by ALS Laboratories (ALS) appeared to have a higher detection power than the sole use of a 10x dissecting microscope at WRB lab.

Based on the Phase 1 findings, and with a focus on trying to streamline sampling methodology and reduce MP contamination, it was recommended that 1L grab samples be used (compared to the 100L samples were collected during Phase 1), and that a larger number of replicates be collected to compensate for the greater variability in smaller sample volumes. Samples were recommended to be analyzed using microscopy and fluorescent tagging (ALS). To better understand MP sources and fate in the environment, it was recommended that samples be collected in additional locations on the Yukon River, including upstream and downstream of communities on the Yukon River.

## 1.2 OBJECTIVES

This study represents the next phase of the microplastics sampling program and incorporates recommendations from Phase 1. The objectives are to:



- Test and evaluate the proposed sampling methodology (1L grab samples with several replicates), moving towards the goal of standardizing sampling methodology; and
- Investigate MP concentrations along the Yukon River (upstream and downstream of communities) to establish a baseline data set for microplastics.

## 2 METHODS

## 2.1 SAMPLE COLLECTION

Two rounds of sampling were completed: one on September 13-14 and 29, 2021, and one on January 20 and 25, 2022. Sampling locations included the Yukon River at (from upstream to downstream): Tagish, Marsh Lake, just upstream of the Takhini River confluence, Carmacks, and Dawson. Locations are shown in Figure 2-1 with close-ups of each site in Figures 2-2 to 2-6. Coordinates are provided in Table 2-1 and photos in Appendix A. Five replicates were collected at each site, in 1-litre HDPE bottles provided by the lab.



Figure 2-1: Microplastics Sampling Locations





Figure 2-2: Tagish Sampling Location

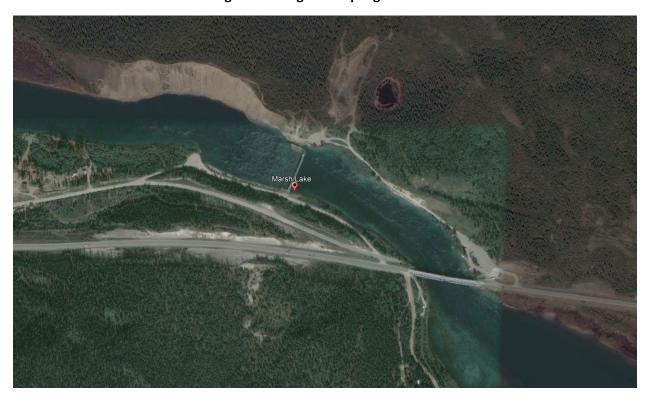


Figure 2-3: Marsh Lake Sampling Location



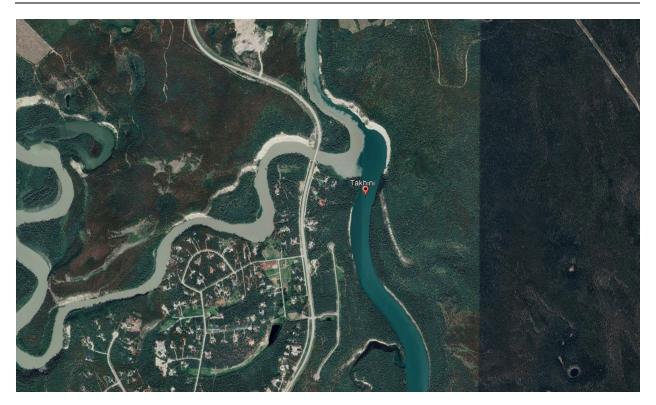


Figure 2-4: Takhini Confluence Sampling Location

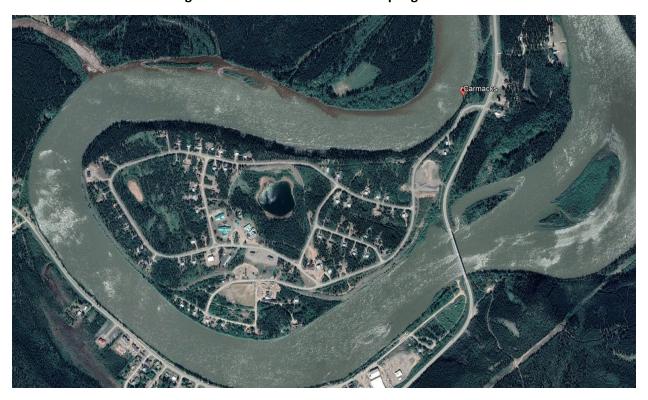


Figure 2-5: Carmacks Sampling Location





Figure 2-6: Dawson Sampling Location

**Table 2-1: Sampling Locations Coordinates** 

Site	Water Body/Water Course	UTM
Tagish	Tagish River (6 mile River)	07W 871425 6705613
Marsh Lake	Yukon River (YEC Gates)	07W 845607 6732432
Takhini Confluence	Yukon River upstream of Takhini Confluence	07W 816056 6758892
Carmacks	Yukon River	07W 746692 6894442
Dawson	Yukon River	07W 576356 7105615

## 2.2 SAMPLE ANALYSIS

Samples were sent to ALS Cincinnati for analysis. Samples were analyzed according to ALS Standard Operating Procedure (SOP) Micro-Fluor-001 for the detection of MP particles using fluorescent tagging and static image analysis. With this method, fluorescent dye is added to the samples. After activation time, samples are filtered, and filters are viewed under the microscope. The fluorescent dye targets polymers like polyethylene, polypropylene, polystyrene, and nylon 6; though it cannot differentiate between them. Particle sizing is performed using static image analysis of representative calibrated two-dimensional photomicrographs.



Analytical sensitivity (AS) - the smallest amount of substance in a sample that can accurately be measured based on the volume and clarity of the sample - was reported by ALS for each sample. The AS ranged from 1 to 3 MP particles per litre (MPP/L) for all samples except for the September Dawson samples, where the AS was 54 MPP/L. The AS is dependant on a number of factors, but primarily the volume of sample analyzed. For most samples, a volume of 500 mL was analyzed, but because the September Dawson samples contained significant visible suspended solids which interfered with the detection of MP, only 25 mL of these samples could be filtered without obscuring the view of fluorescing MP, resulting in a higher AS. The September Dawson MP count results are all <AS; they are still considered valid, but less statistically accurate than higher concentrations.

## 2.3 QA/QC

#### 2.3.1 Field QA/QC

During the September 2021 sampling event, one trip blank and two field blanks were collected. The trip blank was provided by the lab, carried in the field for the duration of the sampling event and returned to the lab for analysis without being opened. The two field blanks (FB-01 and FB-02) were processed at the Tagish site, where deionized water from the lab was transferred into the sampling bottles and returned to the lab for analysis.

In January 2022, additional blanks were collected to investigate potential sources/causes of MP particles detected in the blanks during previous sampling events (September 2021 and March 2021 pilot study). The following QA/QC samples were collected:

- TBA-1 to TBA-5: Trip blanks sent directly from ALS depot in Whitehorse to Cincinnati lab for analysis.
- TBB-1 to TBB-5: Trip blanks sent directly from ALS depot in Whitehorse to Cincinnati lab and held for 30 days prior to analysis.
- TBG-1 to TBG-5: Trip blanks in glass jars, brought into the field with WRB crew for the duration of the sampling event.
- TBP-1 to TBP-5, TB-01, TB-02: Trip blanks in plastic bottles, brought into the field with WRB crew for the duration of the sampling event.
- FBG-1 to FBG-5: Field blanks transferred into glass jars, completed at Tagish site by WRB crew.
- FBP-1 to FB-5, FB-01, FB-02 and FB-03: Field blank transferred into plastic bottles, completed at Tagish site by WRB crew.



#### 2.3.2 Laboratory QA/QC

In microscopy, laboratory QA/QC is performed to ensure and monitor analyst accuracy and precision (rather than that of the instrument in analytical chemistry). Precision is calculated using 2-point relative percent difference (RPD) based on analyses of the same sample under the same conditions. The ALS analyst provided the below information in November 2021. Variance (V), based on the analysis of 52 non-zero duplicates/replicates (T), was 0.0054, which was below the warning (RWL) and control limits (RCL).

Table 2-2: ALS MP Analyst Precision, November 2021

ANALYST A PRECISION								
Т	RPD Sum	RPD Mean	D <sup>2</sup> Sum	V	SD	RWL	RCL	P/F
52	12.950	0.249	2.832	0.054	0.233	0.467	0.700	PASS

#### 2.4 DATA ANALYSIS

Statistical tests were conducted using R software. If distributions were normal and variances equal after outliers (Studentized residuals <-4 or >4) were removed, ANOVA was used to determine significant differences (at  $\alpha$ =0.05) between groups. Where distributions failed the normality test or variances were not equal, non-parametric statistics (Wilcoxon-Mann-Whitney) were used to compare groups. *Post hoc* power analyses were conducted for ANOVA tests, to determine the realized power to detect a significant difference. *A priori* power analyses were also conducted to determine the minimum sample size that would be needed to detect a difference at 0.95 and 0.90 power, for future sampling events.

#### 3 RESULTS

Results are summarized and analyzed in the sections below. Complete lab reports are available in Appendix B and detailed statistical test results are available in Appendix C.

## 3.1 TOTAL MICROPLASTICS PARTICLE COUNT

#### **3.1.1** Blanks

All blanks from September and January were compared to identify differences (if any) in total MP count between the different blank types. Descriptive statistics for total MP count are summarized in Table 3-1, and boxplots are presented in Figure 3-1. Boxplots show the minimum and maximum values (whiskers), first and third quartiles (bottom and top of the box) and the median value (bold line).



Table 3-1: Blanks Descriptive Statistics (Total MP Count)

	Blank1	Blank2	Blank3	Blank4	Blank5	Blank6
Description	Trip blanks sent directly from ALS depot in Whitehorse to Cincinnati lab	Trip blanks in plastic bottles, brought into the field with WRB crew for the duration of the sampling event	Trip blanks in glass jars, brought into the field with WRB crew for the duration of the sampling event	Field blanks transferred into plastic bottles, completed at Tagish site by WRB crew	Field blanks transferred into glass jars, completed at Tagish site by WRB crew	Trip blanks sent directly from ALS depot in Whitehorse to Cincinnati lab and held for 30 days prior to analysis
Samples	January: TBA- 1, TBA-2, TBA- 3, TBA-4, TBA- 5	September: Travel Blank January: TBP-1, TBP-2, TBP-3, TBP-4, TBP-5, TB-01, TB-02	January: TBG- 1, TBG-2, TBG-3, TBG-4, TBG-5	September: FB- 01, FB-02 January: FBP-1, FBP-2, FBP-3, FBP-4, FBP-5, FB-01, FB-02, FB-03	January: FBG- 1, FBG-2, FBG- 3, FBG-4, FBG- 5	January: TBB-1, TBB-2, TBB-3, TBB-4, TBB-5
Total						
Number of Samples	5	8	5	10	5	5
Outliers Removed	0	0	0	0	0	0
N (Number of samples used in the analysis)	5	8	5	10	5	5
Minimum (MP count)	8	7	24	4	25	0
Median (MP count)	12	21	39	29	40	1
Mean (MP count)	12	23	39	33	41	2
Maximum (MP count)	16	48	62	67	60	4
Standard Deviation (MP count)	3	12	16	18	14	1
Standard Error (MP count)	1	4	7	6	6	1

<sup>\*</sup>Bolded values indicate a significant difference with at least one other site



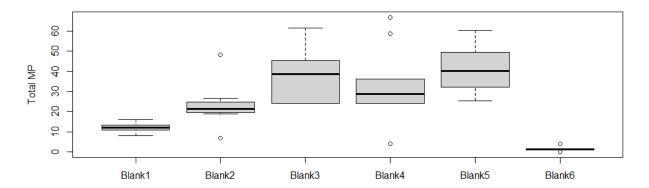


Figure 3-1: Blanks Boxplots (Total MP count)

Non-parametric statistical tests (Wilcoxon-Mann-Whitney) indicated that Blank6's median was significantly lower than all other medians except Blank3, and that all other medians were not significantly different from each other. Blank6 samples were held for 30 days prior to analysis. The intent of these samples was to evaluate whether the HDPE plastic bottles would leach MP particles into the samples over time. Since the median value for these samples was much lower than that of the other blanks, it is hypothesized that MP particles settled during the hold period and were not captured in the analysis. Blank3 and Blank5 were collected in glass jars to investigate whether the contribution of MP particles from plastic HDPE bottles in the sample was significant. Contrary to what was expected, the median MP count was higher for Blank3 and Blank5 compared to blanks collected in HDPE bottles; however, the difference is not statistically significant. The glass jars had plastics lids, and it is suspected that MP particles found in those blanks could have originated in part from the lids, or were already present in the glass bottles, or in the deionized water.

Given these results, and to strengthen our analyses with a larger sample size, all blanks were grouped together, except for Blank6 which was not used in further analyses. This new "Blank" group was used for total MP count comparisons with the different sampling sites presented in sections 3.1.2 and 3.1.3.

#### 3.1.2 September 2021

Results from September 2021 were compared to identify differences (if any) in total MP count between the sites and with blanks. Descriptive statistics for total MP count are summarized in Table 3-2, and boxplots are presented in Figure 3-2.

Table 3-2: September 2021 Sample Descriptive Statistics (Total MP Count)

	Blank	Tagish	MarshLake	Takhini	Carmacks	Dawson
Total Number of Samples	34	5	5	5	5	5
Outliers Removed	0	0	0	0	1 (YCAR-5)	0
N (Number of samples used in the analysis)	34	5	5	5	4	5



	Blank	Tagish	MarshLake	Takhini	Carmacks	Dawson
Minimum (MP count)	4	40	11	11	19	19
Median (MP count)	25	70	24	43	32	27
Mean (MP count)	30	72	22	34	36	31
Maximum (MP count)	67	104	35	51	62	45
Standard Deviation (MP count)	17	24	10	18	18	11
Standard Error (MP count)	3	11	4	8	9	5

<sup>\*</sup>Bolded values indicate a significant difference with at least one other site

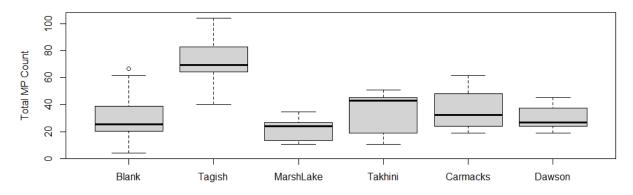


Figure 3-2: September 2021 Boxplots (Total MP count)

Statistical tests (ANOVA) indicated that Tagish mean total MP count was significantly higher than all other means, and that all other means were not significantly different from each other, or from the blanks. The mean MP count for Tagish was higher than at other sites, indicating a potential source of MP near the sampling location or at the time of sampling. Given that this site is the most upstream of the five sampling locations, the MP source may be localized in space and/or time.

## 3.1.3 January 2022

Results from January 2022 were compared to identify differences (if any) in total MP count between the sites and with blanks. Descriptive statistics for total MP counts are summarized in Table 3-3, and boxplots are presented in Figure 3-3.

Table 3-3: January 2022 Sample Descriptive Statistics (Total MP Count)

	Blank	Tagish	MarshLake	Takhini	Carmacks	Dawson
Total Number of Samples	34	5	5	5	5	5
Outliers Removed	0	2 (TRBD-3, TRBD-1)	0	2 (YRUTR-3, YRUTR-5)	0	0
N (Number of samples used in the analysis)	34	3	5	3	5	5



	Blank	Tagish	MarshLake	Takhini	Carmacks	Dawson
Total Number of Samples	34	5	5	5	5	5
Outliers Removed	0	2 (TRBD-3, TRBD-1)	0	2 (YRUTR-3, YRUTR-5)	0	0
Minimum (MP count)	4	515	29	297	23	19
Median (MP count)	25	582	48	298	29	28
Mean (MP count)	30	563	54	303	32	29
Maximum (MP count)	67	593	76	314	43	44
Standard Deviation (MP count)	17	42	21	10	8	11
Standard Error (MP count)	3	24	9	6	4	5

<sup>\*</sup>Bolded values indicate a significant difference with at least one other site

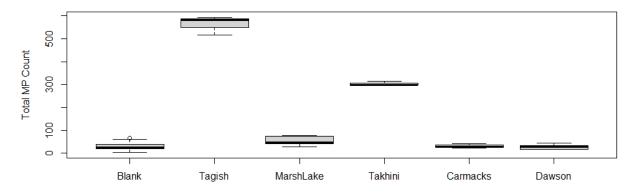


Figure 3-3: January 2022 Boxplots (Total MP count)

Statistical tests (ANOVA) indicated that Tagish and Takhini mean total MP counts were significantly higher than all other means and different from each other, and that all other means were not significantly different from each other or the blanks. In other words, total MP count at Marsh Lake, Carmacks and Dawson cannot be distinguished from the blanks count, indicating that MP contamination is roughly the same in the Yukon River and those sites than in deionized water. The mean MP count for Tagish was the highest followed by Takhini. Tagish total MP count was also found to be elevated in September, indicating a potential source of MP near the sampling location. Takhini was elevated in January but not in September, possibly indicating a temporally isolated source of contamination. Given that this sampling site is located downstream of Whitehorse, the source could be associated with discharge (e.g. storm sewer) or other influence(s) from the city. Air temperature reached a maximum of 5.1°C in Whitehorse on January 25, 2022 (when the Takhini site was sampled), which could have led to snowmelt and increased runoff.

## 3.1.4 Temporal variation

Comparisons were made between January and September results at each site. Total MP count was not significantly different between January and September at Carmacks and Dawson, but was



significantly higher in January at Marsh Lake, Tagish and Takhini. Boxplots for each site are shown in Figure 3-4 to Figure 3-8. Red asterisks indicate a statistically significant difference between September 2021 and January 2022.

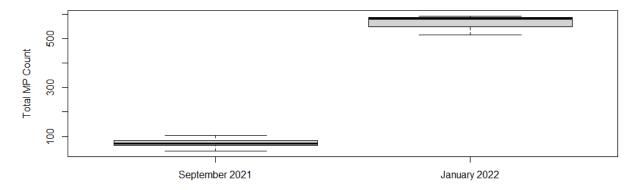


Figure 3-4: Tagish Boxplots (Total MP count) \*

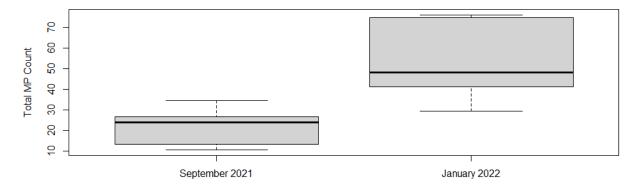


Figure 3-5: Marsh Lake Boxplots (Total MP count) \*

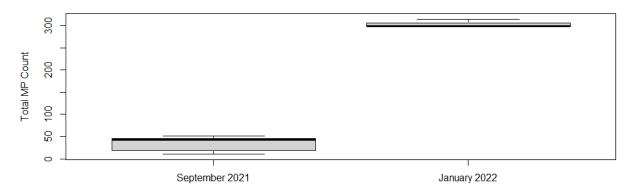


Figure 3-6: Takhini Boxplots (Total MP count) \*



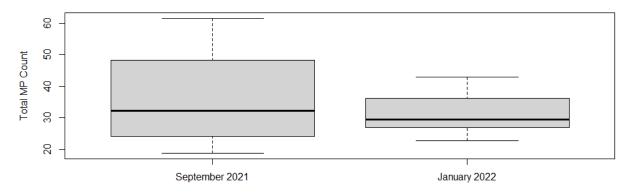


Figure 3-7: Carmacks Boxplots (Total MP count)

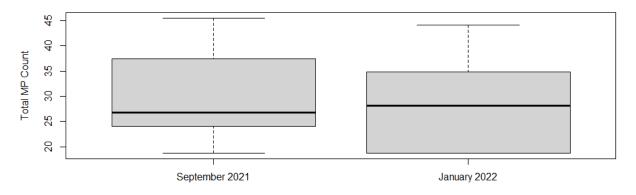


Figure 3-8: Dawson Boxplots (Total MP count)

## 3.2 Particle Size Distribution

MP particle count was broken down into 5 size categories. For all samples, the majority ( $\geq$ 67%) of MP particles fell either in the  $>6.5 \leq 10 \mu m$  or the  $>10 \leq 100 \mu m$  size category, with a smaller fraction in the  $>100 \leq 500 \mu m$ . Very few particles were found to be in the  $>500 \mu m \leq 1 m m$  category and none were in the  $>1 \leq 5 m m$  range. The proportion of total MP count that fell in the smaller size category ( $>6.5 \leq 10 \mu m$ ) was compared between sites, as it may be an indication of potential MP sources.

## **3.2.1** Blanks

All blanks from September and January were compared to identify differences (if any) between the different blank types. Descriptive statistics for proportion of MP counts in the  $>6.5 \le 10 \mu m$  size category are summarized in Table 3-4, and boxplots are presented in Figure 3-9. Average percent for each size category and each blank type are shown in Figure 3-10.



Table 3-4: Blanks Descriptive Statistics (% of MP count in the >6.5≤10μm size category)

	Blank1	Blank2	Blank3	Blank4	Blank5	Blank6
Description	Trip blanks sent directly from ALS depot in Whitehorse to Cincinnati lab	Trip blanks in plastic bottles, brought into the field with WRB crew for the duration of the sampling event	Trip blanks in glass jars, brought into the field with WRB crew for the duration of the sampling event	Field blanks transferred into plastic bottles, completed at Tagish site by WRB crew	Field blanks transferred into glass jars, completed at Tagish site by WRB crew	Trip blanks sent directly from ALS depot in Whitehorse to Cincinnati lab and held for 30 days prior to analysis
Samples	January: TBA- 1, TBA-2, TBA- 3, TBA-4, TBA- 5	September: Travel Blank January: TBP-1, TBP-2, TBP-3, TBP-4, TBP-5, TB-01, TB-02	January: TBG- 1, TBG-2, TBG-3, TBG-4, TBG-5	September: FB- 01, FB-02 January: FBP-1, FBP-2, FBP-3, FBP-4, FBP-5, FB-01, FB-02, FB-03	January: FBG- 1, FBG-2, FBG- 3, FBG-4, FBG- 5	January: TBB-1, TBB-2, TBB-3, TBB-4, TBB-5
Total Number of Samples	5	8	5	10	5	5
Outliers Removed	0	0	0	0	0	0
N (Number of samples used in the analysis)	5	8	5	10	5	5
Minimum (%)	50	0	24	33	33	0
Median (%)	67	71	38	66	47	100
Mean (%)	68	63	45	60	53	60
Maximum (%)	88	86	61	80	84	100
Standard Deviation (%)	13	27	16	17	20	55
Standard Error (%)	6	10	7	5	9	25



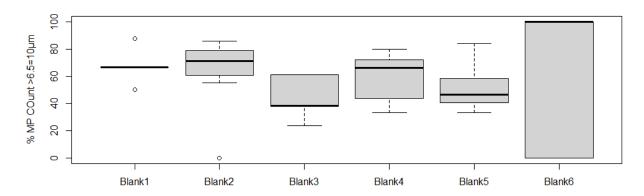


Figure 3-9: Blanks Boxplots (% of MP count in the >6.5≤10μm size category)





Figure 3-10: Mean MP Particle Size Distribution per Blank Type



Non-parametric statistical tests (Wilcoxon-Mann-Whitney) indicated no statistically significant differences between medians. Given this result and to strengthen our analyses with a larger sample size, all blanks were grouped together, and this new "Blank" group was used for in % of MP count in the  $>6.5 \le 10 \mu m$  size category comparisons with the different sampling sites (presented in sections 3.2.2 and 3.2.3).

## 3.2.2 September 2021

Results from September 2021 were compared to identify differences (if any) in proportion of MP count in the  $>6.5 \le 10 \mu m$  size category between the sites and with blanks. Descriptive statistics for proportion (%) of MP count in the  $>6.5 \le 10 \mu m$  size category are summarized in Table 3-5, and boxplots are presented in Figure 3-11. Average percent for each size category and each blank type are shown in Figure 3-12.

Table 3-5: September 2021 Sample Descriptive Statistics (% of MP count in the >6.5≤10μm size category)

	Blank	Tagish	MarshLake	Takhini	Carmacks	Dawson
Total Number of Samples	38	5	5	5	5	5
Outliers Removed	0	0	0	0	0	0
N (Number of samples used in the analysis)	38	5	5	5	5	5
Minimum (%)	0	26	0	0	8	65
Median (%)	65	29	33	47	38	86
Mean (%)	59	33	38	38	38	86
Maximum (%)	100	47	100	57	71	100
Standard Deviation (%)	26	9	39	23	23	15
Standard Error (%)	4	4	18	10	10	7

<sup>\*</sup>Bolded values indicate a significant difference with at least one other site

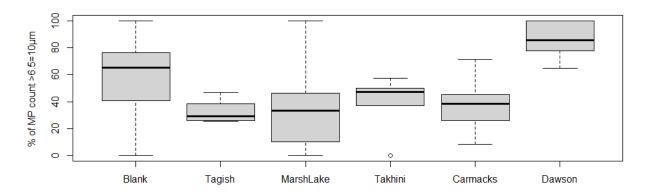
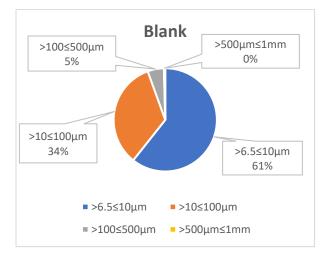
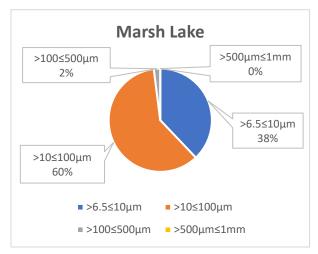


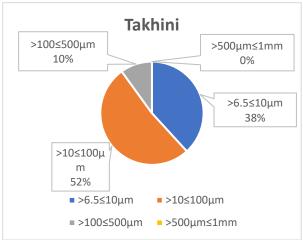
Figure 3-11: September 2021 Boxplots (% of MP count in the >6.5≤10μm size category)











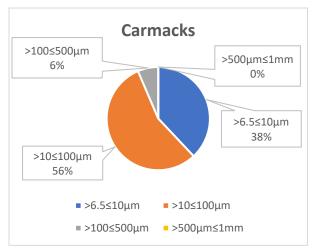




Figure 3-12: Mean MP Particle Size Distribution per Site, September 2021



Statistical tests (ANOVA) indicated mean proportion of MP count in the >6.5 $\leq$ 10µm size category for Dawson was significantly higher than the means for other sites but was not significantly different from the mean for blanks (which are dominated by smaller particle sizes). If the main source of MP is far upstream (e.g., Whitehorse), the greater fraction of smaller particles at Dawson could indicate that deposition and degradation of larger particles may have occurred between the source and sample location. While the total MP count did not indicate an obvious source upstream (section 3.1.2), there would have been significant dilution as the Yukon River flow increases from Whitehorse to Dawson.

#### 3.2.3 January 2022

Results from January 2022 were compared to identify differences (if any) in proportion of MP count in the  $>6.5 \le 10 \mu m$  size category between the sites and with blanks. Descriptive statistics for percent of MP count in the  $>6.5 \le 10 \mu m$  size category are summarized in Table 3-6, and boxplots are presented in Figure 3-13.

Table 3-6: January 2022 Sample Descriptive Statistics (% of MP count in the >6.5≤10μm size category)

	Blank	Tagish	MarshLake	Takhini	Carmacks	Dawson
Total Number of Samples	38	5	5	5	5	5
Outliers Removed	0	0	0	0	0	0
N (Number of samples used in the analysis)	38	5	5	5	5	5
Minimum (MP count)	0	3	21	6	44	31
Median (MP count)	65	6	39	8	64	38
Mean (MP count)	59	7	37	8	64	43
Maximum (MP count)	100	14	64	14	82	57
Standard Deviation (MP count)	26	4	18	3	15	13
Standard Error (MP count)	4	2	8	1	7	6

<sup>\*</sup>Bolded values indicate a significant difference with at least one other site

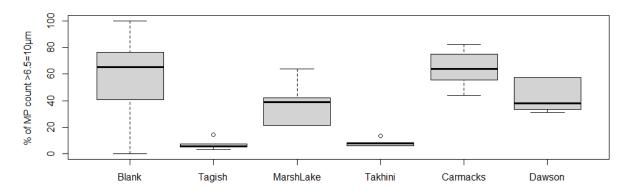
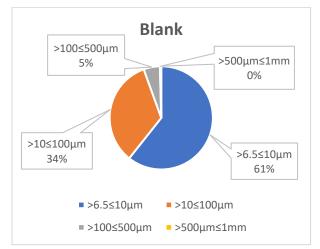
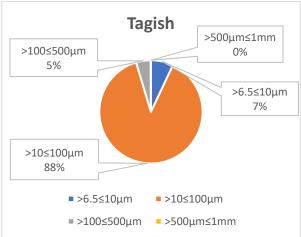
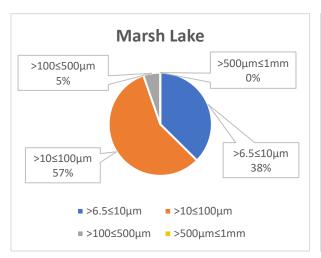


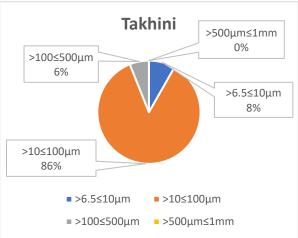
Figure 3-13: January 2022 Boxplots (% of MP count in the >6.5≤10μm size category)

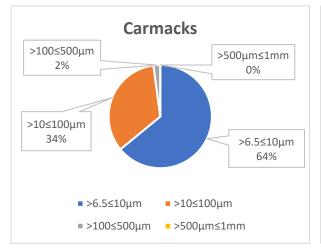












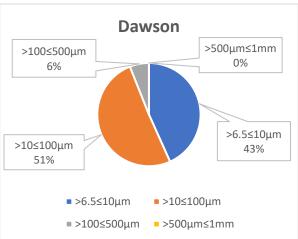


Figure 3-14: Mean MP Particle Size Distribution per Site, January 2022



Statistical tests (Wilcoxon-Mann-Whitney) indicated that Tagish median proportion of MP count in the  $>6.5 \le 10 \mu m$  size category was significantly lower than the blanks, but not significantly different from the other sites. Tagish samples are dominated by larger particles sizes ( $>10 \le 100 \mu m$ ). This result is consistent with the elevated total count at Tagish in January 2022, suggesting less settlement and degradation of larger particles between a nearby source and the sampling location.

### 3.2.1 Temporal variation

Comparisons were made between January and September results at each site. The proportion of MP count in the >6.5≤10µm size category was not significantly different between January and September at Carmacks, Marsh Lake and Takhini, but was significantly higher in September at Dawson and Tagish. Boxplots for each site are shown in Figure 3-15 to Figure 3-19. Red asterisks indicate a statistically significant difference between September 2021 and January 2022.

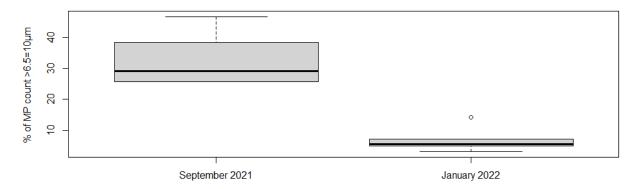


Figure 3-15: Tagish Boxplots (% of MP count in the >6.5≤10μm size category) \*

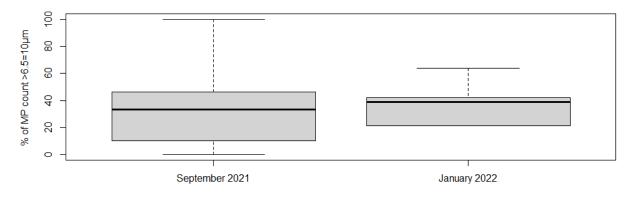


Figure 3-16: Marsh Lake Boxplots (% of MP count in the >6.5≤10μm size category)



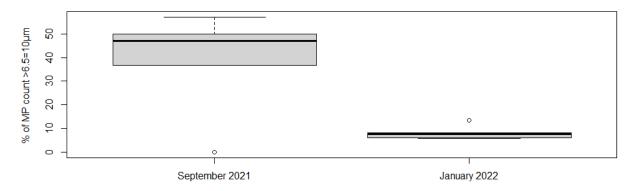


Figure 3-17: Takhini Boxplots (% of MP count in the >6.5≤10μm size category)

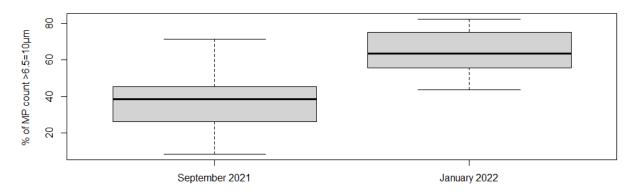


Figure 3-18: Carmacks Boxplots (% of MP count in the >6.5≤10μm size category)

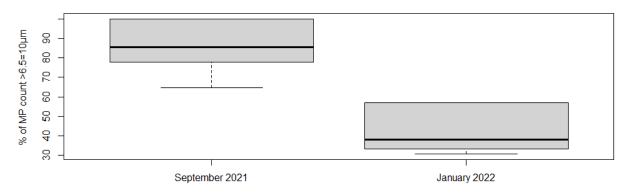


Figure 3-19: Dawson Boxplots (% of MP count in the >6.5≤10μm size category) \*

As described in section 3.2.3, the higher proportion of larger particles at Tagish in January is consistent with the higher total particle count and a potential local source, while it is unclear why the proportion of smaller particles at Dawson was higher in September (see section 3.2.2). A possible explanation is that there was a greater contribution from atmospheric deposition (likely to consist of smaller particles) during open water season, although the total particle count was not significantly different between September and January at Dawson.



## 4 DISCUSSION

#### 4.1 BLANKS

As was found during the March 2021 Phase 1 study, MP particles were present in all blanks (CoreGeo, 2021). Different types of blanks were collected during this Phase 2 investigation to try to identify potential sources of blank contamination. Given that no significant difference was found between the total MP particle count means of the various blanks, except for Blank6 (held for 30 days prior to analysis), it can be hypothesized that the main source of contamination is from the deionized water itself (where the deionization process may not be entirely successful at removing MP particles) or blank preparation process in the lab (rather than from the sampling bottles, sample handling, or air deposition during sampling). ALS laboratory Cincinnati analyzed their own deionized water and found 10 MPP/L on average (Pamela Hizar, 2022, pers. comm.), which is below the average total MP count across our blanks (29.7 MP/L), excluding Blank 6 (1.6 MP/L). It is unknown however how many replicate analyses of deionized water were conducted by ALS or whether they were representative of the deionized water from the ALS Whitehorse depot where the blanks for our study were prepared. Further conversation with the laboratory is needed.

Interpreting field results with non-zero blanks is difficult as there is no standard practice. Some studies subtract the average of blanks from each sample to account for procedural contamination (Gies et al., 2018). In the case of our study however, it is hypothesized that the main source of contamination is not procedural (from sample collection) but from the deionized water or blank preparation, making this approach irrelevant as field samples do not contain deionized water. Other approaches involve reporting the limit of detection (LOD), which in the field of microplastics is used as a threshold for the number or mass of microplastics that can be measured with certainty above laboratory and/or field blanks (Brander at al., 2020). Similarly, the limit of quantification (LOQ) is the minimum number or mass of microplastics of a specified size range that can be reliably counted and that are statistically distinguishable from the study blanks (Brander at al., 2020). The LOD and LOQ are determined using procedural blanks and quantification methods typically used in analytical chemistry, to see if data from environmental samples are sufficiently higher and thus usable, or flagged when below a threshold determined by the average contamination in field and/or laboratory blanks, (Brander et al., 2020) This approach would likely be the most appropriate for our study, however, ALS Laboratory has indicated that:

"There is as [of] yet no standard method for micro plastic analysis and therefore no established limit of detection (LOD). The LOD is the lowest quantity of a substance that can be distinguished from the absence of that substance with a stated confidence level. A method LOD is determined by the analysis of samples with known concentrations of the analyte and establishing a minimum level at which it can be quantified with acceptable accuracy and precision. Since we have no samples with known concentrations of micro plastic particles, we cannot calculate a method LOD.



Rather, we use the term Analytical Sensitivity (AS) which is the smallest amount of analyte that can be detected by this method. Obviously, the smallest number of micro plastic particles that can be detected by microscopy is 1. [...] the AS calculated is based on the detection of 1 micro plastic particle detected in the total area analyzed and is dependent upon a number of factors including the volume of sample filtered, the filter area, the image area, and the number of images analyzed." (Pamela Hizar, 2021, pers. comm.)

In analytical chemistry, there are different methods for calculating the LOD and LOQ, such as visual definition, calculation from the signal-to-noise ratio, calculation from the standard deviation of the blank, or calculation from the calibration line at low concentrations. (Shrivastava and Gupta, 2015) While LOD and LOQ are successfully applied within analytical chemistry, their application to MP is not as straightforward, as steps are needed to differentiate between sample type and MP types (microplastics are highly diverse in color, size, morphology, and composition). For example, LOD for a brightly colored 200  $\mu$ m red fiber may be very different from that of a 200  $\mu$ m translucent film or a 50  $\mu$ m blue particle. (Brander at al., 2020) Also, because larger MP particles are susceptible to breaking down within the sample (resulting in a higher count of smaller particles), applying a LOD or LOQ to the total particle count may not be meaningful. "Systematic correction for secondary contamination of microplastic samples is important in producing robust data; however, the most accurate procedure for such a correction is still under development." (Brander, 2020) Therefore, no correction or interpretation accounting for non-zero blanks have been applied to the field results for the current study.

The much lower particle count in Blank6 (held for 30 days prior to analysis), suggests that MP particles settle over time and that time between sample collection and analysis may impact results unless the sample is agitated prior to analysis. The objective of Blank6 was to see if MP particles leach out of the plastic bottle over time; however, this could not be determined due to the apparent settlement that occurred over the course of the 30 days.

## 4.2 TOTAL PARTICLE COUNT

Results from September 2021 and January 2022 both show a significantly higher total particle count at Tagish compared to other locations, at both times of the year, which points to a localized source. It is also possible that MP sources exist upstream of Tagish, and further investigation at the southern lakes and in precipitation and glacier fed tributaries of the southern lakes could provide additional insight. Furthermore, given the findings associated with Blank6 (MP particles settle over time), sampling lake sediment in the southern lakes would be of interest in advancing our understanding of sources and fate of MP particles.

Elevated results at the Takhini confluence in January 2022 indicate a possible temporally isolated source. Other locations did not show a significant difference with the blanks or between sites during the 2021-2022 sampling program.



The results of the two sampling events suggest that MP counts in the Yukon River are very low and comparable to blanks count along the reach between Marsh Lake and Dawson in both sampling events, except in January, at the confluence of the Takhini River. These results also suggest that the communities along the Yukon River were not significant sources of MP (e.g., by water treatment plant discharge, storm sewers, etc.) as total particle count per liter was not typically found to be higher downstream of communities, compared to upstream. It is also possible that potential MP contribution from communities did not result in increased MP particle concentration due to dilution in the Yukon River as flow increases moving downstream.

It is likely that total particle count alone may not be representative of MP abundance or concentration; a single particle could break down and be identified as several particles over time and/or through transport. For example, as measured by particle count, larger particles closer to a deposition point could represent a lower "concentration" of MP per unit volume than the same MP sampled downstream if degradation of MP during transport results in a greater number of MP particles. Quantification of MP by mass or volume would improve the representativeness of MP analyses; however, refinement of the sampling and/or analytical methods will be necessary. Development of a standardized unit for MP concentration should be a focus of future research. In the interim, an estimate of MP volume could be obtained by assigning an average size for each size category, multiplying by the count for each size category and adding the results for all size categories.

Also, while fluorescent tagging microscopy targets a number of plastic types, "it is now common practice and expected that a minimum amount of suspected synthetic particles across sample types are confirmed using Raman, IFT-IR spectroscopy, or pyrolysis—gas chromatography—mass spectrometry (py-GC-MS)". (Brander et al., 2020) This would add confidence to result interpretation, knowing that all particles counted are indeed MP, and seeing if fluorescent tagging effectively captures the majority of MP particles.

#### 4.3 Particle Size Distribution

September 2021 results at Dawson show a greater proportion of small particle MPs, which could indicate deposition and/or degradation of larger particles may have occurred from a source far upstream (e.g. Whitehorse) by the time they reached Dawson. While the total MP count did not suggest an obvious source upstream, increased dilution as flows increase moving downstream on the Yukon River may limit the ability to identify an upstream source. January 2022 results at Tagish show a larger percentage of larger particles, consistent with the hypothesis of a local source.

The size categories provided by the lab are fairly wide ( $>6.5 \le 10 \mu m$ ,  $>10 \le 100 \mu m$ ,  $>100 \le 500 \mu m$ ,  $>500 \mu m \le 1 mm$ ,  $>1 \le 5 mm$  range) and do not allow for a detailed analysis of particle sizes. As such, most particles observed fell within the two smaller size categories, which is expected given that larger particles are likely to either settle or breakdown into smaller particles over time. Because of this, comparing particle count between samples may not be a reliable comparison as one large particle may represent the same amount of plastic as several smaller particles.



#### 4.4 TEMPORAL VARIATION

Total particle count was higher in samples collected under ice in January at Marsh Lake, Tagish and Takhini compared to samples collected from open water in September. This result suggests that atmospheric inputs may not have been a significant source of MP as the particle count was higher in January when atmospheric deposition would have been inhibited by ice cover. Also, flow is typically lower in winter, resulting in less dilution, which could in part explain some of the higher concentrations observed in winter.

January samples had a lower percentage of larger particles in January at Dawson and Tagish. Smaller particles are expected to be more readily transported by atmospheric circulation, perhaps explaining the lower counts of smaller particles in winter samples at some sites. Further study is required to better understand temporal variation in particle count and size.

#### 4.5 POWER ANALYSIS

*Post hoc* power analyses were conducted for ANOVA tests (see detailed results in Appendix C). Power ranged from 0.78 to 1 depending on the groups tested. The lowest power was achieved for temporal comparison of total particle count at Marsh Lake. *A priori* power analyses were also conducted to determine the minimum sample size that would be required in future sampling events to achieve a given power. The minimum sample size to ensure a power of 0.95 found to be 8 for the temporal comparison of total particle count at Marsh Lake. Samples sizes of 7 or 5 were however sufficient for other comparisons. To achieve a power of 0.90, a minimum sample size of 7 would have been needed for the temporal comparisons of total particle count at Marsh Lake, but 6 or 4 were sufficient elsewhere. Details are available in Appendix C. Given that for most comparisons, a sample size of 5 or less was sufficient to achieve 0.95 power, this sample size is deemed appropriate for future sampling events.

## **5** RECOMMENDATIONS

In consideration of the results and discussion presented herein, CoreGeo suggests the following recommendations to improve the understanding of the fate and transport of MP in the Yukon:

- Continue seasonal monitoring the Yukon River for microplastics during open water and under ice cover to further document the presence or absence of microplastics and particle size distribution to characterize existing conditions.
- Continue to use a sample size of 5 replicates per sites for future sampling events in 1 litre HDPE bottles (blanks collected in glass jars didn't return a lower MP count).
- Sample water from potential MP sources in communities (e.g., water treatment plant discharge, storm sewers, snow dump runoff), as well as the Yukon River immediately upstream and immediately downstream of source discharge points.



- Sample the southern lakes water and sediment, and precipitation and glacier fed tributaries to the southern lakes.
- Send some samples/subsambles to be analyzed using Raman, IFT-IR spectroscopy, or (py-GC-MS) to confirm reliable MP identification using fluorescent tagging and microscopy.
- Work with laboratories to conduct further research on blank contamination, including the
  effects of sample agitation prior to analysis, rigorous analysis and characterization of
  laboratory deionized water, and development of a LOD and LOQ.
- Work with the MP research community and laboratories towards the development of a standardized MP reporting unit (i.e., mass or volume/unit volume).
- Work with laboratories to better understand particle size distribution (i.e., through additional size categories), and how particle such as filaments are classified in terms of size.
- Investigate for potential sources of microplastics near or upstream of the Tagish and Takhini sampling location to explain the higher particle counts at these locations.
- Sample atmospheric deposition (dustfall) for microplastics to better understand contribution from atmospheric transport.

## 6 CLOSURE

We trust this work meets your requirements. If you desire any additional information regarding the contents of this memo or wish to discuss any of the results, please contact CoreGeo at (867) 334-2673, or <a href="mailto:info@coregeo.ca">info@coregeo.ca</a>.

#### 7 REFERENCES

Brander, Susanne M., Violet C. Renick, Melissa M. Foley, Clare Steele, Mary Woo, Amy Lusher, Steve Carr, Paul Helm, Carolynn Box, Sam Cherniak, Robert C. Andrews, and Chelsea M. Rochman. 2020. Sampling and Quality Assurance and Quality Control: A Guide for Scientists Investigation the Occurrence of Microplastics Across Matrices. Applied Spectroscopy. Vol. 74(9) 1099-1125.

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29&mlyRange=%7C&StationID=50842&Prov=YT&urlExtension= e.html&searchType=stnN ame&optLimit=yearRange&StartYear=1840&EndYear=2022&selRowPerPage=25&Line=2& searchMethod=contains&Month=3&Day=29&txtStationName=whitehorse&timeframe=2&Y ear=2022

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# **APPENDIX A**

**Рното Log** 





Photo A-1: Tagish September 2021



Photo A-2: Marsh Lake September 2021



Photo A-3: Takhini September 2021



Photo A-4: Carmacks September 2021



Photo A-5: Carmacks January 2022

Photo A-6: Dawson January 2022



# **APPENDIX B**

**CERTIFICATES OF ANALYSIS** 



# **CERTIFICATE OF ANALYSIS**

**Work Order** : WR2101403 Page : 1 of 4

Client Government of Yukon Laboratory : Whitehorse - Environmental

Contact Devon O'Connor Address

**Account Manager** : Ashton Ostrander

Department of Environment, Environmental Protection and

Address : #12 151 Industrial Road

Assessment Branch 10 Burns Road

Whitehorse YT Canada Y1A 2V3

: 21-Oct-2021 16:52

Whitehorse YT Canada

**Project** 

Telephone : +1 867 668 6689 Date Samples Received : 29-Sep-2021 13:17

PO C-O-C number **Date Analysis Commenced** : 15-Oct-2021

Sampler

Issue Date

Quote number : VA21-GPYT100-011

No. of samples received : 28 No. of samples analysed : 28

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QC Interpretive report to assist with Quality Review and Sample Receipt Notification (SRN).

#### **Signatories**

Telephone

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories Position Laboratory Department

Kaitlyn Gardner Account Manager Assistant Internal Subcontracting, Cincinnati, Ohio Page : 2 of 4

Work Order : WR2101403

Client : Government of Yukon

Project : ---



#### **General Comments**

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Refer to the ALS Quality Control Interpretive report (QCI) for applicable references and methodology summaries. Reference methods may incorporate modifications to improve performance.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Please refer to Quality Control Interpretive report (QCI) for information regarding Holding Time compliance.

Key: CAS Number: Chemical Abstracts Services number is a unique identifier assigned to discrete substances

LOR: Limit of Reporting (detection limit).

Unit	Description
-	No Unit

<: less than.

>: greater than.

Surrogate: An analyte that is similar in behavior to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED on SRN or QCI Report, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Page : 3 of 4

Work Order : WR2101403

Client : Government of Yukon

Project : ---



## Analytical Results

Sub-Matrix: Water			Cl	ient sample ID	TRDB-01	TRDB-02	TRDB-03	TRDB-04	TRDB-05
(Matrix: Water)									
			Client samp	ling date / time	13-Sep-2021 13:10	13-Sep-2021 13:10	13-Sep-2021 13:10	13-Sep-2021 13:10	13-Sep-2021 13:10
Analyte	CAS Number	Method	LOR	Unit	WR2101403-001	WR2101403-002	WR2101403-003	WR2101403-004	WR2101403-005
					Result	Result	Result	Result	Result
Physical Tests									
microplastic particles	n/a	MicroPlasticS	-	-	See	See attached	See attached	See attached	See attached
		RN			attached				

Please refer to the General Comments section for an explanation of any qualifiers detected.

#### Analytical Results

Sub-Matrix: Water			CI	ient sample ID	FB-01	FB-02	Travel Blank	YRMLD-01	YRMLD-02
(Matrix: Water)									
			Client samp	ling date / time	13-Sep-2021 13:20	13-Sep-2021 13:20	13-Sep-2021	13-Sep-2021 11:45	13-Sep-2021 11:45
Analyte	CAS Number	Method	LOR	Unit	WR2101403-006	WR2101403-007	WR2101403-008	WR2101403-009	WR2101403-010
					Result	Result	Result	Result	Result
Physical Tests									
microplastic particles	n/a	MicroPlasticS	-	-	See	See attached	See attached	See attached	See attached
		RN			attached				

Please refer to the General Comments section for an explanation of any qualifiers detected.

# Analytical Results

Sub-Matrix: Water			CI	ient sample ID	YRMLD-03	YRMLD-04	YRMLD-05	YCAR-01	YCAR-02
(Matrix: Water)									
			Client samp	ling date / time	13-Sep-2021 11:45	13-Sep-2021 11:45	13-Sep-2021 11:45	14-Sep-2021 16:50	14-Sep-2021 16:50
Analyte	CAS Number	Method	LOR	Unit	WR2101403-011	WR2101403-012	WR2101403-013	WR2101403-014	WR2101403-015
				ľ	Result	Result	Result	Result	Result
Physical Tests									
microplastic particles	n/a	MicroPlasticS	-	-	See	See attached	See attached	See attached	See attached
		RN			attached				

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Client : Government of Yukon

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## Analytical Results

Sub-Matrix: Water			CI	ient sample ID	YCAR-03	YCAR-04	YCAR-05	YRUTR-01	YRUTR-02
(Matrix: Water)									
			Client samp	ling date / time	14-Sep-2021 16:50	14-Sep-2021 16:50	14-Sep-2021 16:50	13-Sep-2021 09:45	13-Sep-2021 09:45
Analyte	CAS Number	Method	LOR	Unit	WR2101403-016	WR2101403-017	WR2101403-018	WR2101403-019	WR2101403-020
				Î	Result	Result	Result	Result	Result
Physical Tests									
microplastic particles	n/a	MicroPlasticS	-	-	See	See attached	See attached	See attached	See attached
		RN			attached				

Please refer to the General Comments section for an explanation of any qualifiers detected.

#### Analytical Results

Sub-Matrix: Water			CI	ient sample ID	YRUTR-03	YRUTR-04	YRUTR-05	YRDRAW-01	YRDRAW-02
(Matrix: Water)									
			Client samp	ling date / time	13-Sep-2021 09:45	13-Sep-2021 09:45	13-Sep-2021 09:45	14-Sep-2021 16:45	29-Sep-2021
Analyte	CAS Number	Method	LOR	Unit	WR2101403-021	WR2101403-022	WR2101403-023	WR2101403-024	WR2101403-025
					Result	Result	Result	Result	Result
Physical Tests									
microplastic particles	n/a	MicroPlasticS	-	-	See	See attached	See attached	See attached	See attached
		RN			attached				

Please refer to the General Comments section for an explanation of any qualifiers detected.

# Analytical Results

_								
Sub-Matrix: Water			Ci	lient sample ID	YRDRAW-03	YRDRAW-04	YRDRAW-05	 
(Matrix: Water)								
			Client samp	oling date / time	29-Sep-2021	29-Sep-2021	29-Sep-2021	 
Analyte	CAS Number	Method	LOR	Unit	WR2101403-026	WR2101403-027	WR2101403-028	 
					Result	Result	Result	 
Physical Tests								
microplastic particles	n/a	MicroPlasticS	-	-	See	See attached	See attached	 
		RN			attached			



# **QUALITY CONTROL INTERPRETIVE REPORT**

**Work Order** : **WR2101403** Page : 1 of 7

Client : Government of Yukon Laboratory : Whitehorse - Environmental

Contact : Devon O'Connor Account Manager : Ashton Ostrander

Address : Department of Environment Environmental Protection and Address : #12 151 Industrial Ro

Department of Environment, Environmental Protection and Address :#12 151 Industrial Road

Assessment Branch 10 Burns Road Whitehorse, Yukon Canada Y1A 2V3
Whitehorse YT Canada

Telephone : ---- : +1 867 668 6689

Project : --- Date Samples Received : 29-Sep-2021 13:17

PO :--- Issue Date : 21-Oct-2021 16:52
C-O-C number :--Sampler :---

Quote number : VA21-GPYT100-011

No. of samples received : 28 No. of samples analysed : 28

This report is automatically generated by the ALS LIMS (Laboratory Information Management System) through evaluation of Quality Control (QC) results and other QA parameters associated with this submission, and is intended to facilitate rapid data validation by auditors or reviewers. The report highlights any exceptions and outliers to ALS Data Quality Objectives, provides holding time details and exceptions, summarizes QC sample frequencies, and lists applicable methodology references and summaries.

#### Key

Site

Anonymous: Refers to samples which are not part of this work order, but which formed part of the QC process lot.

CAS Number: Chemical Abstracts Services number is a unique identifier assigned to discrete substances.

DQO: Data Quality Objective.

LOR: Limit of Reporting (detection limit).

RPD: Relative Percent Difference.

#### **Summary of Outliers**

#### **Outliers: Quality Control Samples**

- No Method Blank value outliers occur.
- No Duplicate outliers occur.
- No Laboratory Control Sample (LCS) outliers occur
- No Matrix Spike outliers occur.
- No Test sample Surrogate recovery outliers exist.

#### Outliers: Reference Material (RM) Samples

• No Reference Material (RM) Sample outliers occur.

#### **Outliers : Analysis Holding Time Compliance (Breaches)**

• No Analysis Holding Time Outliers exist.

#### **Outliers : Frequency of Quality Control Samples**

• No Quality Control Sample Frequency Outliers occur.

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Client : Government of Yukon

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# **Analysis Holding Time Compliance**

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times, which are selected to meet known provincial and/or federal requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by organizations such as CCME, US EPA, APHA Standard Methods, ASTM, or Environment Canada (where available). Dates and holding times reported below represent the first dates of extraction or analysis. If subsequent tests or dilutions exceeded holding times, qualifiers are added (refer to COA).

If samples are identified below as having been analyzed or extracted outside of recommended holding times, measurement uncertainties may be increased, and this should be taken into consideration when interpreting results.

Where actual sampling date is not provided on the chain of custody, the date of receipt with time at 00:00 is used for calculation purposes.

Where only the sample date without time is provided on the chain of custody, the sampling date at 00:00 is used for calculation purposes.

Matrix: Water					Ev	raluation: 🗴 =	Holding time excee	edance ; •	= Within	<b>Holding Time</b>
Analyte Group	Method	Sampling Date	Ext	raction / Pr	eparation			Analys	is	
Container / Client Sample ID(s)			Preparation	Holding	g Times	Eval	Analysis Date	Holding	g Times	Eval
			Date	Rec	Actual			Rec	Actual	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE FB-01	MicroPlasticSRN	13-Sep-2021					15-Oct-2021			
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE FB-02	MicroPlasticSRN	13-Sep-2021					15-Oct-2021			
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE Travel Blank	MicroPlasticSRN	13-Sep-2021					15-Oct-2021			
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE TRDB-01	MicroPlasticSRN	13-Sep-2021					15-Oct-2021			
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE TRDB-02	MicroPlasticSRN	13-Sep-2021					15-Oct-2021			
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE TRDB-03	MicroPlasticSRN	13-Sep-2021					15-Oct-2021			
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE TRDB-04	MicroPlasticSRN	13-Sep-2021					15-Oct-2021			

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Client : Government of Yukon

Project : ---



Matrix: Water Evaluation: x = Holding time exceedance; ✓ = Within Holding Time Analyte Group Extraction / Preparation Method Sampling Date Analysis Container / Client Sample ID(s) Preparation **Holding Times** Eval Analysis Date Holding Times Eval Rec Actual Rec Actual Date Physical Tests: Microplastic Particles Screening in pure water by SEM HDPE TRDB-05 MicroPlasticSRN 13-Sep-2021 15-Oct-2021 Physical Tests: Microplastic Particles Screening in pure water by SEM HDPE YCAR-01 MicroPlasticSRN 14-Sep-2021 15-Oct-2021 ------------Physical Tests: Microplastic Particles Screening in pure water by SEM HDPE YCAR-02 MicroPlasticSRN 14-Sep-2021 15-Oct-2021 Physical Tests: Microplastic Particles Screening in pure water by SEM HDPE MicroPlasticSRN 15-Oct-2021 YCAR-03 14-Sep-2021 Physical Tests: Microplastic Particles Screening in pure water by SEM HDPE YCAR-04 MicroPlasticSRN 14-Sep-2021 15-Oct-2021 Physical Tests: Microplastic Particles Screening in pure water by SEM HDPE 14-Sep-2021 15-Oct-2021 YCAR-05 MicroPlasticSRN Physical Tests: Microplastic Particles Screening in pure water by SEM **HDPE** YRDRAW-01 MicroPlasticSRN 14-Sep-2021 15-Oct-2021 Physical Tests: Microplastic Particles Screening in pure water by SEM HDPE YRDRAW-02 MicroPlasticSRN 29-Sep-2021 15-Oct-2021 Physical Tests: Microplastic Particles Screening in pure water by SEM HDPE YRDRAW-03 MicroPlasticSRN 29-Sep-2021 15-Oct-2021 ------------

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Matrix: Water Evaluation: x = Holding time exceedance; ✓ = Within Holding Time Analyte Group Extraction / Preparation Method Sampling Date Analysis Container / Client Sample ID(s) Preparation **Holding Times** Eval Analysis Date Holding Times Eval Rec Actual Rec Actual Date Physical Tests: Microplastic Particles Screening in pure water by SEM HDPE YRDRAW-04 MicroPlasticSRN 29-Sep-2021 15-Oct-2021 Physical Tests : Microplastic Particles Screening in pure water by SEM HDPE YRDRAW-05 MicroPlasticSRN 29-Sep-2021 15-Oct-2021 ------------Physical Tests: Microplastic Particles Screening in pure water by SEM HDPE YRMLD-01 MicroPlasticSRN 13-Sep-2021 15-Oct-2021 Physical Tests: Microplastic Particles Screening in pure water by SEM HDPE YRMLD-02 MicroPlasticSRN 15-Oct-2021 13-Sep-2021 Physical Tests: Microplastic Particles Screening in pure water by SEM HDPE YRMLD-03 MicroPlasticSRN 13-Sep-2021 15-Oct-2021 Physical Tests: Microplastic Particles Screening in pure water by SEM HDPE 13-Sep-2021 15-Oct-2021 YRMLD-04 MicroPlasticSRN Physical Tests: Microplastic Particles Screening in pure water by SEM **HDPE** YRMLD-05 MicroPlasticSRN 13-Sep-2021 15-Oct-2021 Physical Tests: Microplastic Particles Screening in pure water by SEM HDPE YRUTR-01 MicroPlasticSRN 13-Sep-2021 15-Oct-2021 Physical Tests: Microplastic Particles Screening in pure water by SEM HDPE YRUTR-02 MicroPlasticSRN 13-Sep-2021 15-Oct-2021 ------------

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Work Order : WR2101403

Client : Government of Yukon

Project : ---



Matrix: Water Evaluation: ▼ = Holding time exceedance; ✓ = Within Holding Time

Analyte Group	Method	Sampling Date	Ext	raction / Pre	eparation			Analys	sis	
Container / Client Sample ID(s)			Preparation	Holding	Times	Eval	Analysis Date	Holding	g Times	Eval
			Date	Rec	Actual			Rec	Actual	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE YRUTR-03	MicroPlasticSRN	13-Sep-2021					15-Oct-2021			
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE YRUTR-04	MicroPlasticSRN	13-Sep-2021					15-Oct-2021			
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE YRUTR-05	MicroPlasticSRN	13-Sep-2021					15-Oct-2021			

#### Legend & Qualifier Definitions

Rec. HT: ALS recommended hold time (see units).

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# **Quality Control Parameter Frequency Compliance**

No Quality Control data available for this section.

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Client : Government of Yukon

Project : --



# **Methodology References and Summaries**

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Reference methods may incorporate modifications to improve performance (indicated by "mod").

Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Microplastic Particles Screening in pure water by SEM	MicroPlasticSRN  Cincinnati - Environmental - 4388	Water	See attached.	Samples were prepared and analyzed according to ALS SOP Micro-Fluor-001 for the detection of microplastic particles in drinking water using Nile Red dye for fluorescent tagging. See attached report for details.
	Glendale-Milford Road Cincinnati Ohio United States 45242			



# **QUALITY CONTROL REPORT**

**Work Order** : **WR2101403** Page : 1 of 2

Client : Government of Yukon Laboratory : Whitehorse - Environmental

Contact : Devon O'Connor : Ashton Ostrander

Department of Environment, Environmental Protection and Address :#12 151 Industrial Road

Assessment Branch 10 Burns Road Whitehorse, Yukon Canada Y1A 2V3
Whitehorse YT Canada

Telephone :--- Telephone :+1 867 668 6689

Project : 29-Sep-2021 13:17

PO :--- Date Analysis Commenced :15-Oct-2021
C-O-C number :--- Issue Date :21-Oct-2021 16:52

Sampler :----

Site :---Quote number :VA21-GPYT100-011

No. of samples analysed : 28
No. of samples analysed : 28

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits
- Reference Material (RM) Report; Recovery and Acceptance Limits
- Method Blank (MB) Report; Recovery and Acceptance Limits
- Laboratory Control Sample (LCS) Report; Recovery and Acceptance Limits

#### Signatories

Address

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories Position Laboratory Department

Kaitlyn Gardner Account Manager Assistant Internal Subcontracting, Cincinnati, Ohio

Page : 2 of 2 Work Order : WR2101403

Client : Government of Yukon

Project : ---



#### **General Comments**

The ALS Quality Control (QC) report is optionally provided to ALS clients upon request. ALS test methods include comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against predetermined Data Quality Objectives (DQOs) to provide confidence in the accuracy of associated test results. This report contains detailed results for all QC results applicable to this sample submission. Please refer to the ALS Quality Control Interpretation report (QCI) for applicable method references and methodology summaries.

#### Key:

Anonymous = Refers to samples which are not part of this work order, but which formed part of the QC process lot.

CAS Number = Chemical Abstracts Services number is a unique identifier assigned to discrete substances.

DQO = Data Quality Objective.

LOR = Limit of Reporting (detection limit).

RPD = Relative Percentage Difference

# = Indicates a QC result that did not meet the ALS DQO.



Contact: Heather McKenzie Company: ALS Whitehorse Address: 12-151 Industrial Rd, Whitehorse, YT, Y1A2V3

Project / Location: WR2101403 PO Number: WR2101403 ALS Work Order: 21100154

NARRATIVE: This method was based on the study, "Synthetic Polymer Contamination in Bottled Water" conducted at the State University of New York at Fredonia which found an average of 325 MPP/L in bottled water brands from around the globe. The efficacy of this method for the detection of MPP in non-potable waters or other matrices has not been determined. Samples were analyzed according to ALS SOP Micro-Fluor-001 for the detection of micro plastic.

according to ALS SOP Micro-Fluor-001 for the detection of micro plastic particles (MPP) using fluorescent tagging and static image analysis. This method has been shown to be sufficient for the rapid detection of polymerics including polyethylene, polypropylene, polystyrene and nylon 6 though it

cannot differentiate between them.

Particle sizing is performed using static image analysis of representative calibrated two dimensional photomicrographs. The minimum caliper is the shortest distance between any 2 points along a single particle boundary and represents the approximate width/diameter of the particle/fiber. The maximum caliper is the longest distance between any 2 points along a single particle boundary and represents the length of the particle/fiber. The smallest single particle dimension confidently resolved by this method at the lowest available magnification has been determined to be approximately 6.5µm. Additionally, particles whose largest single dimension is greater than 5mm fall outside the generally accepted definition of MPP. Therefore, the total MPP concentration reported includes only fluorescing particles >6.5µm<5mm.

The dimension of interest (DOI) is selected based on observation of dominant particle morphology and determines the particle dimensions reported herein. Samples observed to contain primarily fibrous MPP exhibiting a length to width aspect ratio of 3:1 or greater are categorized according to maximum caliper (length). Samples observed to contain primarily non-fibrous MPP are categorized according to minimum caliper (diameter or width). Samples observed to contain an approximately equal mixture of both fibrous and non-fibrous MPP are categorized according to total area in square µm or mm. The analytical sensitivity (AS) for this method is based on the detection of one particle in the total area analyzed. When possible sufficient sample is analyzed to yield an AS<10 MPP/L. However, the volume of sample that can be analyzed is dependent upon clarity. Therefore, samples containing significant concentrations of interferences may not attain the desired AS. Interferences such as opaque suspended solids may result in a negative bias and lipid-rich interferences such as fats, waxes, and oils may result in a positive bias.

All sample collection is performed outside ALS and is the sole responsibility of the client. Filtered samples are archived for 60 days prior to disposal. Results apply only to portions analyzed. Microscopy is not suitable for the examination of all types of materials. Additional testing may be required.

IDEN	JTI		$\sim$ V	TI	ΛNI
IDEI	4 I I	Г	CA		OIA

 $>500\mu m \le 1mm$ :

>1<u><</u>5mm:

TOTAL:

0.00

0.00

58.86

IDENTIFICATION					
Client Sample ID:	WR2101403- 001 / TRDB-01	WR2101403- 002 / TRDB-02	WR2101403- 003 / TRDB-03	WR2101403- 004 / TRDB-04	WR2101403- 005 / TRDB-05
ALS Sample ID: Collection Date: ANALYSIS	21100154-01 9/13/2021	21100154-02 9/13/2021	21100154-03 9/13/2021	21100154-04 9/13/2021	21100154-05 9/13/2021
	December 112 and	Described Process	Described Process	December 112 and	Described Process
Analyst: Date: Filtered Volume (mL):	10/11/2021 500	Pamela Hizar 10/11/2021 500	Pamela Hizar 10/11/2021 500	Pamela Hizar 10/11/2021 500	Pamela Hizar 10/11/2021 500
AS (MPP/L):	2.68	2.68	2.68	2.68	2.68
DOI:	DIAMETER	DIAMETER	DIAMETER	DIAMETER	DIAMETER
CONCENTRATION (MPP	,				
>6.5 <u>&lt;</u> 10µm:	26.75	21.40	18.73	18.73	26.75
>10 <u>&lt;</u> 100µm:	40.13	56.18	34.78	21.40	74.91
>100 <u>&lt;</u> 500µm:	2.68	5.35	10.70	0.00	2.68
	0.00	0.00	0.00	0.00	0.00
>500µm <u>&lt;</u> 1mm:		0.00	0.00	0.00	0.00
>500µm <u>&lt;</u> 1mm: >1 <u>&lt;</u> 5mm:	0.00	0.00	0.00	0.00	0.00
	0.00 <b>69.56</b>	0.00 <b>82.94</b>	64.21	<b>40.13</b>	104.34
>1 <u>&lt;</u> 5mm:			64.21	40.13	104.34
>1 <u>&lt;</u> 5mm: <b>TOTAL:</b>					
>1 <u>&lt;</u> 5mm: TOTAL: IDENTIFICATION	<b>69.56</b> WR2101403-	<b>82.94</b> WR2101403-	<b>64.21</b> WR2101403- 008 / Travel	<b>40.13</b> WR2101403- 009 / YRMLD-	104.34 WR2101403- 010 / YRMLD-
>1 <u>&lt;</u> 5mm: TOTAL:  IDENTIFICATION  Client Sample ID:	69.56 WR2101403- 006 / FB-01	<b>82.94</b> WR2101403- 007 / FB-02	64.21 WR2101403- 008 / Travel Blank	<b>40.13</b> WR2101403- 009 / YRMLD- 01	WR2101403- 010 / YRMLD- 02
>1 <u>&lt;</u> 5mm: TOTAL:  IDENTIFICATION  Client Sample ID: ALS Sample ID:	69.56 WR2101403- 006 / FB-01 21100154-06	<b>82.94</b> WR2101403- 007 / FB-02 21100154-07	WR2101403- 008 / Travel Blank 21100154-08	WR2101403- 009 / YRMLD- 01 21100154-09	WR2101403- 010 / YRMLD- 02 21100154-10
>1 <u>&lt;</u> 5mm: TOTAL:  IDENTIFICATION  Client Sample ID: ALS Sample ID: Collection Date:	69.56 WR2101403- 006 / FB-01 21100154-06 9/13/2021	<b>82.94</b> WR2101403- 007 / FB-02 21100154-07	WR2101403- 008 / Travel Blank 21100154-08	WR2101403- 009 / YRMLD- 01 21100154-09	WR2101403- 010 / YRMLD- 02 21100154-10
>1≤5mm: TOTAL:  IDENTIFICATION  Client Sample ID: ALS Sample ID: Collection Date: ANALYSIS	69.56 WR2101403- 006 / FB-01 21100154-06 9/13/2021	82.94 WR2101403- 007 / FB-02 21100154-07 9/13/2021	64.21 WR2101403- 008 / Travel Blank 21100154-08 9/13/2021	40.13 WR2101403- 009 / YRMLD- 01 21100154-09 9/13/2021	WR2101403- 010 / YRMLD- 02 21100154-10 9/13/2021
>1≤5mm: TOTAL:  IDENTIFICATION  Client Sample ID: ALS Sample ID: Collection Date: ANALYSIS  Analyst:	69.56 WR2101403- 006 / FB-01 21100154-06 9/13/2021 Pamela Hizar	82.94 WR2101403- 007 / FB-02 21100154-07 9/13/2021 Pamela Hizar	64.21  WR2101403- 008 / Travel Blank 21100154-08 9/13/2021  Pamela Hizar	40.13 WR2101403- 009 / YRMLD- 01 21100154-09 9/13/2021 Pamela Hizar	WR2101403- 010 / YRMLD- 02 21100154-10 9/13/2021 Pamela Hizar
>1≤5mm: TOTAL:  IDENTIFICATION  Client Sample ID:     ALS Sample ID:     Collection Date:  ANALYSIS  Analyst:     Date: Filtered Volume (mL):	69.56  WR2101403- 006 / FB-01 21100154-06 9/13/2021  Pamela Hizar 10/11/2021 1000	82.94 WR2101403- 007 / FB-02 21100154-07 9/13/2021 Pamela Hizar 10/11/2021 1000	64.21  WR2101403- 008 / Travel Blank 21100154-08 9/13/2021  Pamela Hizar 10/11/2021 1000	WR2101403- 009 / YRMLD- 01 21100154-09 9/13/2021 Pamela Hizar 10/11/2021 500	WR2101403- 010 / YRMLD- 02 21100154-10 9/13/2021 Pamela Hizar 10/11/2021 500
>1≤5mm: TOTAL:  IDENTIFICATION  Client Sample ID:     ALS Sample ID:     Collection Date:  ANALYSIS  Analyst:     Date:     Filtered Volume (mL):     AS (MPP/L):	69.56  WR2101403- 006 / FB-01  21100154-06 9/13/2021  Pamela Hizar 10/11/2021 1000 1.34	82.94  WR2101403- 007 / FB-02  21100154-07 9/13/2021  Pamela Hizar 10/11/2021 1000 1.34	64.21  WR2101403- 008 / Travel Blank 21100154-08 9/13/2021  Pamela Hizar 10/11/2021 1000 1.34	WR2101403- 009 / YRMLD- 01 21100154-09 9/13/2021 Pamela Hizar 10/11/2021 500 2.68	WR2101403- 010 / YRMLD- 02 21100154-10 9/13/2021 Pamela Hizar 10/11/2021 500 2.68
>1≤5mm: TOTAL:  IDENTIFICATION  Client Sample ID:     ALS Sample ID:     Collection Date:  ANALYSIS  Analyst:     Date:     Filtered Volume (mL):     AS (MPP/L):     DOI:	69.56  WR2101403- 006 / FB-01  21100154-06 9/13/2021  Pamela Hizar 10/11/2021 1000 1.34 DIAMETER	82.94 WR2101403- 007 / FB-02 21100154-07 9/13/2021 Pamela Hizar 10/11/2021 1000	64.21  WR2101403- 008 / Travel Blank 21100154-08 9/13/2021  Pamela Hizar 10/11/2021 1000	WR2101403- 009 / YRMLD- 01 21100154-09 9/13/2021 Pamela Hizar 10/11/2021 500	WR2101403- 010 / YRMLD- 02 21100154-10 9/13/2021 Pamela Hizar 10/11/2021 500
>1≤5mm: TOTAL:  IDENTIFICATION  Client Sample ID:     ALS Sample ID:     Collection Date:  ANALYSIS  Analyst:     Date:     Filtered Volume (mL):     AS (MPP/L):     DOI: CONCENTRATION (MPP	69.56  WR2101403- 006 / FB-01 21100154-06 9/13/2021  Pamela Hizar 10/11/2021 1000 1.34 DIAMETER /L)	82.94  WR2101403- 007 / FB-02  21100154-07 9/13/2021  Pamela Hizar 10/11/2021 1000 1.34 DIAMETER	64.21  WR2101403- 008 / Travel Blank 21100154-08 9/13/2021  Pamela Hizar 10/11/2021 1000 1.34 DIAMETER	WR2101403- 009 / YRMLD- 01 21100154-09 9/13/2021 Pamela Hizar 10/11/2021 500 2.68 DIAMETER	WR2101403- 010 / YRMLD- 02 21100154-10 9/13/2021 Pamela Hizar 10/11/2021 500 2.68 DIAMETER
>1≤5mm: TOTAL:  IDENTIFICATION  Client Sample ID:     ALS Sample ID:     Collection Date:  ANALYSIS  Analyst:     Date:     Filtered Volume (mL):     AS (MPP/L):     DOI: CONCENTRATION (MPP)     >6.5≤10μm:	69.56  WR2101403- 006 / FB-01  21100154-06 9/13/2021  Pamela Hizar 10/11/2021 1000 1.34 DIAMETER /L)  21.40	82.94  WR2101403- 007 / FB-02  21100154-07 9/13/2021  Pamela Hizar 10/11/2021 1000 1.34 DIAMETER	64.21  WR2101403- 008 / Travel Blank 21100154-08 9/13/2021  Pamela Hizar 10/11/2021 1000 1.34 DIAMETER  32.10	40.13 WR2101403- 009 / YRMLD- 01 21100154-09 9/13/2021 Pamela Hizar 10/11/2021 500 2.68 DIAMETER	WR2101403- 010 / YRMLD- 02 21100154-10 9/13/2021 Pamela Hizar 10/11/2021 500 2.68 DIAMETER
>1≤5mm: TOTAL:  IDENTIFICATION  Client Sample ID:     ALS Sample ID:     Collection Date:  ANALYSIS  Analyst:     Date:     Filtered Volume (mL):     AS (MPP/L):     DOI: CONCENTRATION (MPP	69.56  WR2101403- 006 / FB-01 21100154-06 9/13/2021  Pamela Hizar 10/11/2021 1000 1.34 DIAMETER /L)	82.94  WR2101403- 007 / FB-02  21100154-07 9/13/2021  Pamela Hizar 10/11/2021 1000 1.34 DIAMETER	64.21  WR2101403- 008 / Travel Blank 21100154-08 9/13/2021  Pamela Hizar 10/11/2021 1000 1.34 DIAMETER	WR2101403- 009 / YRMLD- 01 21100154-09 9/13/2021 Pamela Hizar 10/11/2021 500 2.68 DIAMETER	WR2101403- 010 / YRMLD- 02 21100154-10 9/13/2021 Pamela Hizar 10/11/2021 500 2.68 DIAMETER

0.00

0.00

66.88

0.00

0.00

48.16

0.00

0.00

26.75

0.00

0.00

10.70

IDENTIFICATION					
IDENTIFICATION	WR2101403- 011 / YRMLD-	WR2101403- 012 / YRMLD-	WR2101403- 013 / YRMLD-	WR2101403-	WR2101403-
Client Sample ID:	03	04	05	014 / YCAR-01	015 / YCAR-02
ALS Sample ID:	21100154-11	21100154-12	21100154-13	21100154-14	21100154-15
Collection Date:	9/13/2021	9/13/2021	9/13/2021	9/14/2021	9/14/2021
ANALYSIS					
Analyst:	Pamela Hizar	Pamela Hizar	Pamela Hizar	Pamela Hizar	Pamela Hizar
Date:	10/11/2021	10/11/2021	10/11/2021	10/11/2021	10/11/2021
Filtered Volume (mL):	500	500	500	500	500
AS (MPP/L):	2.68	2.68	2.68	2.68	2.68
DOI:	DIAMETER	DIAMETER	DIAMETER	DIAMETER	DIAMETER
CONCENTRATION (MPP	/ <b>L)</b>				
>6.5 <u>&lt;</u> 10µm:	8.03	13.38	16.05	16.05	13.38
>10 <u>&lt;</u> 100µm:	16.05	0.00	18.73	40.13	21.40
>100 <u>&lt;</u> 500µm:	0.00	0.00	0.00	5.35	0.00
>500µm <u>&lt;</u> 1mm:	0.00	0.00	0.00	0.00	0.00
>1 <u>&lt;</u> 5mm:	0.00	0.00	0.00	0.00	0.00
TOTAL:	24.08	13.38	34.78	61.53	34.78

<b>IDENTIFICATION</b>

Client Sample ID:	WR2101403- 016 / YCAR-03	WR2101403- 017 / YCAR-04	WR2101403- 018 / YCAR-05	WR2101403- 019 / YRUTR- 01	WR2101403- 020 / YRUTR- 02
ALS Sample ID:		21100154-17	21100154-18	21100154-19	21100154-20
Collection Date:	9/14/2021	9/14/2021	9/14/2021	9/13/2021	9/13/2021
ANALYSIS					
Analyst:	Pamela Hizar	Pamela Hizar	Pamela Hizar	Pamela Hizar	Pamela Hizar
Date:	10/11/2021	10/11/2021	10/11/2021	10/11/2021	10/11/2021
Filtered Volume (mL):	500	500	500	500	500
AS (MPP/L):	2.68	2.68	2.68	2.68	2.68
DOI:	DIAMETER	DIAMETER	DIAMETER	DIAMETER	DIAMETER
CONCENTRATION (MPP	/ <b>L)</b>				
>6.5 <u>&lt;</u> 10µm:	13.38	13.38	13.38	0.00	21.40
>10 <u>&lt;</u> 100µm:	2.68	13.38	144.47	8.03	24.08
>100 <u>&lt;</u> 500μm:	2.68	2.68	0.00	2.68	0.00
>500µm <u>&lt;</u> 1mm:	0.00	0.00	0.00	0.00	0.00
>1 <u>&lt;</u> 5mm:	0.00	0.00	0.00	0.00	0.00
TOTAL:	18.73	29.43	157.85	10.70	45.48

<u> </u>	DENTIFICATION
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	WR2101403-	WR2101403-	WR2101403-	WR2101403-	WR2101403-
	021 / YRUTR-	022 / YRUTR-	023 / YRUTR-	024 /	025 /
Client Sample ID:	03	04	05	YRDRAW-01	YRDRAW-02
ALS Sample ID:	21100154-21	21100154-22	21100154-23	21100154-24	21100154-25
Collection Date:	9/13/2021	9/13/2021	9/13/2021	9/14/2021	9/29/2021
ANALYSIS					
Analyst:	Pamela Hizar				
Date:	10/11/2021	10/11/2021	10/11/2021	10/11/2021	10/11/2021
Filtered Volume (mL):	500	500	500	25	25
AS (MPP/L):	2.68	2.68	2.68	53.51	53.51
DOI:	DIAMETER	DIAMETER	DIAMETER	DIAMETER	DIAMETER
CONCENTRATION (MPP)	/L)				
>6.5 <u>&lt;</u> 10µm:	21.40	10.70	18.73	18.73	26.75
>10 <u>&lt;</u> 100μm:	21.40	5.35	26.75	2.68	0.00
>100 <u>&lt;</u> 500μm:	0.00	2.68	5.35	2.68	0.00
>500µm <u>&lt;</u> 1mm:	0.00	0.00	0.00	0.00	0.00
>1 <u>&lt;</u> 5mm:	0.00	0.00	0.00	0.00	0.00
TOTAL:	42.81	18.73	50.83	24.08	26.75

# **IDENTIFICATION**

	WR2101403-	WR2101403-	WR2101403-	
	026 /	027 /	028 /	
Client Sample ID:	YRDRAW-03	YRDRAW-04	YRDRAW-05	
ALS Sample ID:	21100154-26	21100154-27	21100154-28	
Collection Date:	9/29/2021	9/29/2021	9/29/2021	
ANALYSIS				
Analyst:	Pamela Hizar	Pamela Hizar	Pamela Hizar	
Date:	10/11/2021	10/11/2021	10/11/2021	
Filtered Volume (mL):	25	25	25	
AS (MPP/L):	53.51	53.51	53.51	
DOI:	DIAMETER	DIAMETER	DIAMETER	
CONCENTRATION (MPP)	/ <b>L)</b>			
>6.5 <u>&lt;</u> 10μm:	18.73	32.10	29.43	
>10 <u>&lt;</u> 100µm:	0.00	5.35	16.05	
>100 <u>&lt;</u> 500μm:	0.00	0.00	0.00	
>500µm <u>&lt;</u> 1mm:	0.00	0.00	0.00	
>1 <u>&lt;</u> 5mm:	0.00	0.00	0.00	
TOTAL:	18.73	37.46	45.48	

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COC Number: 21 -

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Environmental Division
Whitehorse
Work Order Reference
WR2101403

Report To	Contact and company name below will app									Turnaround Time (TAT) Requested											
Company:	YUKON GOVERNEN	Select Report F	ormat: PDF	EXCEL E	EDD (DIGITAL)				ed by 3pm		STATE OF THE PROPERTY.		6			MA.			I		
Contact:	Devon O'Connor		Merge QC/QCI	Reports with COA	YES N	IO N/A	-			d by 3pm								. W. Y.			
Phone:	867-689-1894		Compare Resul	ts to Criteria on Report						ed by 3pm ed by 3pm						∭₩	10.8				
	Company address below will appear on the fir	nal report	Select Distribution		MAIL	105500				by 3pm			A ATTOC SECTION -			III Q.V					
Street:			Email 1 or Fax	Devon. O'C	onnor@y	okon,ca		Same day	[E2] if re	ceived by 1	10am M-5	5 - 200%	rush surc	harge		.HI   III   16	ACE TAK	IT' I lail			
City/Province:			Email 2				8523		Additiona	l fees may	apply to r	ush reque	sts on we	eken	Telepho	one: +1	867 668	6689			
Postal Code:			Email 3			0		Date ar	nd Time R	equired fo	r all E&P	TATs:									
Invoice To	Same as Report To			Invoice R	ecipients					For all tests	with rush	TATs req	uested, pl	ease conta	ct your /	AM to conf	irm availa	bility.			
	Copy of Invoice with Report YES	□ NO	Select Invoice D	istribution: E	MAIL   MAIL	FAX						,	Analysis	s Reque	est						
Company:			Email 1 or Fax				SS		Ind	licate Filter	ed (F), Pr	eserved (	P) or Filter	red and Pr	reserved	I (F/P) bel	ow		П	e	(\$
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ALS Lab Wor	k Order # (ALS use only):		ALS Contact:		Sampler:			Micro											SAMPLES	EXTENDED	SUSPECTED HAZARD (see notes)
ALS Sample #	Sample Identification	and/or Coordinates		Date	Time	Commis Tun	NUMBER	13											Ξ	三	SPE
(ALS use only)	(This description will	appear on the report)		(dd-mmm-yy)	(hh:mm)	Sample Typ	۳ z	2											S	E	SU
	TRDB-01			13-Sep-21	13:10	water	1	V											П		
	TRDB-02			13-Sep-21	13:10	water	1	1											$\neg$		
	TRDB-03			13-Sep-21	13:10	water	1/	1/											$\neg$	$\neg$	
	TRDB-04			13-Sep-21	13:10	water	(	$\Box$							$\overline{}$	$\overline{}$	_		$\neg$	$\dashv$	$\neg$
10 10 70 July 1	TRDB-05			13-Sep-21	13:10	water	1	H		+			+		+	+	+	$\vdash$	$\dashv$	$\dashv$	$\dashv$
THE PERSON	FB-01			13-Sep-21	13:20	water	+	+	-			-	+		+	_	+		$\dashv$	$\dashv$	$\dashv$
	FB-02			13-Sep-21	13:20		+	+++	-	_		-	+		+	_	+		$\dashv$	$\dashv$	
8	Travel Blank					water	1	1	-		$\vdash$	_	-	-	+	+	_	$\vdash$	$\dashv$	-	$\dashv$
8	Traver Blank			13-Sep-21	0:00	water	4	V				_	_	$\vdash$	$\rightarrow$	-			_	_	$\dashv$
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				0																	
Drinking	Water (DW) Samples <sup>1</sup> (client use)	Notes / Specify I		aluation by selecti	ng from drop-dov	vn below	0.00	SAMPLE RECEIPT DETAIL													
	en from a Regulated DW System?	(Ex	cel COC only)			_	Cooling Method: NONE ICE ICE PACKS														
	ES NO						Submission Comments identified on Sample Receipt Notif														
	human consumption/ use?		C				Cool			ls Intact:		YES [	N/A	Samı							
CONTRACTOR OF THE PROPERTY OF	ES NO		7				0	/ IN	11	OLER TEM	PEHATU	HES °C		111 50							
	SHIPMENT RELEASE (client use	\	INITIAL CHIPMENT DESCRIPTION (ALC				1/	0	20			IAL OU	DME	DEC							
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Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

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COC Number: 21 -

Page of

Report To	Contact and company name below will ap	pear on the final report	Reports / Recipients					Turnaround Time (TAT) Requested										Secretary.	DE POR	177.00	
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	YRMLD-02			13-Sep-21	11:45	Water	1	i													
				13-Sep-21	11:45	Water															
	YRMLD-03			13-Sep-21	11:45	Water															
	YRMLD-04			13-Sep-21	11:45	Water													$\top$	$\top$	
	YRMLD-05			13-Sep-21	11:45	Water									+	$\top$		$\top$	1	$\vdash$	
	YCAR-01			14-Sep-21	16:50	Water							$\dashv$	+	+	+		+	+	+	
	YCAR-02			14-Sep-21	16:50	Water			+				+		+	$\vdash$	$\vdash$	+	+	+-	
AND THE RESERVE	YCAR-03			14-Sep-21	16:50	Water		+	+			-	$\dashv$	_	+			+	+	+	
	YCAR-04			14-Sep-21	16:50	Water		+	+	-	+	-	+	-	+	+	$\vdash$	+	+	+-	
18	YCAR-05			14-Sep-21	16:50	Water		4		+	+	+	+	+	+-	+	$\vdash$	+	+	╁	
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				cel COC only)	3		Cooli	ng Method	d:	NONE [					ROZEN		COOL	ING INT	TATED		
	n from a Regulated DW System?						Subm	ission Co	mments i									□ NO	IATED	A YEAR	
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LSD:	America		Location:				_ ₽	0	+ 1		1 1						7	δ   Ş	NAZARD (see notes)								
ALS Lab Worl	k Order # (ALS use only):		ALS Contact:		Sampler:			2											TED TED								
ALS Sample # (ALS use only)	Sample Identification (This description will a			Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER	Mic										SAMPLES	SUSPECTED HAZARD (see notes)								
19	YRUTR-01	, in the second		13-Sep-21	9:45	Water	- 2		_		+	_		+	+			מ נ	) IS								
	YRUTR-02			13-Sep-21	9:45		-	1	-	_	-	_		+	_	+	$\vdash$	$\perp$									
	YRUTR-03			13-Sep-21		Water						_	_					$\perp$	$\perp$								
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	YRUTR-05			13-Sep-21	9:45	Water	-										$\perp$										
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Drinking 1	Water (DW) Samples <sup>1</sup> (client use)	Notes / Specify	Limits for result e	valuation by selecting cel COC only)	ng from drop-dov	n below	Ally	ur	grant in	SAI	MPLE RE	CEIPT	DETAIL	S (ALS	ise onl	1)		S. SE	Service Control								
re samples taker	n from a Regulated DW System?		(E)	xcei coc oniy)			Cooling Method: NONE ICE ICE PACKS FROZEN COOLING INITIATED																				
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COC Number: 21 -

**Environmental Division** 



Canada	Toll	Free:	1	800	668	987
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Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy. 1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form



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COC Number: 21 -

Page 2 of 3

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# **CERTIFICATE OF ANALYSIS**

Work Order : WR2200058

Client : Government of Yukon

Contact : Devon O'Connor

Address : 113 Industrial Road

Whitehorse YT Canada Y1A 2T7

Telephone : --Project : ---

PO : ----

C-O-C number : ----Sampler : ----

Quote number : VA21-GPYT100-011

No. of samples received : 60 No. of samples analysed : 55 Page : 1 of 6

Laboratory : Whitehorse - Environmental

Account Manager : Tasnia Tarannum

Address : #12 151 Industrial Road

Whitehorse YT Canada Y1A 2V3

Telephone : +1 867 668 6689

Date Samples Received : 27-Jan-2022 12:30

Date Analysis Commenced : 15-Feb-2022

Issue Date : 07-Mar-2022 11:51

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QC Interpretive report to assist with Quality Review and Sample Receipt Notification (SRN).

#### Signatories

Site

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories Position Laboratory Department

Kaitlyn Gardner Account Manager Assistant Internal Subcontracting, Cincinnati, Ohio Trace Chometsky Account Manager Assistant Internal Subcontracting, Cincinnati, Ohio

Page : 2 of 6

Work Order : WR2200058

Client : Government of Yukon

Project : ---



#### **General Comments**

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Refer to the ALS Quality Control Interpretive report (QCI) for applicable references and methodology summaries. Reference methods may incorporate modifications to improve performance.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Please refer to Quality Control Interpretive report (QCI) for information regarding Holding Time compliance.

Key: CAS Number: Chemical Abstracts Services number is a unique identifier assigned to discrete substances

LOR: Limit of Reporting (detection limit).

Unit	Description
-	No Unit

<: less than.

>: greater than.

Surrogate: An analyte that is similar in behavior to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED on SRN or QCI Report, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

#### **Workorder Comments**

Wait 30 days from receipt to analyse tbb 1-5

Page : 3 of 6

Work Order : WR2200058

Client : Government of Yukon

Project : ---



## Analytical Results

Sub-Matrix: Drinking Water			Cl	ient sample ID	TBA-1	TBA-2	TBA-3	TBA-4	TBA-5
(Matrix: Water)									
			Client samp	ling date / time	25-Jan-2022	25-Jan-2022	25-Jan-2022	25-Jan-2022	25-Jan-2022
Analyte	CAS Number	Method	LOR	Unit	WR2200058-001	WR2200058-002	WR2200058-003	WR2200058-004	WR2200058-005
					Result	Result	Result	Result	Result
Physical Tests									
microplastic particles	n/a	MicroPlasticS	-	-	See	See attached	See attached	See attached	See attached
		RN			attached				

Please refer to the General Comments section for an explanation of any qualifiers detected.

#### Analytical Results

_									
Sub-Matrix: Drinking Water			CI	lient sample ID	YRDAW-1	YRDAW-2	YRDAW-3	YRDAW-4	YRDAW-5
(Matrix: Water)									
			Client samp	oling date / time	20-Jan-2022 10:00	20-Jan-2022 10:00	20-Jan-2022 10:00	20-Jan-2022 10:00	20-Jan-2022 10:00
Analyte	CAS Number	Method	LOR	Unit	WR2200058-011	WR2200058-012	WR2200058-013	WR2200058-014	WR2200058-01
					Result	Result	Result	Result	Result
Physical Tests									
microplastic particles	n/a	MicroPlasticS	-	-	See	See attached	See attached	See attached	See attached
		RN			attached				

Please refer to the General Comments section for an explanation of any qualifiers detected.

## Analytical Results

Sub-Matrix: Drinking Water			Ci	lient sample ID	TBP-1	TBP-2	TBP-3	TBP-4	TBP-5
(Matrix: Water)									
			Client samp	oling date / time	25-Jan-2022	25-Jan-2022	25-Jan-2022	25-Jan-2022	25-Jan-2022
Analyte	CAS Number	Method	LOR	Unit	WR2200058-016	WR2200058-017	WR2200058-018	WR2200058-019	WR2200058-020
					Result	Result	Result	Result	Result
Physical Tests									
microplastic particles	n/a	MicroPlasticS	-	-	See	See attached	See attached	See attached	See attached
		RN			attached				

Page : 4 of 6

Work Order : WR2200058

Client : Government of Yukon

Project : ---



## Analytical Results

Sub-Matrix: Drinking Water			Cli	ient sample ID	TBG-1	TBG-2	TBG-3	TBG-4	TBG-5
(Matrix: Water)									
			Client samp	ling date / time	25-Jan-2022	25-Jan-2022	25-Jan-2022	25-Jan-2022	25-Jan-2022
Analyte	CAS Number	Method	LOR	Unit	WR2200058-021	WR2200058-022	WR2200058-023	WR2200058-024	WR2200058-025
					Result	Result	Result	Result	Result
Physical Tests									
microplastic particles	n/a	MicroPlasticS	-	-	See	See attached	See attached	See attached	See attached
		RN			attached				

Please refer to the General Comments section for an explanation of any qualifiers detected.

## Analytical Results

Sub-Matrix: Drinking Water			Cli	ient sample ID	TB-01	TB-02	FB-01	FB-02	FB-03
(Matrix: Water)									
			Client samp	ling date / time	25-Jan-2022	25-Jan-2022	25-Jan-2022 15:15	25-Jan-2022 15:15	25-Jan-2022 15:15
Analyte	CAS Number	Method	LOR	Unit	WR2200058-026	WR2200058-027	WR2200058-028	WR2200058-029	WR2200058-030
					Result	Result	Result	Result	Result
Physical Tests									
microplastic particles	n/a	MicroPlasticS	-	-	See	See attached	See attached	See attached	See attached
		RN			attached				

Please refer to the General Comments section for an explanation of any qualifiers detected.

# Analytical Results

Sub-Matrix: Drinking Water			CI	ient sample ID	YRMLD-01	YRMLD-02	YRMLD-03	YRMLD-04	YRMLD-05
(Matrix: Water)									
			Client samp	ling date / time	25-Jan-2022 14:15	25-Jan-2022 14:15	25-Jan-2022 14:15	25-Jan-2022 14:15	25-Jan-2022 14:15
Analyte	CAS Number	Method	LOR	Unit	WR2200058-031	WR2200058-032	WR2200058-033	WR2200058-034	WR2200058-035
				ľ	Result	Result	Result	Result	Result
Physical Tests									
microplastic particles	n/a	MicroPlasticS	-	-	See	See attached	See attached	See attached	See attached
		RN			attached				

Page : 5 of 6

Work Order : WR2200058

Client : Government of Yukon

Project : ---



## Analytical Results

Sub-Matrix: Drinking Water			CI	ient sample ID	TRDB-01	TRDB-02	TRDB-03	TRDB-04	TRDB-05
(Matrix: Water)									
			Client samp	ling date / time	25-Jan-2022 15:10	25-Jan-2022 15:10	25-Jan-2022 15:10	25-Jan-2022 15:10	25-Jan-2022 15:10
Analyte	CAS Number	Method	LOR	Unit	WR2200058-036	WR2200058-037	WR2200058-038	WR2200058-039	WR2200058-040
					Result	Result	Result	Result	Result
Physical Tests									
microplastic particles	n/a	MicroPlasticS	-	-	See	See attached	See attached	See attached	See attached
		RN			attached				

Please refer to the General Comments section for an explanation of any qualifiers detected.

#### Analytical Results

Sub-Matrix: Drinking Water			CI	ient sample ID	YCAR-01	YCAR-02	YCAR-03	YCAR-04	YCAR-05
(Matrix: Water)									
			Client samp	ling date / time	25-Jan-2022 10:45	25-Jan-2022 10:45	25-Jan-2022 10:45	25-Jan-2022 10:45	25-Jan-2022 10:45
Analyte	CAS Number	Method	LOR	Unit	WR2200058-041	WR2200058-042	WR2200058-043	WR2200058-044	WR2200058-045
					Result	Result	Result	Result	Result
Physical Tests									
microplastic particles	n/a	MicroPlasticS	-	-	See	See attached	See attached	See attached	See attached
		RN			attached				

Please refer to the General Comments section for an explanation of any qualifiers detected.

# Analytical Results

Sub-Matrix: Drinking Water			CI	ient sample ID	YRUTR-01	YRUTR-02	YRUTR-03	YRUTR-04	YRUTR-05
(Matrix: Water)									
			Client samp	ling date / time	25-Jan-2022 13:00	25-Jan-2022 13:00	25-Jan-2022 13:00	25-Jan-2022 13:00	25-Jan-2022 13:00
Analyte	CAS Number	Method	LOR	Unit	WR2200058-046	WR2200058-047	WR2200058-048	WR2200058-049	WR2200058-050
				ľ	Result	Result	Result	Result	Result
Physical Tests									
microplastic particles	n/a	MicroPlasticS	-	-	See	See attached	See attached	See attached	See attached
		RN			attached				

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Client : Government of Yukon

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## Analytical Results

Sub-Matrix: Drinking Water			CI	ient sample ID	FBP-01	FBP-02	FBP-03	FBP-04	FBP-05
(Matrix: Water)									
			Client samp	ling date / time	25-Jan-2022 15:25	25-Jan-2022 15:25	25-Jan-2022 15:25	25-Jan-2022 15:25	25-Jan-2022 15:25
Analyte	CAS Number	Method	LOR	Unit	WR2200058-051	WR2200058-052	WR2200058-053	WR2200058-054	WR2200058-055
					Result	Result	Result	Result	Result
Physical Tests									
microplastic particles	n/a	MicroPlasticS	-	-	See	See attached	See attached	See attached	See attached
		RN			attached				

Please refer to the General Comments section for an explanation of any qualifiers detected.

#### Analytical Results

Sub-Matrix: Drinking Water			Client sample ID		FBG-1	FBG-2	FBG-3	FBG-4	FBG-5
(Matrix: Water)									
			Client sampling date / time		25-Jan-2022 15:15	25-Jan-2022 15:15	25-Jan-2022 15:15	25-Jan-2022 15:15	25-Jan-2022 15:15
Analyte	CAS Number	Method	LOR	Unit	WR2200058-056	WR2200058-057	WR2200058-058	WR2200058-059	WR2200058-060
					Result	Result	Result	Result	Result
Physical Tests									
microplastic particles	n/a	MicroPlasticS	-	-	See	See attached	See attached	See attached	See attached
		RN			attached				



# **QUALITY CONTROL INTERPRETIVE REPORT**

**Work Order** : **WR2200058** Page : 1 of 10

Client : Government of Yukon Laboratory : Whitehorse - Environmental

Contact : Devon O'Connor Account Manager : Tasnia Tarannum

Address : 113 Industrial Road Address :#12 151 Industrial Road

Whitehorse YT Canada Y1A 2T7

Whitehorse YT Canada Y1A 2T7

Telephone : ---- Telephone : +1 867 668 6689

 Project
 : -- Date Samples Received
 : 27-Jan-2022 12:30

 PO
 : -- Issue Date
 : 07-Mar-2022 11:51

 C-O-C number
 : -- : -- : -- 

Sampler : ----

: VA21-GPYT100-011

Site :---

No. of samples received : 60

No. of samples analysed : 55

This report is automatically generated by the ALS LIMS (Laboratory Information Management System) through evaluation of Quality Control (QC) results and other QA parameters associated with this submission, and is intended to facilitate rapid data validation by auditors or reviewers. The report highlights any exceptions and outliers to ALS Data Quality Objectives, provides holding time details and exceptions, summarizes QC sample frequencies, and lists applicable methodology references and summaries.

#### Key

Quote number

Anonymous: Refers to samples which are not part of this work order, but which formed part of the QC process lot.

CAS Number: Chemical Abstracts Services number is a unique identifier assigned to discrete substances.

DQO: Data Quality Objective.

LOR: Limit of Reporting (detection limit).

RPD: Relative Percent Difference.

# **Summary of Outliers**

#### **Outliers: Quality Control Samples**

- No Method Blank value outliers occur.
- No Duplicate outliers occur.
- No Laboratory Control Sample (LCS) outliers occur
- No Matrix Spike outliers occur.
- No Test sample Surrogate recovery outliers exist.

#### Outliers: Reference Material (RM) Samples

• No Reference Material (RM) Sample outliers occur.

#### **Outliers : Analysis Holding Time Compliance (Breaches)**

• No Analysis Holding Time Outliers exist.

#### **Outliers: Frequency of Quality Control Samples**

• No Quality Control Sample Frequency Outliers occur.

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Client : Government of Yukon

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# **Analysis Holding Time Compliance**

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times, which are selected to meet known provincial and/or federal requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by organizations such as CCME, US EPA, APHA Standard Methods, ASTM, or Environment Canada (where available). Dates and holding times reported below represent the first dates of extraction or analysis. If subsequent tests or dilutions exceeded holding times, qualifiers are added (refer to COA).

If samples are identified below as having been analyzed or extracted outside of recommended holding times, measurement uncertainties may be increased, and this should be taken into consideration when interpreting results.

Where actual sampling date is not provided on the chain of custody, the date of receipt with time at 00:00 is used for calculation purposes.

Where only the sample date without time is provided on the chain of custody, the sampling date at 00:00 is used for calculation purposes.

Matrix: Water Evaluation: ▼ = Holding time exceedance; ✓ = Within Holding Time										
Analyte Group	Method	Sampling Date	Ext	raction / Preparation				Analysis		
Container / Client Sample ID(s)			Preparation Holding 7		g Times	Eval	Analysis Date	Holding Times		Eval
			Date	Rec	Actual			Rec	Actual	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE										
FB-01	MicroPlasticSRN	25-Jan-2022					15-Feb-2022			
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE										
FB-02	MicroPlasticSRN	25-Jan-2022					15-Feb-2022			
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE										
FB-03	MicroPlasticSRN	25-Jan-2022					15-Feb-2022			
Physical Tests : Microplastic Particles Screening in pure water by SEM										
Compliant container										
FBG-1	MicroPlasticSRN	25-Jan-2022					15-Feb-2022			
Physical Tests : Microplastic Particles Screening in pure water by SEM				ı	ı					
Compliant container	14: DI (1 OD)	05 1 0000					45.5.1.0000			
FBG-2	MicroPlasticSRN	25-Jan-2022					15-Feb-2022			
Physical Tests : Microplastic Particles Screening in pure water by SEM										
Compliant container	MicroPlasticSRN	25-Jan-2022					15-Feb-2022			
FBG-3	MICIOPIASIICSKN	25-Jan-2022					15-Feb-2022			
Physical Tests : Microplastic Particles Screening in pure water by SEM					ı					
Compliant container FBG-4	MicroPlasticSRN	25-Jan-2022					15-Feb-2022			
FDU-4	MICIOFIASIICSKIN	20-Jan-2022	<b></b>				13-F60-2022			

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Client : Government of Yukon

Project : ---



Matrix: Water Evaluation: **x** = Holding time exceedance; ✓ = Within Holding Time Analyte Group Extraction / Preparation Method Sampling Date Analysis Container / Client Sample ID(s) Preparation **Holding Times** Eval Analysis Date Holding Times Eval Rec Actual Rec Actual Date Physical Tests: Microplastic Particles Screening in pure water by SEM **Compliant container** FBG-5 MicroPlasticSRN 25-Jan-2022 15-Feb-2022 Physical Tests: Microplastic Particles Screening in pure water by SEM HDPE FBP-01 MicroPlasticSRN 25-Jan-2022 15-Feb-2022 ------------Physical Tests: Microplastic Particles Screening in pure water by SEM HDPE FBP-02 MicroPlasticSRN 25-Jan-2022 15-Feb-2022 Physical Tests: Microplastic Particles Screening in pure water by SEM HDPE MicroPlasticSRN 15-Feb-2022 FBP-03 25-Jan-2022 Physical Tests: Microplastic Particles Screening in pure water by SEM HDPE FBP-04 MicroPlasticSRN 25-Jan-2022 15-Feb-2022 Physical Tests: Microplastic Particles Screening in pure water by SEM HDPE 15-Feb-2022 FBP-05 MicroPlasticSRN 25-Jan-2022 Physical Tests: Microplastic Particles Screening in pure water by SEM HDPE TB-01 MicroPlasticSRN 25-Jan-2022 15-Feb-2022 Physical Tests: Microplastic Particles Screening in pure water by SEM HDPE TB-02 MicroPlasticSRN 25-Jan-2022 15-Feb-2022 Physical Tests: Microplastic Particles Screening in pure water by SEM HDPE MicroPlasticSRN 25-Jan-2022 04-Mar-2022 TBA-1 --------

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Client : Government of Yukon

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Matrix: Water Evaluation: x = Holding time exceedance; ✓ = Within Holding Time Analyte Group Extraction / Preparation Method Sampling Date Analysis Container / Client Sample ID(s) Preparation **Holding Times** Eval Analysis Date Holding Times Eval Rec Actual Rec Actual Date Physical Tests: Microplastic Particles Screening in pure water by SEM HDPE TBA-2 MicroPlasticSRN 25-Jan-2022 15-Feb-2022 Physical Tests: Microplastic Particles Screening in pure water by SEM HDPE TBA-3 MicroPlasticSRN 25-Jan-2022 15-Feb-2022 --------Physical Tests: Microplastic Particles Screening in pure water by SEM HDPE MicroPlasticSRN 25-Jan-2022 15-Feb-2022 TBA-4 ----Physical Tests: Microplastic Particles Screening in pure water by SEM HDPE MicroPlasticSRN 15-Feb-2022 TBA-5 25-Jan-2022 Physical Tests: Microplastic Particles Screening in pure water by SEM Compliant container TBG-1 MicroPlasticSRN 25-Jan-2022 15-Feb-2022 Physical Tests: Microplastic Particles Screening in pure water by SEM Compliant container TBG-2 25-Jan-2022 15-Feb-2022 MicroPlasticSRN Physical Tests: Microplastic Particles Screening in pure water by SEM Compliant container TBG-3 MicroPlasticSRN 25-Jan-2022 15-Feb-2022 Physical Tests : Microplastic Particles Screening in pure water by SEM Compliant container TBG-4 MicroPlasticSRN 25-Jan-2022 15-Feb-2022 Physical Tests: Microplastic Particles Screening in pure water by SEM Compliant container TBG-5 MicroPlasticSRN 25-Jan-2022 15-Feb-2022 ------------

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Client : Government of Yukon

Project : ---



Matrix: Water Evaluation: x = Holding time exceedance; ✓ = Within Holding Time Analyte Group Extraction / Preparation Method Sampling Date Analysis Container / Client Sample ID(s) Preparation **Holding Times** Eval Analysis Date **Holding Times** Eval Actual Rec Actual Date Physical Tests: Microplastic Particles Screening in pure water by SEM HDPE TBP-1 MicroPlasticSRN 25-Jan-2022 15-Feb-2022 Physical Tests: Microplastic Particles Screening in pure water by SEM HDPE TBP-2 MicroPlasticSRN 25-Jan-2022 15-Feb-2022 --------Physical Tests: Microplastic Particles Screening in pure water by SEM HDPE TBP-3 MicroPlasticSRN 25-Jan-2022 15-Feb-2022 Physical Tests: Microplastic Particles Screening in pure water by SEM HDPE MicroPlasticSRN 15-Feb-2022 TBP-4 25-Jan-2022 Physical Tests: Microplastic Particles Screening in pure water by SEM HDPE TBP-5 MicroPlasticSRN 25-Jan-2022 15-Feb-2022 Physical Tests: Microplastic Particles Screening in pure water by SEM HDPE 15-Feb-2022 TRDB-01 MicroPlasticSRN 25-Jan-2022 Physical Tests: Microplastic Particles Screening in pure water by SEM HDPE TRDB-02 MicroPlasticSRN 25-Jan-2022 15-Feb-2022 Physical Tests: Microplastic Particles Screening in pure water by SEM HDPE TRDB-03 MicroPlasticSRN 25-Jan-2022 15-Feb-2022 Physical Tests: Microplastic Particles Screening in pure water by SEM HDPE TRDB-04 MicroPlasticSRN 25-Jan-2022 15-Feb-2022 --------

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Client : Government of Yukon

Project : ---



Matrix: Water Evaluation: x = Holding time exceedance; ✓ = Within Holding Time Analyte Group Extraction / Preparation Method Sampling Date Analysis Container / Client Sample ID(s) Preparation **Holding Times** Eval Analysis Date **Holding Times** Eval Actual Rec Actual Date Physical Tests: Microplastic Particles Screening in pure water by SEM HDPE TRDB-05 MicroPlasticSRN 25-Jan-2022 15-Feb-2022 Physical Tests: Microplastic Particles Screening in pure water by SEM HDPE YCAR-01 MicroPlasticSRN 25-Jan-2022 15-Feb-2022 --------Physical Tests: Microplastic Particles Screening in pure water by SEM HDPE YCAR-02 MicroPlasticSRN 25-Jan-2022 15-Feb-2022 Physical Tests: Microplastic Particles Screening in pure water by SEM HDPE MicroPlasticSRN 15-Feb-2022 YCAR-03 25-Jan-2022 Physical Tests: Microplastic Particles Screening in pure water by SEM HDPE YCAR-04 MicroPlasticSRN 25-Jan-2022 15-Feb-2022 Physical Tests: Microplastic Particles Screening in pure water by SEM HDPE 15-Feb-2022 YCAR-05 MicroPlasticSRN 25-Jan-2022 Physical Tests: Microplastic Particles Screening in pure water by SEM **HDPE** YRDAW-1 MicroPlasticSRN 20-Jan-2022 15-Feb-2022 Physical Tests: Microplastic Particles Screening in pure water by SEM HDPE YRDAW-2 MicroPlasticSRN 20-Jan-2022 15-Feb-2022 Physical Tests: Microplastic Particles Screening in pure water by SEM HDPE YRDAW-3 MicroPlasticSRN 20-Jan-2022 15-Feb-2022 --------

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Client : Government of Yukon

Project : ---



Matrix: Water Evaluation: x = Holding time exceedance; ✓ = Within Holding Time Analyte Group Extraction / Preparation Method Sampling Date Analysis Container / Client Sample ID(s) Preparation **Holding Times** Eval Analysis Date **Holding Times** Eval Actual Rec Actual Date Physical Tests: Microplastic Particles Screening in pure water by SEM HDPE YRDAW-4 MicroPlasticSRN 20-Jan-2022 15-Feb-2022 Physical Tests: Microplastic Particles Screening in pure water by SEM HDPE YRDAW-5 MicroPlasticSRN 20-Jan-2022 15-Feb-2022 --------Physical Tests: Microplastic Particles Screening in pure water by SEM HDPE YRMLD-01 MicroPlasticSRN 25-Jan-2022 15-Feb-2022 Physical Tests: Microplastic Particles Screening in pure water by SEM HDPE MicroPlasticSRN 15-Feb-2022 YRMLD-02 25-Jan-2022 Physical Tests: Microplastic Particles Screening in pure water by SEM HDPE YRMLD-03 MicroPlasticSRN 25-Jan-2022 15-Feb-2022 Physical Tests: Microplastic Particles Screening in pure water by SEM HDPE 15-Feb-2022 YRMLD-04 MicroPlasticSRN 25-Jan-2022 Physical Tests: Microplastic Particles Screening in pure water by SEM **HDPE** YRMLD-05 MicroPlasticSRN 25-Jan-2022 15-Feb-2022 Physical Tests: Microplastic Particles Screening in pure water by SEM HDPE YRUTR-01 MicroPlasticSRN 25-Jan-2022 15-Feb-2022 Physical Tests: Microplastic Particles Screening in pure water by SEM HDPE YRUTR-02 MicroPlasticSRN 25-Jan-2022 15-Feb-2022 --------

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Project : ---



Matrix: Water Evaluation: ▼ = Holding time exceedance; ✓ = Within Holding Time

Analyte Group	Method	Sampling Date	Ext	raction / Pro	eparation			Analys	sis	
Container / Client Sample ID(s)			Preparation	Holding	Times	Eval	Analysis Date	Holding	g Times	Eval
			Date	Rec	Actual			Rec	Actual	
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE										
YRUTR-03	MicroPlasticSRN	25-Jan-2022					15-Feb-2022			
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE										
YRUTR-04	MicroPlasticSRN	25-Jan-2022					15-Feb-2022			
Physical Tests : Microplastic Particles Screening in pure water by SEM										
HDPE										
YRUTR-05	MicroPlasticSRN	25-Jan-2022					15-Feb-2022			

#### Legend & Qualifier Definitions

Rec. HT: ALS recommended hold time (see units).

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Client : Government of Yukon

Project : ---



## **Quality Control Parameter Frequency Compliance**

No Quality Control data available for this section.

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Client : Government of Yukon

Project : ---



## **Methodology References and Summaries**

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Reference methods may incorporate modifications to improve performance (indicated by "mod").

Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Microplastic Particles Screening in pure water	MicroPlasticSRN	Water	See attached.	Samples were prepared and analyzed according to ALS SOP Micro-Fluor-001 for the
by SEM				detection of microplastic particles in drinking water using Nile Red dye for fluorescent
	Cincinnati -			tagging. See attached report for details.
	Environmental - 4388			
	Glendale-Milford Road			
	Cincinnati Ohio United			
	States 45242			



## **QUALITY CONTROL REPORT**

**Work Order** Page :WR2200058

Client : Government of Yukon Laboratory : Whitehorse - Environmental

Contact : Devon O'Connor **Account Manager** : Tasnia Tarannum

> Address : 113 Industrial Road :#12 151 Industrial Road Whitehorse YT Canada Y1A 2T7

Whitehorse, Yukon Canada Y1A 2V3

: 1 of 2

Telephone :+1 867 668 6689 **Date Samples Received** :27-Jan-2022 12:30

**Date Analysis Commenced** : 15-Feb-2022

:07-Mar-2022 11:51 C-O-C number Issue Date Sampler

Quote number : VA21-GPYT100-011

No. of samples received : 60 No. of samples analysed : 55

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full. This Quality Control Report contains the following information:

Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits

- Matrix Spike (MS) Report; Recovery and Acceptance Limits
- Reference Material (RM) Report; Recovery and Acceptance Limits
- Method Blank (MB) Report; Recovery and Acceptance Limits
- Laboratory Control Sample (LCS) Report; Recovery and Acceptance Limits

#### Signatories

Address

Telephone

Project

Site

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories Position Laboratory Department

Kaitlyn Gardner Account Manager Assistant Internal Subcontracting, Cincinnati, Ohio Trace Chometsky Account Manager Assistant Internal Subcontracting, Cincinnati, Ohio Page : 2 of 2

Work Order : WR2200058

Client : Government of Yukon

Project : ---



#### **General Comments**

The ALS Quality Control (QC) report is optionally provided to ALS clients upon request. ALS test methods include comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against predetermined Data Quality Objectives (DQOs) to provide confidence in the accuracy of associated test results. This report contains detailed results for all QC results applicable to this sample submission. Please refer to the ALS Quality Control Interpretation report (QCI) for applicable method references and methodology summaries.

Key:

Anonymous = Refers to samples which are not part of this work order, but which formed part of the QC process lot.

CAS Number = Chemical Abstracts Services number is a unique identifier assigned to discrete substances.

DQO = Data Quality Objective.

LOR = Limit of Reporting (detection limit).

RPD = Relative Percentage Difference

# = Indicates a QC result that did not meet the ALS DQO.



Contact: Tasnia Tarannum
Company: ALS Whitehorse
Address: 12-151 Industrial Rd,
Whitehorse, YT, Y1A2V3

Project / Location: WR2200058 PO Number: WR2200058 ALS Work Order: 22020139

The samples herein were analyzed according to ALS SOP Micro-Fluor-001 for the detection of micro plastic particles (MPP) using fluorescent tagging with Nile Red (NR) stain and static image analysis. This method, based on the study, "Synthetic Polymer Contamination in Bottled Water" which was conducted at the State University of New York (SUNY) at Fredonia, found an average of 325 MPP/L in bottled water brands from around the globe and has been shown to be sufficient for the rapid detection of polymerics including polyethylene (PE), polypropylene (PP), polystyrene (PS) and nylon 6 (PA6) though it cannot differentiate between them.

The efficacy of this method for the detection of MPP in non-potable waters including waste, effluent, influent, ground, surface, or marine waters has not yet been determined.

Particle sizing is performed using static image analysis of a series of representative two dimensional photomicrographs. Minimum caliper is the shortest distance between any 2 points along a single particle boundary and represents the approximate width/diameter of the particle/fiber. Maximum caliper is the longest distance between any 2 points along a single particle boundary and represents the length of the particle/fiber. The smallest single particle dimension confidently resolved by this method at the lowest available magnification has been determined to be approximately 6.5 $\mu$ m. Additionally, particles whose largest single dimension is greater than 5mm fall outside the generally accepted definition of MPP. Therefore, the total MPP concentration reported includes only fluorescing particles >6.5 $\mu$ m<5mm in the dimension of interest (DOI).

DOI is selected by the analyst based on observation of the dominant particle morphology. Samples observed to contain primarily fibrous MPP exhibiting a length to width aspect ratio of 3:1 or greater are categorized according to maximum caliper. Samples containing primarily non-fibrous MPP are categorized according to minimum caliper. Samples containing an approximately equal mixture of fibrous and non-fibrous MPP are categorized according to total area in units squared. The analytical sensitivity (AS) for this method is based on the detection of one particle in the total area analyzed. When possible, sufficient sample is analyzed to yield an AS<10 MPP/L. However, the volume of sample that can be analyzed is dependent upon water clarity. Therefore, samples with

Interferences such as opaque suspended solids may result in a negative bias while lipid-rich interferences such as fats, waxes, and oils may result in a positive bias. For this reason, the filtered aliquot selected for analysis is one that exhibits the greatest number of adequately dispersed fluorescing MPP affected by the least interference possible.

significant concentrations of interferences may not attain the desired AS.

All sample collection is performed outside ALS and is the sole responsibility of the client. Filtered samples are archived for 60 days prior to disposal. Results apply only to portions analyzed. Microscopy is not suitable for the analysis of all types of materials. Therefore, additional testing may be required.

Representative photomicrographs and/or binary threshold images are not automatically included but may be made available upon request for an additional per item fee.

Pamela M. Hizar

Pamela M. Hiyar

ALS Microscopy Technical Manager

IDENTIFICATION					
	WR2200058-	WR2200058-	WR2200058-	WR2200058-	WR2200058-
Client Sample ID:	001 / TBA-1	002 / TBA-2	003 / TBA-3	004 / TBA-4	005 / TBA-5
ALS Sample ID:	22020139-01	22020139-02	22020139-03	22020139-04	22020139-05
Collection Date:	1/25/2022	1/25/2022	1/25/2022	1/25/2022	1/25/2022
ANALYSIS					
Analyst:	Pamela Hizar	Pamela Hizar	Pamela Hizar	Pamela Hizar	Pamela Hizar
Date:	2/7/2022	2/7/2022	2/7/2022	2/7/2022	2/7/2022
Filtered Volume (mL):	1000	1000	1000	1000	1000
AS (MPP/L):	1.34	1.34	1.34	1.34	1.34
DOI:	DIAMETER	DIAMETER	DIAMETER	DIAMETER	DIAMETER
CONCENTRATION (MPP	/ <b>L)</b>				
>6.5 <u>&lt;</u> 10µm:	5.35	9.36	10.70	6.69	8.03
>10 <u>&lt;</u> 100µm:	2.68	0.00	5.35	4.01	4.01
>100 <u>&lt;</u> 500μm:	0.00	0.00	0.00	2.68	0.00
>500µm <u>&lt;</u> 1mm:	0.00	1.34	0.00	0.00	0.00
>1 <u>&lt;</u> 5mm:	0.00	0.00	0.00	0.00	0.00
TOTAL:	8.03	10.70	16.05	13.38	12.04
IDENTIFICATION					
IDENTIFICATION	WR2200058-	WR2200058-	WR2200058-	WR2200058-	WR2200058-
	WR2200058- 011 / YRDAW-				
Client Sample ID:					
	011 / YRDAW-	012 / YRDAW-	013 / YRDAW-	014 / YRDAW-	015 / YRDAW-
Client Sample ID:	011 / YRDAW- 1	012 / YRDAW- 2	013 / YRDAW- 3	014 / YRDAW- 4	015 / YRDAW- 5
Client Sample ID: ALS Sample ID:	011 / YRDAW- 1 22020139-06 1/25/2022	012 / YRDAW- 2 22020139-07 1/25/2022	013 / YRDAW- 3 22020139-08 1/25/2022	014 / YRDAW- 4 22020139-09 1/25/2022	015 / YRDAW- 5 22020139-10 1/25/2022
Client Sample ID: ALS Sample ID: Collection Date: ANALYSIS Analyst:	011 / YRDAW- 1 22020139-06 1/25/2022 Pamela Hizar	012 / YRDAW- 2 22020139-07 1/25/2022 Pamela Hizar	013 / YRDAW- 3 22020139-08 1/25/2022 Pamela Hizar	014 / YRDAW- 4 22020139-09 1/25/2022 Pamela Hizar	015 / YRDAW- 5 22020139-10 1/25/2022 Pamela Hizar
Client Sample ID: ALS Sample ID: Collection Date:	011 / YRDAW- 1 22020139-06 1/25/2022 Pamela Hizar 2/7/2022	012 / YRDAW- 2 22020139-07 1/25/2022 Pamela Hizar 2/7/2022	013 / YRDAW- 3 22020139-08 1/25/2022 Pamela Hizar 2/7/2022	014 / YRDAW- 4 22020139-09 1/25/2022 Pamela Hizar 2/8/2022	015 / YRDAW- 5 22020139-10 1/25/2022 Pamela Hizar 2/8/2022
Client Sample ID: ALS Sample ID: Collection Date: ANALYSIS Analyst:	011 / YRDAW- 1 22020139-06 1/25/2022 Pamela Hizar	012 / YRDAW- 2 22020139-07 1/25/2022 Pamela Hizar	013 / YRDAW- 3 22020139-08 1/25/2022 Pamela Hizar	014 / YRDAW- 4 22020139-09 1/25/2022 Pamela Hizar	015 / YRDAW- 5 22020139-10 1/25/2022 Pamela Hizar
Client Sample ID: ALS Sample ID: Collection Date: ANALYSIS Analyst: Date:	011 / YRDAW- 1 22020139-06 1/25/2022 Pamela Hizar 2/7/2022	012 / YRDAW- 2 22020139-07 1/25/2022 Pamela Hizar 2/7/2022	013 / YRDAW- 3 22020139-08 1/25/2022 Pamela Hizar 2/7/2022	014 / YRDAW- 4 22020139-09 1/25/2022 Pamela Hizar 2/8/2022	015 / YRDAW- 5 22020139-10 1/25/2022 Pamela Hizar 2/8/2022
Client Sample ID: ALS Sample ID: Collection Date: ANALYSIS  Analyst: Date: Filtered Volume (mL):	011 / YRDAW- 1 22020139-06 1/25/2022 Pamela Hizar 2/7/2022 1000	012 / YRDAW- 2 22020139-07 1/25/2022 Pamela Hizar 2/7/2022 1000	013 / YRDAW- 3 22020139-08 1/25/2022 Pamela Hizar 2/7/2022 1000	014 / YRDAW- 4 22020139-09 1/25/2022 Pamela Hizar 2/8/2022 1000	015 / YRDAW- 5 22020139-10 1/25/2022 Pamela Hizar 2/8/2022 1000
Client Sample ID: ALS Sample ID: Collection Date: ANALYSIS  Analyst: Date: Filtered Volume (mL): AS (MPP/L):	011 / YRDAW- 1 22020139-06 1/25/2022 Pamela Hizar 2/7/2022 1000 1.34 DIAMETER /L)	012 / YRDAW-2 22020139-07 1/25/2022 Pamela Hizar 2/7/2022 1000 1.34	013 / YRDAW- 3 22020139-08 1/25/2022 Pamela Hizar 2/7/2022 1000 1.34 DIAMETER	014 / YRDAW- 4 22020139-09 1/25/2022 Pamela Hizar 2/8/2022 1000 1.34 DIAMETER	015 / YRDAW- 5 22020139-10 1/25/2022 Pamela Hizar 2/8/2022 1000 1.34
Client Sample ID: ALS Sample ID: Collection Date: ANALYSIS  Analyst: Date: Filtered Volume (mL): AS (MPP/L): DOI: CONCENTRATION (MPP) >6.5≤10μm:	011 / YRDAW- 1 22020139-06 1/25/2022 Pamela Hizar 2/7/2022 1000 1.34 DIAMETER /L)	012 / YRDAW-2 22020139-07 1/25/2022 Pamela Hizar 2/7/2022 1000 1.34 DIAMETER	013 / YRDAW-3 22020139-08 1/25/2022 Pamela Hizar 2/7/2022 1000 1.34 DIAMETER	014 / YRDAW- 4 22020139-09 1/25/2022 Pamela Hizar 2/8/2022 1000 1.34 DIAMETER	015 / YRDAW- 5 22020139-10 1/25/2022 Pamela Hizar 2/8/2022 1000 1.34 DIAMETER
Client Sample ID: ALS Sample ID: Collection Date: ANALYSIS  Analyst: Date: Filtered Volume (mL): AS (MPP/L): DOI: CONCENTRATION (MPP) >6.5≤10µm: >10≤100µm:	011 / YRDAW- 1 22020139-06 1/25/2022 Pamela Hizar 2/7/2022 1000 1.34 DIAMETER /L)	012 / YRDAW- 2 22020139-07 1/25/2022 Pamela Hizar 2/7/2022 1000 1.34 DIAMETER	013 / YRDAW- 3 22020139-08 1/25/2022 Pamela Hizar 2/7/2022 1000 1.34 DIAMETER	014 / YRDAW- 4 22020139-09 1/25/2022 Pamela Hizar 2/8/2022 1000 1.34 DIAMETER	015 / YRDAW- 5 22020139-10 1/25/2022 Pamela Hizar 2/8/2022 1000 1.34 DIAMETER
Client Sample ID: ALS Sample ID: Collection Date: ANALYSIS  Analyst: Date: Filtered Volume (mL): AS (MPP/L): DOI: CONCENTRATION (MPP) >6.5≤10μm:	011 / YRDAW- 1 22020139-06 1/25/2022 Pamela Hizar 2/7/2022 1000 1.34 DIAMETER /L)	012 / YRDAW-2 22020139-07 1/25/2022 Pamela Hizar 2/7/2022 1000 1.34 DIAMETER	013 / YRDAW-3 22020139-08 1/25/2022 Pamela Hizar 2/7/2022 1000 1.34 DIAMETER	014 / YRDAW- 4 22020139-09 1/25/2022 Pamela Hizar 2/8/2022 1000 1.34 DIAMETER	015 / YRDAW- 5 22020139-10 1/25/2022 Pamela Hizar 2/8/2022 1000 1.34 DIAMETER
Client Sample ID: ALS Sample ID: Collection Date: ANALYSIS  Analyst: Date: Filtered Volume (mL): AS (MPP/L): DOI: CONCENTRATION (MPP) >6.5≤10µm: >10≤100µm:	011 / YRDAW- 1 22020139-06 1/25/2022 Pamela Hizar 2/7/2022 1000 1.34 DIAMETER /L) 10.70 8.03	012 / YRDAW-2 22020139-07 1/25/2022 Pamela Hizar 2/7/2022 1000 1.34 DIAMETER  10.70 17.39	013 / YRDAW-3 22020139-08 1/25/2022  Pamela Hizar 2/7/2022 1000 1.34 DIAMETER  10.70 16.05	014 / YRDAW- 4 22020139-09 1/25/2022 Pamela Hizar 2/8/2022 1000 1.34 DIAMETER 14.71 26.75	015 / YRDAW- 5 22020139-10 1/25/2022 Pamela Hizar 2/8/2022 1000 1.34 DIAMETER 10.70 8.03
Client Sample ID: ALS Sample ID: Collection Date: ANALYSIS  Analyst: Date: Filtered Volume (mL): AS (MPP/L): DOI: CONCENTRATION (MPP) >6.5≤10µm: >10≤100µm: >100≤500µm:	011 / YRDAW- 1 22020139-06 1/25/2022 Pamela Hizar 2/7/2022 1000 1.34 DIAMETER /L) 10.70 8.03 0.00	012 / YRDAW-2 22020139-07 1/25/2022  Pamela Hizar 2/7/2022 1000 1.34 DIAMETER  10.70 17.39 6.69	013 / YRDAW-3 22020139-08 1/25/2022  Pamela Hizar 2/7/2022 1000 1.34 DIAMETER  10.70 16.05 1.34	014 / YRDAW- 4 22020139-09 1/25/2022 Pamela Hizar 2/8/2022 1000 1.34 DIAMETER 14.71 26.75 2.68	015 / YRDAW- 5 22020139-10 1/25/2022 Pamela Hizar 2/8/2022 1000 1.34 DIAMETER 10.70 8.03 0.00
Client Sample ID: ALS Sample ID: Collection Date:  ANALYSIS  Analyst: Date: Filtered Volume (mL): AS (MPP/L): DOI: CONCENTRATION (MPP) >6.5≤10µm: >10≤100µm: >100≤500µm: >500µm≤1mm:	011 / YRDAW- 1 22020139-06 1/25/2022  Pamela Hizar 2/7/2022 1000 1.34 DIAMETER /L) 10.70 8.03 0.00 0.00	012 / YRDAW-2 22020139-07 1/25/2022  Pamela Hizar 2/7/2022 1000 1.34 DIAMETER  10.70 17.39 6.69 0.00	013 / YRDAW-3 22020139-08 1/25/2022  Pamela Hizar 2/7/2022 1000 1.34 DIAMETER  10.70 16.05 1.34 0.00	014 / YRDAW- 4 22020139-09 1/25/2022 Pamela Hizar 2/8/2022 1000 1.34 DIAMETER 14.71 26.75 2.68 0.00	015 / YRDAW- 5 22020139-10 1/25/2022 Pamela Hizar 2/8/2022 1000 1.34 DIAMETER 10.70 8.03 0.00 0.00

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IDENTIFICATION					
	WR2200058-	WR2200058-	WR2200058-	WR2200058-	WR2200058-
Client Sample ID:	016 / TBP-1	017 / TBP-2	018 / TBP-3	019 / TBP-4	020 / TBP-5
ALS Sample ID:	22020139-11	22020139-12	22020139-13	22020139-14	22020139-15
Collection Date:	1/25/2022	1/25/2022	1/25/2022	1/25/2022	1/25/2022
ANALYSIS					
Analyst:	Pamela Hizar				
Date:	2/8/2022	2/8/2022	2/8/2022	2/8/2022	2/8/2022
Filtered Volume (mL):	1000	1000	1000	1000	1000
AS (MPP/L):	1.34	1.34	1.34	1.34	1.34
DOI:	DIAMETER	DIAMETER	DIAMETER	DIAMETER	DIAMETER
CONCENTRATION (MPP	/ <b>L)</b>				
>6.5 <u>&lt;</u> 10μm:	16.05	14.71	14.71	14.71	17.39
>10 <u>&lt;</u> 100µm:	2.68	6.69	10.70	5.35	4.01
>100 <u>&lt;</u> 500µm:	0.00	0.00	1.34	0.00	0.00
>500µm <u>&lt;</u> 1mm:	0.00	0.00	0.00	0.00	0.00
>1 <u>&lt;</u> 5mm:	0.00	0.00	0.00	0.00	0.00
TOTAL:	18.73	21.40	26.75	20.07	21.40
IDENTIFICATION					
	WR2200058-	WR2200058-	WR2200058-	WR2200058-	WR2200058-
Client Sample ID:	021 / TBG-1	022 / TBG-2	023 / TBG-3	024 / TBG-4	025 / TBG-5
ALS Sample ID:	22020139-16	22020139-17	22020139-18	22020139-19	22020139-20
Collection Date:	1/25/2022	1/25/2022	1/25/2022	1/25/2022	1/25/2022
ANALYSIS					
Analyst:	Pamela Hizar				
Date:	2/8/2022	2/8/2022	2/8/2022	2/8/2022	2/8/2022
Filtered Volume (mL):	975	940	960	910	925
AS (MPP/L):	1.37	1.42	1.39	1.47	1.45
DOI:	DIAMETER	DIAMETER	DIAMETER	DIAMETER	DIAMETER
CONCENTRATION (MPP	/ <b>L)</b>				
>6.5 <u>&lt;</u> 10µm:	14.71	14.71	17.39	14.71	14.71
>10 <u>&lt;</u> 100µm:	17.39	41.47	20.07	8.03	9.36
>100 <u>&lt;</u> 500µm:	6.69	5.35	6.69	1.34	0.00
>500µm <u>&lt;</u> 1mm:	0.00	0.00	1.34	0.00	0.00
>1<5mm:					
/ 1 <u>3</u> 01111111	0.00	0.00	0.00	0.00	0.00

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	WR2200058-	WR2200058-	WR2200058-	WR2200058-	WR2200058-
	026 / TB-01	028 / FB-01	029 / FB-02	031 / YRMLD-	032 / YRMLD-
Client Sample ID:				01	02
ALS Sample ID:	22020139-21	22020139-22	22020139-23	22020139-24	22020139-25
Collection Date:	1/25/2022	1/25/2022	1/25/2022	1/25/2022	1/25/2022
ANALYSIS					
Analyst:	Pamela Hizar	Pamela Hizar	Pamela Hizar	Pamela Hizar	Pamela Hizar
Date:	2/9/2022	2/9/2022	2/9/2022	2/9/2022	2/9/2022
Filtered Volume (mL):	1000	1000	1000	1000	1000
AS (MPP/L):	1.34	1.34	1.34	1.34	1.34
DOI:	DIAMETER	DIAMETER	DIAMETER	DIAMETER	DIAMETER
CONCENTRATION (MPP	<b>/L)</b>				
>6.5 <u>&lt;</u> 10µm:	17.39	20.07	20.07	16.05	16.05
>10 <u>&lt;</u> 100µm:	4.01	9.36	6.69	52.17	56.18
>100 <u>&lt;</u> 500µm:	1.34	6.69	1.34	6.69	4.01
>500µm <u>&lt;</u> 1mm:	0.00	0.00	0.00	0.00	0.00
>1 <u>&lt;</u> 5mm:	0.00	0.00	0.00	0.00	0.00
TOTAL:	22.74	36.12	28.09	74.91	76.25
IDENTIFICATION					
IDENTIFICATION					
IDENTIFICATION	WR2200058-	WR2200058-	WR2200058-	N/Doogoo.	NA DOCUMENTO
IDENTIFICATION	WR2200058- 033 / YRMLD-	WR2200058- 034 / YRMLD-	WR2200058- 035 / YRMLD-	WR2200058-	WR2200058-
	033 / YRMLD-	WR2200058- 034 / YRMLD- 04	WR2200058- 035 / YRMLD- 05	WR2200058- 036 / TRDB-01	
Client Sample ID:	033 / YRMLD- 03	034 / YRMLD- 04	035 / YRMLD- 05	036 / TRDB-01	037 / TRDB-02
Client Sample ID: ALS Sample ID:	033 / YRMLD- 03 22020139-26	034 / YRMLD- 04 22020139-27	035 / YRMLD- 05 22020139-28	036 / TRDB-01 22020139-29	037 / TRDB-02 22020139-30
Client Sample ID:	033 / YRMLD- 03	034 / YRMLD- 04	035 / YRMLD- 05	036 / TRDB-01	037 / TRDB-02
Client Sample ID: ALS Sample ID: Collection Date:	033 / YRMLD- 03 22020139-26 1/25/2022	034 / YRMLD- 04 22020139-27 1/25/2022	035 / YRMLD- 05 22020139-28	036 / TRDB-01 22020139-29	037 / TRDB-02 22020139-30
Client Sample ID: ALS Sample ID: Collection Date:	033 / YRMLD- 03 22020139-26 1/25/2022	034 / YRMLD- 04 22020139-27	035 / YRMLD- 05 22020139-28 1/25/2022	036 / TRDB-01 22020139-29 1/25/2022	037 / TRDB-02 22020139-30 1/25/2022
Client Sample ID: ALS Sample ID: Collection Date: ANALYSIS Analyst: Date:	033 / YRMLD- 03 22020139-26 1/25/2022 Pamela Hizar 2/9/2022	034 / YRMLD- 04 22020139-27 1/25/2022 Pamela Hizar	035 / YRMLD- 05 22020139-28 1/25/2022 Pamela Hizar	036 / TRDB-01 22020139-29 1/25/2022 Pamela Hizar	037 / TRDB-02 22020139-30 1/25/2022 Pamela Hizar 2/9/2022
Client Sample ID: ALS Sample ID: Collection Date: ANALYSIS Analyst: Date: Filtered Volume (mL):	033 / YRMLD- 03 22020139-26 1/25/2022 Pamela Hizar 2/9/2022 1000	034 / YRMLD- 04 22020139-27 1/25/2022 Pamela Hizar 2/9/2022 1000	035 / YRMLD- 05 22020139-28 1/25/2022 Pamela Hizar 2/9/2022 1000	036 / TRDB-01 22020139-29 1/25/2022 Pamela Hizar 2/9/2022 1000	037 / TRDB-02 22020139-30 1/25/2022 Pamela Hizar 2/9/2022 1000
Client Sample ID: ALS Sample ID: Collection Date: ANALYSIS  Analyst: Date: Filtered Volume (mL): AS (MPP/L):	033 / YRMLD- 03 22020139-26 1/25/2022 Pamela Hizar 2/9/2022 1000 1.34	034 / YRMLD- 04 22020139-27 1/25/2022 Pamela Hizar 2/9/2022 1000 1.34	035 / YRMLD- 05 22020139-28 1/25/2022 Pamela Hizar 2/9/2022 1000 1.34	036 / TRDB-01 22020139-29 1/25/2022 Pamela Hizar 2/9/2022 1000 1.34	037 / TRDB-02 22020139-30 1/25/2022 Pamela Hizar 2/9/2022 1000 1.34
Client Sample ID: ALS Sample ID: Collection Date: ANALYSIS  Analyst: Date: Filtered Volume (mL): AS (MPP/L): DOI:	033 / YRMLD- 03 22020139-26 1/25/2022 Pamela Hizar 2/9/2022 1000 1.34 DIAMETER	034 / YRMLD- 04 22020139-27 1/25/2022 Pamela Hizar 2/9/2022 1000	035 / YRMLD- 05 22020139-28 1/25/2022 Pamela Hizar 2/9/2022 1000	036 / TRDB-01 22020139-29 1/25/2022 Pamela Hizar 2/9/2022 1000	037 / TRDB-02 22020139-30 1/25/2022 Pamela Hizar 2/9/2022 1000
Client Sample ID: ALS Sample ID: Collection Date: ANALYSIS  Analyst: Date: Filtered Volume (mL): AS (MPP/L): DOI: CONCENTRATION (MPP	033 / YRMLD- 03 22020139-26 1/25/2022 Pamela Hizar 2/9/2022 1000 1.34 DIAMETER (L)	034 / YRMLD- 04 22020139-27 1/25/2022 Pamela Hizar 2/9/2022 1000 1.34 DIAMETER	035 / YRMLD- 05 22020139-28 1/25/2022 Pamela Hizar 2/9/2022 1000 1.34 DIAMETER	036 / TRDB-01 22020139-29 1/25/2022 Pamela Hizar 2/9/2022 1000 1.34 DIAMETER	037 / TRDB-02 22020139-30 1/25/2022 Pamela Hizar 2/9/2022 1000 1.34 DIAMETER
Client Sample ID: ALS Sample ID: Collection Date: ANALYSIS  Analyst: Date: Filtered Volume (mL): AS (MPP/L): DOI: CONCENTRATION (MPP) >6.5≤10μm:	033 / YRMLD- 03 22020139-26 1/25/2022 Pamela Hizar 2/9/2022 1000 1.34 DIAMETER /L)	034 / YRMLD- 04 22020139-27 1/25/2022 Pamela Hizar 2/9/2022 1000 1.34 DIAMETER	035 / YRMLD- 05 22020139-28 1/25/2022 Pamela Hizar 2/9/2022 1000 1.34 DIAMETER	036 / TRDB-01 22020139-29 1/25/2022 Pamela Hizar 2/9/2022 1000 1.34 DIAMETER	037 / TRDB-02 22020139-30 1/25/2022 Pamela Hizar 2/9/2022 1000 1.34 DIAMETER
Client Sample ID: ALS Sample ID: Collection Date: ANALYSIS  Analyst: Date: Filtered Volume (mL): AS (MPP/L): DOI: CONCENTRATION (MPP) >6.5≤10µm: >10≤100µm:	033 / YRMLD- 03 22020139-26 1/25/2022 Pamela Hizar 2/9/2022 1000 1.34 DIAMETER /L) 18.73 8.03	034 / YRMLD- 04 22020139-27 1/25/2022 Pamela Hizar 2/9/2022 1000 1.34 DIAMETER 18.73 29.43	035 / YRMLD- 05 22020139-28 1/25/2022 Pamela Hizar 2/9/2022 1000 1.34 DIAMETER 17.39 22.74	036 / TRDB-01 22020139-29 1/25/2022 Pamela Hizar 2/9/2022 1000 1.34 DIAMETER 20.07 243.46	037 / TRDB-02 22020139-30 1/25/2022 Pamela Hizar 2/9/2022 1000 1.34 DIAMETER 32.10 523.03
Client Sample ID: ALS Sample ID: Collection Date: ANALYSIS  Analyst: Date: Filtered Volume (mL): AS (MPP/L): DOI: CONCENTRATION (MPP) >6.5≤10µm: >10≤100µm: >100≤500µm:	033 / YRMLD- 03 22020139-26 1/25/2022 Pamela Hizar 2/9/2022 1000 1.34 DIAMETER /L) 18.73 8.03 2.68	034 / YRMLD- 04 22020139-27 1/25/2022 Pamela Hizar 2/9/2022 1000 1.34 DIAMETER 18.73 29.43 0.00	035 / YRMLD- 05 22020139-28 1/25/2022 Pamela Hizar 2/9/2022 1000 1.34 DIAMETER 17.39 22.74 1.34	036 / TRDB-01 22020139-29 1/25/2022 Pamela Hizar 2/9/2022 1000 1.34 DIAMETER 20.07 243.46 16.05	037 / TRDB-02 22020139-30 1/25/2022 Pamela Hizar 2/9/2022 1000 1.34 DIAMETER 32.10 523.03 26.75
Client Sample ID: ALS Sample ID: Collection Date:  ANALYSIS  Analyst: Date: Filtered Volume (mL): AS (MPP/L): DOI: CONCENTRATION (MPP) >6.5≤10µm: >10≤100µm: >100≤500µm: >500µm≤1mm:	033 / YRMLD- 03 22020139-26 1/25/2022 Pamela Hizar 2/9/2022 1000 1.34 DIAMETER /L) 18.73 8.03 2.68 0.00	034 / YRMLD- 04 22020139-27 1/25/2022 Pamela Hizar 2/9/2022 1000 1.34 DIAMETER 18.73 29.43 0.00 0.00	035 / YRMLD- 05 22020139-28 1/25/2022 Pamela Hizar 2/9/2022 1000 1.34 DIAMETER 17.39 22.74 1.34 0.00	036 / TRDB-01 22020139-29 1/25/2022 Pamela Hizar 2/9/2022 1000 1.34 DIAMETER 20.07 243.46 16.05 0.00	037 / TRDB-02 22020139-30 1/25/2022 Pamela Hizar 2/9/2022 1000 1.34 DIAMETER 32.10 523.03 26.75 0.00
Client Sample ID: ALS Sample ID: Collection Date: ANALYSIS  Analyst: Date: Filtered Volume (mL): AS (MPP/L): DOI: CONCENTRATION (MPP) >6.5≤10µm: >10≤100µm: >100≤500µm:	033 / YRMLD- 03 22020139-26 1/25/2022 Pamela Hizar 2/9/2022 1000 1.34 DIAMETER /L) 18.73 8.03 2.68	034 / YRMLD- 04 22020139-27 1/25/2022 Pamela Hizar 2/9/2022 1000 1.34 DIAMETER 18.73 29.43 0.00	035 / YRMLD- 05 22020139-28 1/25/2022 Pamela Hizar 2/9/2022 1000 1.34 DIAMETER 17.39 22.74 1.34	036 / TRDB-01 22020139-29 1/25/2022 Pamela Hizar 2/9/2022 1000 1.34 DIAMETER 20.07 243.46 16.05	037 / TRDB-02 22020139-30 1/25/2022 Pamela Hizar 2/9/2022 1000 1.34 DIAMETER 32.10 523.03 26.75

## **IDENTIFICATION**

Client Sample ID: 038 / TRDB-03 039 / TRDB-04 040 / TRDB-03 041 / YCAR-01 042 / YCAR-0	
ANALYSIS	ır
Analyst: Pamela Hizar Pamela Hizar Pamela Hizar Pamela Hizar Pamela Hizar	
Date: 2/10/2022 2/10/2022 2/10/2022 2/10/2022 2/10/2022	
Filtered Volume (mL): 800 1000 1000 1000 1000	
AS (MPP/L): 1.67 1.34 1.34 1.34 1.34	
DOI: DIAMETER DIAMETER DIAMETER DIAMETER	ί
CONCENTRATION (MPP/L)	
>6.5≤10µm: 13.38 25.42 18.73 18.73 20.07	
>10≤100µm: 77.59 468.19 539.09 4.01 6.69	
>100 <u>&lt;</u> 500µm: 2.68 20.07 34.78 0.00 0.00	
>500µm≤1mm: 0.00 1.34 0.00 0.00 0.00	
>1≤5mm: 0.00 0.00 0.00 0.00 0.00	
TOTAL: 93.64 515.01 592.59 22.74 26.75	
IDENTIFICATION	
WR2200058- WR2200058- WR2200058- WR2200058- WR2200058-	
042 / VCAB 02 044 / VCAB 04 045 / VCAB 05 046 / YRUTR- 04/ / YRUTI	<b>{</b> -
Client Sample ID: 01 02	_
ALS Sample ID: 22020139-36 22020139-37 22020139-38 22020139-39 22020139-4	0
Collection Date: 1/25/2022 1/25/2022 1/25/2022 1/25/2022 1/25/2022	
Analysis  Analysis Damala Lines	
Analyst: Pamela Hizar Pamela Hizar Pamela Hizar Pamela Hizar Date: 2/10/2022 2/10/2022 2/11/2022 2/11/2022	ır
Filtered Volume (mL): 1000 1000 1000 1000 1000 1000 AS (MPP/L): 1.34 1.34 1.34 1.34 1.34	
DOI: DIAMETER DIAMETER DIAMETER DIAMETER DIAMETER	,
CONCENTRATION (MPP/L)	•
>6.5<10µm: 18.73 20.07 18.73 18.73 22.74	_
>10≤100μm: 10.70 13.38 22.74 287.60 250.15	
>100≤500µm: 0.00 2.68 1.34 8.03 25.42	
>500μm<1mm: 0.00 0.00 0.00 0.00 0.00	
>1≤5mm: 0.00 0.00 0.00 0.00 0.00	
TOTAL: 29.43 36.12 42.81 314.36 298.30	

IDENTIFICATION					
	WR2200058-	WR2200058-	WR2200058-	WR2200058-	WR2200058-
	048 / YRUTR-	049 / YRUTR-	050 / YRUTR-	051 / FBP-01	052 / FBP-02
Client Sample ID:	03	04	05		
ALS Sample ID:	22020139-41	22020139-42	22020139-43	22020139-44	22020139-45
Collection Date:	1/25/2022	1/25/2022	1/25/2022	1/25/2022	1/25/2022
ANALYSIS	December 112 and	December 11' and	December 11 const	December 112 and	December 11' and
Analyst:	Pamela Hizar	Pamela Hizar	Pamela Hizar	Pamela Hizar	Pamela Hizar
Date:	2/11/2022	2/11/2022	2/11/2022	2/11/2022	2/11/2022
Filtered Volume (mL):	1000	1000	1000	1000	1000
AS (MPP/L): DOI:	1.34	1.34	1.34	1.34	1.34
CONCENTRATION (MPP	DIAMETER	DIAMETER	DIAMETER	DIAMETER	DIAMETER
>6.5<10μm:	20.07	17.39	17.39	18.73	20.07
>0.5 <u>&lt;</u> 10μm:	112.37	262.19	188.61	4.01	9.36
>10 <u>&lt;</u> 100μm:	16.05	17.39	5.35	1.34	0.00
>500 <u>&lt;</u> 500μm:	0.00	0.00	0.00	0.00	0.00
>000µm <u>&lt;</u> 1mm: >1≤5mm:	0.00	0.00	0.00	0.00	0.00
TOTAL:	148.48	296.97	211.35	24.08	29.43
			2	•	201.10
IDENTIFICATION					
	WR2200058-	WR2200058-	WR2200058-	WR2200058-	WR2200058-
Client Sample ID:	053 / FBP-03	WR2200058- 054 / FBP-04	WR2200058- 055 / FBP-05	WR2200058- 056 / FBG-01	WR2200058- 057 / FBG-02
Client Sample ID: ALS Sample ID:	053 / FBP-03 22020139-46	054 / FBP-04 22020139-47	055 / FBP-05 22020139-48	056 / FBG-01 22020139-49	057 / FBG-02 22020139-50
Client Sample ID: ALS Sample ID: Collection Date:	053 / FBP-03	054 / FBP-04	055 / FBP-05	056 / FBG-01	057 / FBG-02
Client Sample ID: ALS Sample ID: Collection Date:	053 / FBP-03 22020139-46 1/25/2022	054 / FBP-04 22020139-47 1/25/2022	055 / FBP-05 22020139-48 1/25/2022	056 / FBG-01 22020139-49 1/25/2022	057 / FBG-02 22020139-50 1/25/2022
Client Sample ID: ALS Sample ID: Collection Date: ANALYSIS Analyst:	053 / FBP-03 22020139-46 1/25/2022 Pamela Hizar	054 / FBP-04 22020139-47 1/25/2022 Pamela Hizar	055 / FBP-05 22020139-48 1/25/2022 Pamela Hizar	056 / FBG-01 22020139-49 1/25/2022 Pamela Hizar	057 / FBG-02 22020139-50 1/25/2022 Pamela Hizar
Client Sample ID: ALS Sample ID: Collection Date: ANALYSIS Analyst: Date:	053 / FBP-03 22020139-46 1/25/2022 Pamela Hizar 2/11/2022	054 / FBP-04 22020139-47 1/25/2022 Pamela Hizar 2/11/2022	055 / FBP-05 22020139-48 1/25/2022 Pamela Hizar 2/11/2022	056 / FBG-01 22020139-49 1/25/2022 Pamela Hizar 2/11/2022	057 / FBG-02 22020139-50 1/25/2022 Pamela Hizar 2/11/2022
Client Sample ID: ALS Sample ID: Collection Date: ANALYSIS Analyst: Date: Filtered Volume (mL):	053 / FBP-03 22020139-46 1/25/2022 Pamela Hizar 2/11/2022 1000	054 / FBP-04 22020139-47 1/25/2022 Pamela Hizar 2/11/2022 1000	055 / FBP-05 22020139-48 1/25/2022 Pamela Hizar 2/11/2022 1000	056 / FBG-01 22020139-49 1/25/2022 Pamela Hizar 2/11/2022 950	057 / FBG-02 22020139-50 1/25/2022 Pamela Hizar 2/11/2022 910
Client Sample ID: ALS Sample ID: Collection Date: ANALYSIS  Analyst: Date: Filtered Volume (mL): AS (MPP/L):	053 / FBP-03 22020139-46 1/25/2022 Pamela Hizar 2/11/2022 1000 1.34	054 / FBP-04 22020139-47 1/25/2022 Pamela Hizar 2/11/2022 1000 1.34	055 / FBP-05 22020139-48 1/25/2022 Pamela Hizar 2/11/2022 1000 1.34	056 / FBG-01 22020139-49 1/25/2022 Pamela Hizar 2/11/2022 950 1.41	057 / FBG-02 22020139-50 1/25/2022 Pamela Hizar 2/11/2022 910 1.47
Client Sample ID: ALS Sample ID: Collection Date: ANALYSIS  Analyst: Date: Filtered Volume (mL): AS (MPP/L): DOI:	053 / FBP-03 22020139-46 1/25/2022 Pamela Hizar 2/11/2022 1000 1.34 DIAMETER	054 / FBP-04 22020139-47 1/25/2022 Pamela Hizar 2/11/2022 1000	055 / FBP-05 22020139-48 1/25/2022 Pamela Hizar 2/11/2022 1000	056 / FBG-01 22020139-49 1/25/2022 Pamela Hizar 2/11/2022 950	057 / FBG-02 22020139-50 1/25/2022 Pamela Hizar 2/11/2022 910
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Client Sample ID: ALS Sample ID: Collection Date:  ANALYSIS  Analyst: Date: Filtered Volume (mL): AS (MPP/L): DOI: CONCENTRATION (MPP) >6.5≤10μm:	053 / FBP-03 22020139-46 1/25/2022 Pamela Hizar 2/11/2022 1000 1.34 DIAMETER /L)	054 / FBP-04 22020139-47 1/25/2022 Pamela Hizar 2/11/2022 1000 1.34 DIAMETER	055 / FBP-05 22020139-48 1/25/2022 Pamela Hizar 2/11/2022 1000 1.34 DIAMETER	056 / FBG-01 22020139-49 1/25/2022 Pamela Hizar 2/11/2022 950 1.41 DIAMETER	057 / FBG-02 22020139-50 1/25/2022 Pamela Hizar 2/11/2022 910 1.47 DIAMETER
Client Sample ID: ALS Sample ID: Collection Date: ANALYSIS  Analyst: Date: Filtered Volume (mL): AS (MPP/L): DOI: CONCENTRATION (MPP) >6.5≤10µm: >10≤100µm:	053 / FBP-03 22020139-46 1/25/2022 Pamela Hizar 2/11/2022 1000 1.34 DIAMETER /L) 21.40 9.36	054 / FBP-04 22020139-47 1/25/2022 Pamela Hizar 2/11/2022 1000 1.34 DIAMETER 17.39 6.69	055 / FBP-05 22020139-48 1/25/2022 Pamela Hizar 2/11/2022 1000 1.34 DIAMETER 21.40 1.34	056 / FBG-01 22020139-49 1/25/2022 Pamela Hizar 2/11/2022 950 1.41 DIAMETER 18.73 10.70	057 / FBG-02 22020139-50 1/25/2022 Pamela Hizar 2/11/2022 910 1.47 DIAMETER 20.07 36.12
Client Sample ID: ALS Sample ID: Collection Date:  ANALYSIS  Analyst: Date: Filtered Volume (mL): AS (MPP/L): DOI: CONCENTRATION (MPP) >6.5≤10µm: >10≤100µm: >100≤500µm:	053 / FBP-03 22020139-46 1/25/2022 Pamela Hizar 2/11/2022 1000 1.34 DIAMETER /L) 21.40 9.36 2.68	054 / FBP-04 22020139-47 1/25/2022 Pamela Hizar 2/11/2022 1000 1.34 DIAMETER 17.39 6.69 0.00	055 / FBP-05 22020139-48 1/25/2022 Pamela Hizar 2/11/2022 1000 1.34 DIAMETER 21.40 1.34 4.01	056 / FBG-01 22020139-49 1/25/2022 Pamela Hizar 2/11/2022 950 1.41 DIAMETER 18.73 10.70 2.68	057 / FBG-02 22020139-50 1/25/2022 Pamela Hizar 2/11/2022 910 1.47 DIAMETER 20.07 36.12 4.01
Client Sample ID: ALS Sample ID: Collection Date: ANALYSIS  Analyst: Date: Filtered Volume (mL): AS (MPP/L): DOI: CONCENTRATION (MPP) >6.5≤10µm: >10≤100µm:	053 / FBP-03 22020139-46 1/25/2022 Pamela Hizar 2/11/2022 1000 1.34 DIAMETER /L) 21.40 9.36	054 / FBP-04 22020139-47 1/25/2022 Pamela Hizar 2/11/2022 1000 1.34 DIAMETER 17.39 6.69	055 / FBP-05 22020139-48 1/25/2022 Pamela Hizar 2/11/2022 1000 1.34 DIAMETER 21.40 1.34	056 / FBG-01 22020139-49 1/25/2022 Pamela Hizar 2/11/2022 950 1.41 DIAMETER 18.73 10.70	057 / FBG-02 22020139-50 1/25/2022 Pamela Hizar 2/11/2022 910 1.47 DIAMETER 20.07 36.12

24.08

26.75

32.10

60.20

TOTAL:

33.44

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	WR2200058-	WR2200058-	WR2200058-	WR2200058-	WR2200058-
Client Sample ID:	058 / FBG-03	059 / FBG-04	060 / FBG-05	006 / TBB-1	007 / TBB-2
ALS Sample ID:	22020139-51	22020139-52	22020139-53	22020139-54	22020139-55
Collection Date:	1/25/2022	1/25/2022	1/25/2022	1/25/2022	1/25/2022
ANALYSIS					
Analyst:	Pamela Hizar	Pamela Hizar	Pamela Hizar	NA	NA
Date:	2/11/2022	2/11/2022	2/11/2022	NA	NA
Filtered Volume (mL):	975	915	920	NA	NA
AS (MPP/L):	1.37	1.46	1.45	NA	NA
DOI:	DIAMETER	DIAMETER	DIAMETER	NA	NA
CONCENTRATION (MPP/	L)				
>6.5 <u>&lt;</u> 10μm:	20.07	18.73	21.40	NA	NA
>10 <u>&lt;</u> 100μm:	29.43	21.40	4.01	NA	NA
>100 <u>&lt;</u> 500µm:	0.00	0.00	0.00	NA	NA
>500µm <u>&lt;</u> 1mm:	0.00	0.00	0.00	NA	NA
>1 <u>&lt;</u> 5mm:	0.00	0.00	0.00	NA	NA
TOTAL:	49.49	40.13	25.42	NA	NA
IDENTIFICATION					

	WR2200058-	WR2200058-	WR2200058-	WR00058-027	WR00058-030
Client Sample ID:	008 / TBB-3	009 / TBB-4	010 / TBB-5	/ TB-02	/ FB-03
ALS Sample ID:	22020139-56	22020139-57	22020139-58	22020139-59	22020139-60
Collection Date:	1/25/2022	1/25/2022	1/25/2022	1/25/2022	1/25/2022
ANALYSIS					
Analyst:	NA	NA	NA	Pamela Hizar	Pamela Hizar
Date:	NA	NA	NA	2/11/2022	2/11/2022
Filtered Volume (mL):	NA	NA	NA	1000	1000
AS (MPP/L):	NA	NA	NA	1.34	1.34
DOI:	NA	NA	NA	DIAMETER	DIAMETER
CONCENTRATION (MPP/	<b>(L)</b>				
>6.5 <u>&lt;</u> 10μm:	NA	NA	NA	0.00	1.34
>10 <u>&lt;</u> 100μm:	NA	NA	NA	5.35	1.34
>100 <u>&lt;</u> 500µm:	NA	NA	NA	1.34	1.34
>500μm <u>&lt;</u> 1mm:	NA	NA	NA	0.00	0.00
>1 <u>&lt;</u> 5mm:	NA	NA	NA	0.00	0.00
TOTAL:	NA	NA	NA	6.69	4.01

#### **NOTES**

Ten samples, WR2200058-021 / TBG-1 through WR2200058-25 and WR2200058-056 / FBG-1 through WR2200058-60 / FBG-5, arrived in wide mouth clear glass bottles which hold exactly 1L when filled to the brim with no head space. The addition of NR stain solution, head space required for ultra sonication, and minor sample loss while pouring resulted in a total volume filtered of less than 1L for these samples.

Filtration of sample WR2200058-038 was terminated with 800mL when the filter media became clogged with primarily organic solids from the aqueous sample.

Per client instructions, samples WR2200058-006 / TBB-1 through WR2200058-010 / TBB-5 were not analyzed but were placed on a 30 day hold. Samples will be disposed on 3/7/2022 unless the analyst listed herein is otherwise instructed.

COC Number: 21 -



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**Environmental Division** Whitehorse Work Order Reference

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Phone:	Company address below will appear on the fin	nal report	Select Distribution	_	☐ MAIL ☐ I				received by a							W		ð <b>1</b>		
Street:	419 Range Road		Email 1 or Eax	devon.o'connor@y	yukon.ca				] if receive									\$ <b>!</b>	$\parallel \parallel$	
City/Province:	Whitehore, YT			amelie.janin@yuko				Ad	ditional fees	з тау арр	y to rush re	quests or	weeke			(I = 1	Jania, i		Ш	
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ALS Sample #	Sample Identification	and/or Coordinates		Date	Time	Sample Type	5	Microplastics										A.	Ę	ျာ
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	TBP-1 -> TBP-5			25-Jan-22	0:00	Water		R										$\perp \perp$	$oxed{oxed}$	
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	YRMLD-01 -> YRMLD-05			25-Jan-22	14:15	Water	5	R											'	
	TRDB-01 -> TRDB-05			25-Jan-22	15:10	Water	1	R										igsqcut	<u> </u>	
	YCAR-01 -> YCAR-05			25-Jan-22	10:45	Water		R							$\perp \perp$			<u> </u>		
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City/Province:	Whitehore, YT	Email 2	amelie.janin@yuk	on.ca				dditional fe				sts on we	ekends,	statutory	y holiday	s and fo	r non-rout	ne tests.		
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Street:	419 Range Road	Email 1 or Fax	devon.o'connor@	yukon.ca		∐San	ne day [E	2] if recei	ved by 10	am M-S	- 200%	rush surc	harge			' Y. I	V.	(5)		
City/Province:	Whitehore, YT	Email 2	amelie.janin@yuk	on.ca			A	dditional fe	es may a	pply to ru	ish reque	sts on we	eken	<b>-</b>		n min	i Milit.		1 1111	
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COC Number: 21 -

Page 2 of 2



Canada Toll Free: 1 800 668 9878

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Contact: Tasnia Tarannum
Company: ALS Whitehorse
Address: 12-151 Industrial Rd,
Whitehorse, YT, Y1A2V3

Project / Location: WR2200058 PO Number: WR2200058 ALS Work Order: 22030808

The samples herein were analyzed according to ALS SOP Micro-Fluor-001 for the detection of micro plastic particles (MPP) using fluorescent tagging with Nile Red (NR) stain and static image analysis. This method, based on the study, "Synthetic Polymer Contamination in Bottled Water" which was conducted at the State University of New York (SUNY) at Fredonia, found an average of 325 MPP/L in bottled water brands from around the globe and has been shown to be sufficient for the rapid detection of polymerics including polyethylene (PE), polypropylene (PP), polystyrene (PS) and nylon 6 (PA6) though it cannot differentiate between them.

The efficacy of this method for the detection of MPP in non-potable waters including waste, effluent, influent, ground, surface, or marine waters has not yet been determined.

Particle sizing is performed using static image analysis of a series of representative two dimensional photomicrographs. Minimum caliper is the shortest distance between any 2 points along a single particle boundary and represents the approximate width/diameter of the particle/fiber. Maximum caliper is the longest distance between any 2 points along a single particle boundary and represents the length of the particle/fiber. The smallest single particle dimension confidently resolved by this method at the lowest available magnification has been determined to be approximately 6.5 $\mu$ m. Additionally, particles whose largest single dimension is greater than 5mm fall outside the generally accepted definition of MPP. Therefore, the total MPP concentration reported includes only fluorescing particles >6.5 $\mu$ m<5mm in the dimension of interest (DOI).

DOI is selected by the analyst based on observation of the dominant particle morphology. Samples observed to contain primarily fibrous MPP exhibiting a length to width aspect ratio of 3:1 or greater are categorized according to maximum caliper. Samples containing primarily non-fibrous MPP are categorized according to minimum caliper. Samples containing an approximately equal mixture of fibrous and non-fibrous MPP are categorized according to total area in units squared. The analytical sensitivity (AS) for this method is based on the detection of one particle in the total area analyzed. When possible, sufficient sample is analyzed to yield an AS<10 MPP/L. However, the volume of sample that can be analyzed is dependent upon water clarity. Therefore, samples with significant concentrations of interferences may not attain the desired AS.

Interferences such as opaque suspended solids may result in a negative bias while lipid-rich interferences such as fats, waxes, and oils may result in a positive bias. For this reason, the filtered aliquot selected for analysis is one that exhibits the greatest number of adequately dispersed fluorescing MPP affected by the least interference possible.

All sample collection is performed outside ALS and is the sole responsibility of the client. Filtered samples are archived for 60 days prior to disposal. Results apply only to portions analyzed. Microscopy is not suitable for the analysis of all types of materials. Therefore, additional testing may be required.

Representative photomicrographs and/or binary threshold images are not automatically included but may be made available upon request for an additional per item fee.

Pamela M. Hizar

ALS Microscopy Technical Manager

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IDENTIFICATION					
	WR2200058-	WR2200058-	WR2200058-	WR2200058-	WR2200058-
Client Sample ID:	006/ TBB-1	007/ TBB-2	008/ TBB-3	009/ TBB-4	010/ TBB-5
ALS Sample ID:	22030808-01A	22030808-02A	22030808-03A	22030808-04A	22030808-05A
Collection Date:	1/25/2022	1/25/2022	1/25/2022	1/25/2022	1/25/2022
ANALYSIS					
Analyst:	Pamela Hizar	Pamela Hizar	Pamela Hizar	Pamela Hizar	Pamela Hizar
Date:	3/21/2022	3/21/2022	3/21/2022	3/21/2022	3/21/2022
Filtered Volume (mL):	1000	1000	1000	1000	1000
AS (MPP/L):	1.34	1.34	1.34	1.34	1.34
DOI:	DIAMETER	DIAMETER	DIAMETER	DIAMETER	DIAMETER
CONCENTRATION (MPP	/ <b>L)</b>				
>6.5 <u>&lt;</u> 10μm:	4.01	0.00	1.34	0.00	0.00
>10 <u>&lt;</u> 100µm:	0.00	0.00	0.00	1.34	1.34
>100 <u>&lt;</u> 500µm:	0.00	0.00	0.00	0.00	0.00
>500µm <u>&lt;</u> 1mm:	0.00	0.00	0.00	0.00	0.00
>1 <u>&lt;</u> 5mm:	0.00	0.00	0.00	0.00	0.00
TOTAL:	4.01	0.00	1.34	1.34	1.34

#### **NOTES**

Samples were relogged from ALS WO 22020139 (samples 54-58) after being placed on hold for 42 days from receipt on 2/4/2022.



# APPENDIX C

**STATISTICAL TESTS RESULTS** 



Comparison	Distributions normal?	Variances equal?	Statistical test	Significant differences	% difference	Power (ANOVA only)	Minimum sample size for 0.95 power	Minimum sample size for 0.95 power
				Total MP Count				
				Blank6-Blank1	-88.9			
AUDI	.,		Wilcoxon-	Blank6-Blank2	-93.7	,	,	,
All Blanks	Y	N	Mann- Whitney	Blank6-Blank4	-95.3	n/a	n/a	n/a
			,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	Blank6-Blank5	-96.7			
				Tagish-Blank	142.5			
				Tagish-Carmacks	100.0			
September 2021	Υ	Υ	ANOVA	Tagish-Dawson	129.4	0.98	5	4
				Tagish-MarshLake	229.3			
				Tagish-Takhini	114.3			
				Tagish-Blank	2189.1			
				Tagish-Carmacks	1684.0			
				Tagish-Dawson	1849.5			
				Tagish-MarshLake	942.2			
January 2022	Υ	Υ	ANOVA	Tagish-Takhini	85.8	1	5	5
				Tahkini-Blank	921.9			
				Takhini-Carmacks	860.4			
				Takhini-Dawson	949.5			
				Takhini-MarshLake	461.1			
	V	V	ANOVA	MarshLake Sept - MarskLake Jan	-59.4	0.78	8	7
	Y	Y	ANOVA	Tagish Sept - Tagish Jan	-87.2	1	3	3
Temporal	Y	N	Wilcoxon- Mann- Whitney	Takhini Sept -Takhini Jan	-85.6	n/a	n/a	n/a
				6 of MP count in the >6.5≤10μm siz	e category			
All Blanks	N	N	Wilcoxon- Mann- Whitney	None	n/a	n/a	n/a	n/a
September 2021	Y	Υ	ANOVA	Dawson-Carmacks	125.4	0.86	7	6



Comparison	Distributions normal?	Variances equal?	Statistical test	Significant differences	% difference	Power (ANOVA only)	Minimum sample size for 0.95 power	Minimum sample size for 0.95 power
				Dawson-MarshLake	125.9			
				Dawson-Tagish	158.3			
				Dawson-Takhini	124.2			
January 2022	Υ	N	Wilcoxon- Mann- Whitney	Tagish-Blank	-91.5	n/a	n/a	n/a
Tamananal	V	V	ANOVA	Dawson Sept - Dawson Jan	97.8	0.99	5	4
Temporal	Y		ANOVA	Tagish Sept - Tagish Jan	428.4	0.99	3	3