STANDARD PROCEDURES FOR TRIBAL HAZARDOUS WASTE CHARACTERIZATION

A Collection

Abstract

This document is a compilation of several other documents that are considered useful for Tribes and the characterization of hazardous waste in their municipal solid waste (MSW) stream. The documents include a Quality Assurance Project Plan (QAPP), Health and Safety Plan (HASP) and studies cited in the development of the QAPP.

Saint Regis Mohawk Tribe, Solid Waste Program

Acknowledgment: This project was developed with the support of the USEPA, Tribal Hazardous Waste Grant Program.

Introduction

The Saint Regis Mohawk Tribe (Tribe) identified the need to properly identify hazardous waste and substances entering its Municipal Solid Waste (MSW) waste-stream to enable it to develop meaningful, community-based management plans. At the outset of the project there was the need to construct a sound sampling and data collection plan to ensure high data quality.

Because the sampling is performed at an active solid waste transfer station, where work place hazards are present in the form of inherent risks as well as unknown risks to hazardous substances, the project developed a Health and Safety Plan (HASP). The HASP identified risk hazards and measures to minimize them.

The project cites two references that present concepts and considerations for waste characterization. The first one, MSW Characterization Methodology, developed by USEPA, Office of Resource Conservation and Recovery, is a general guide consisting of fact sheets and data tables with brief descriptions and an overview of methodology. The other is a research article on sampling protocols for MSW. It is detailed and contains useful information about data quality. It provides greater detail on sampling and data analysis.

U.S. EPA REGION 2 - QUALITY ASSURANCE PROJECT PLAN APPROVAL FORM

PROJECT INFORMATION

Quality Assurance Officer:	Brian Hulme
Project Officer:	Grant Jonathan
Title of Quality Assurance Project Plan:	Hazardous Waste Material Flow Characterization
Assistance Agreement or Contract #:	99267205
QA File Number:	2021 - 39

REGIONAL QA MANAGER OR DELEGATED APPROVER

Approved ☑ Conditionally Approved* ☐

*** Conditional Approval may be provided when there are unresolved comments that do not impact the data collection or the quality of the data and where the project has a small window of opportunity to collect such data. Conditional Approval expires 30 days from the signature date. If updated quality documentation (QD) is not provided by the expiration date or another due date is not agreed upon by EPA, then the QD will be considered delinquent.**

Comments:

Signature EPA QA Officer

Signature EPA PO or Project lead

REVIEW SUMMARY:

A review was conducted on the above referenced Quality Assurance Project Plan. The subject QAPP was reviewed for conformance with the *EPA Requirements for Quality Assurance Project Plans* (EPA QA/R-5), EPA/240/B-01/003, March 2001; USEPA Region 2 Guidance for the Development of QAPPs for Environmental Monitoring Projects, April 2004 and other EPA QAPP guidance documents as appropriate.

This approval form documents EPA's decision of approval or conditional approval* for the aforementioned QAPP. After the QAPP is approved by EPA via this approval form, obtain the required signatures from your organization on the QAPP Title/Signature page. Send the signed QAPP to the EPA Project Officer and others on the QAPP distribution list within the timeframe stipulated in the AA terms and conditions.

1. Title and Approval Sheet (A1)

Project Title – Hazardous Waste Material Flow Characterization
Organization Name – Saint Regis Mohawk Tribe, Solid Waste Program
Effective Date of Plan: September 1, 2021 – August 30, 2022

Approving SRMT Officials

Principle Investigator Angela Benedict	Signature/Date 09/22/2021
Tribal Quality Assurance Officer (TQAO)	Signature/Date
SRMT - Division Director	Signature/Date

A signature indicates both approval of the plan and commitment to follow the procedures noted.

2. Table of Contents(A2)

Contents

3. Distribution List(A3)

Key Personnel who should get a copy of the approved QAPP.

This list includes the names and addresses of those who receive copies of the approved QAPP, subsequent revisions and final reports.

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4. Project/Task/Organization (A4)

The Tribe's management team consists of the Tribal Environmental Administrative and Technical staff who collectively have the experience to implement the data collection, analysis and reporting consistent with established the Quality Control (QC) measures. This team consists of the Solid Waste Program Manager, the Solid Waste Operations Supervisor, the Tribal Quality Assurance Officer and the Assistant Director. Together the team will ensure that the personnel resources, materials and project oversight are in place before and during the data collection and analysis. The responsibilities within the team, including the QC responsibilities have the highest degree for separation of duties to ensure accountability of staff in fulfilling their respective roles and responsibilities.

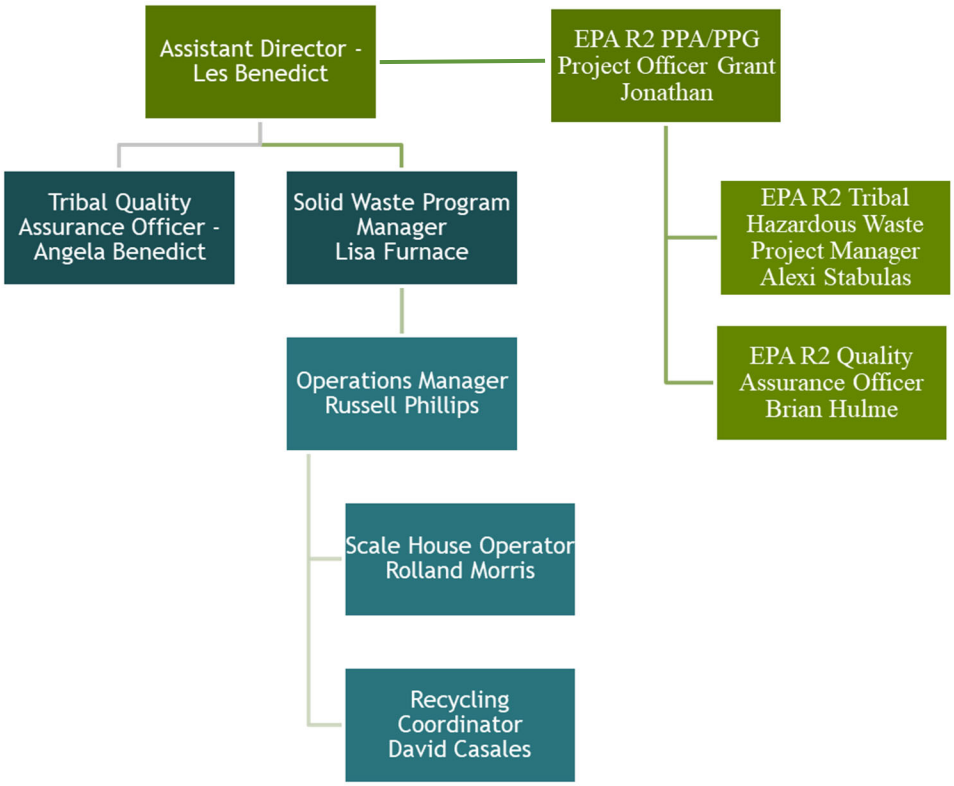


Figure 1 Organizational Chart

Table 1 Organization

Name and Title	QC Responsibilities
David C. Casales, SRMT Recycling Coordinator	Conduct sampling operations following QAPP. Perform scale calibrations, maintain sampling records and sample collection documents. Process raw data.
Les Benedict, Env. Div. Assistant Director	Sampling Quality Assurance/Control (QA/QC) oversight. Overall project coordination, conducts performance checks of Recycling Coordinator. Overall responsibility for project. Data validation, conduct performance checks. Project reporting.
Brian Hulme, EPA Region 2 QAO	EPA QA/QC Coordination, review and approval for EPA.
Angela Benedict, Tribal QAO	Overall QA/QC Coordination. Tribal QA Officer is responsible for reviewing, approving, updating, and maintaining QAPP according to the Tribe's Quality Assurance Management Plan, 2007 (QAMP) and Quality Assurance Management Project Plan (QAPP) Guidance, September 6, 2001. She has

	signing authority for a project work plan for the SRMT Environment Division.
Lisa Furnace. Solid Waste Program Manager	Principle Investigator. Conduct performance checks and data validation.
Russell Phillips, Operations Manager	Perform equipment checks.
Rolland Morris, Scale House Operator	Consult in load selection.
Anthony David, Env. Div. Director	Division Approval of QAPP. Primary authority signing authority for work plans.
Grant Jonathan, EPA R2, PPA/PPG Project Officer	Approves project within scope of PPA/PPG. Receives and forwards QAPP to for review process.
Alexis Stabulas, EPA, R2 Tribal Hazardous Waste Project Manager	Approves project within scope of Tribal Hazardous Waste grant program.

Team efforts will focus on the collection of hazardous materials through sorting and weighing of Municipal Solid Waste (MSW) samples over a period of time to account for seasonal variation. Using an established organizational hierarchy, the Recycling Coordinator will be tasked with sample collection following an established protocol for sorting, weighing and recording data. The management structure will ensure training of the Recycling Coordinator in performing data collection and handling while also providing periodic QC checks of procedures, and documentation. Health and Safety in the form of a Health and Safety Plan (HASP) will be addressed to ensure employee health while handling of materials.

5. Special Training Needs/Certification (A8)

Table 2 Training and Certification

Project Personnel	**Training/ Certification**	**Documentation and Assurances**
David Casales	Hazardous Materials Awareness Level Training	Certificate of Course Completion
	Training in operation and maintenance of scale	Review and acknowledgement of operations manual and conformance to manufacturer's instructions
	OSHA 10 General Industry	Certificate of Course Completion
	QAPP Introductory Training	Letter/certificate of course completion
	Competency training in use of PPE	Letter/certificate of course completion

Course/Training Rationale

Hazardous Materials Awareness Level Training - The HAZWOPER First Responder Awareness course is required training for any individuals who may be likely to encounter the release of a hazardous substance and will be responsible for notifying emergency personnel. There is a potential for encountering hazardous substances while collecting samples for this project.

Training and Operation and Maintenance of Scale – Training in scale operation and maintenance, in addition to improving skills and knowledge, will ensure uniformity of work processes during sample collection and processing, minimize supervision and provide overall quality assurance.

OHSA 10, General Industry – OSHA 10 is an outreach and voluntary training program provided by Occupational Safety Health Administration (OSHA), United States Department of Labor. It provides 10 hours of training to the workers and employees touching on appreciation, prevention, avoidance and reduction of safety and health hazards in the workplace. The work place environment has known safety and health hazards that workers need to be aware of and understand how to work safely.

QAPP Introductory Training – In-house Quality Assurance Project Plan introductory training will provide staff with a fundamental understanding of the sampling plan objectives, steps utilized for ensuring data quality, roles and responsibilities of personnel involved and how together data quality objectives will be met and how to address problems that might be encountered in the field.

Competency in Personal Protective Equipment (PPE) Use – Competency in PPE reflects OSHA 1910.132-140, where PPE may be used to prevent worker injury in the work place when engineering and administrative controls fail to eliminate the hazard. Competency training will instruct in understanding when PPE is needed, what PPE is needed, how to properly don't and doff PPE and how to care for it and understand PPE useful life. PPE will be utilized for sample collection in this project.

6. Problem Definition/Background (A5)

This project is being undertaken in order to provide the Tribe with information that will enable it to make decisions for the management of hazardous waste on the Saint Regis Mohawk Reservation.

The data will be used to assess the quantity and type(s) of hazardous waste entering the waste stream and to develop strategies for managing it, e.g. – education and awareness, regulations, technical assistance.

The data users are: the Solid Waste Program Manager, the Recycling Coordinator, the Environment Division Director, Tribal Executive Director and the Tribal Council.

6.1 Problem Definition

Goals

- To characterize the quantity and type of hazardous materials entering the Tribe's waste stream
- Support the Tribe's hazardous waste management goal for protecting tribal member health

Objectives

- Collect waste characterization data for a period of 4-quarters
- Provide a report that summarizes the hazardous waste stream data, that identifies the quantities and types of materials observed on a temporal scale by the end of 12-months

6.2 Background

Hazardous waste generators of all sizes exist in almost every community in the country. In 2017, (year with most recent data), nearly 212,000 tons of hazardous waste (424,000,000 pounds) were generated on federal and tribal lands, which accounted for half of a percent of the total hazardous waste generated in the United States.[1]

Tribes have an important responsibility to ensure the health of community members and the environment by preventing and reducing chemical exposures including those from hazardous waste materials. Several important management actions that a Tribe can take are:

- Develop and implement codes, regulations, ordinances, policies and/or guidance to regulate hazardous waste management activities and facilities such as generators, transporters, and treatment, storage and disposal facilities.
- Develop and implement tribal integrated hazardous waste management plans (including source reduction/recycling).
- Implement used oil collection and other programs to reduce the improper management of hazardous waste in the community. Used oil collection programs must be in accordance with Title 40 of the Code of Federal Regulations (CFR) in Part 279.
- Implement household hazardous waste collection events and/or programs that provide sustainable or long-term solutions for disposal of household hazardous waste.
- Implement universal waste collection events and/or programs that provide sustainable or long-term solutions for disposal of universal waste for the

[1] Yavrom, Deeba. (November 18, 2020). [Web page]. Hazardous Waste Generation on Federal and Tribal Lands. https://rcrapublic.epa.gov/rcra-public-web/action/posts/4

community. Universal waste programs must be conducted in accordance with Title 40 of the CFR in Part 273.

The Tribe seeks to better understand the nature of hazardous wastes (including Household Hazardous Wastes) entering its waste stream. The Tribe's Solid Waste Program will conduct a Waste Characterization study to accurately measure hazardous waste materials entering its waste stream. The waste stream consists of materials that are entering its Solid Waste Transfer Station (SWTS), with a final destination of the County of Franklin Solid Waste Authority sanitary landfill.

The Saint Regis Mohawk Reservation is approximately 16,000 acres with a population of about 9,500 tribal members. The Tribe's SWTS is on trust land, just east of the reservation.

No previous data has been collected to characterize the hazardous waste component in the Tribe's waste stream. This effort will establish a baseline for decision making.

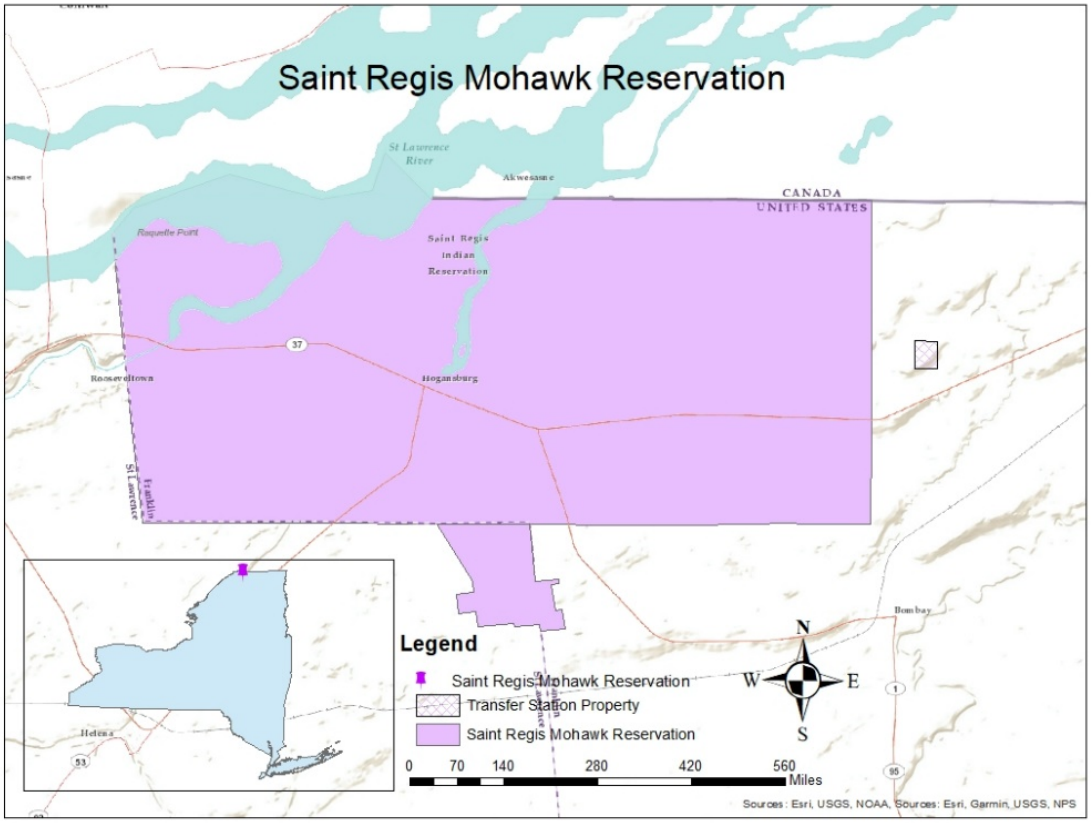


Figure 2 - Locator Map

7. Project/Task Description (A6)

This section provides a management summary of the work that will be conducted and a schedule for implementation. Specific technical details about the work will be provided in later sections of the QAPP.

All samples will be collected at the Tribe's Transfer Station located at 179 County Route 43, Ft. Covington, NY.

The approach for collecting samples on a quarterly basis will account for seasonal variations, differentiating residential and commercial loads will provide and understanding of the generation of materials from each source. Random selection of loads and sub-samples provides the highest level of quality control for the project. Ultimately, the identification of hazardous materials in the context of MSW flow into the Tribe's transfer station will provide the Tribe with information that will drive decision making for management of hazardous waste on tribal lands.

The project schedule calls for the collection of a week-long (5-day week) sampling period once per-quarter for 4 quarters.

Table 3 Project Schedule – Sampling

4-Quarters	**Sampling period**	**Sample**	**Sub-Sample**
October-December 2021	5 consecutive days	1-Randomly Selected Vehicle 200-lb minimum load	Random Grid*
Jan-Mar 2022	5 consecutive days	1-Randomly Selected Vehicle 200—lb minimum load	Random Grid
Apr-June 2022	5 consecutive days	1-Randomly Selected Vehicle 200-lb minimum load	Random Grid
July-September 2022	5 consecutive days	1-Randomly Selected Vehicle 200-lb minimum load	Random Grid

*(See section 10.1 for detail on grid size and description)

Table 4 Tasks

Task	**Activity**	**Start Date**	**Estimated Duration**
#1	Starting Hazardous Waste Plan field logistics	July 2021	1 month
#2	Purchase items Obtain equipment	July 2021	1 week
#3	Training hazard certificate	July 2021	1 day
#4	Submit SRMT Hazardous waste characterization plan	August 2021	1 month
#5	Implement hazardous waste sample collection protocol	Oct 2021 – Sept 2022	5 days each quarter/ 4 quarters total

#6	Apply safety measurements	Oct 2021	5 days each quarter/ 4 quarters total
#7	Sort, weigh & record hazardous waste data entry sheet	Oct 2021- Sept 2022	5 days each quarter/ 4 quarters total
	Sample collection	Oct 2021- Sept 2022	5 days each quarter/ 4 quarters total
#8	Maintain area	Oct 2021- Sept 2022	5 days each quarter/ 4 quarters total
#9	Reporting results	Oct 2021- Sept 2022	Quarterly
#10	Compare results	Oct 2021- Sept 2022	Quarterly
#11	Data analysis	Oct 2021- Sept 2022	Quarterly
#12	Assessment & data review	Oct 2021- Sept 2022	1-month
#13	Draft final audit report	Oct 2022	1-month

No specialized personnel are required for this project. The Recycling Coordinator, David Casales will be performing sorting and recording.

Specialized equipment includes:

- Bobcat type loader with bucket and grapple
- Digital weigh scale

Appropriate specific quality standards include:

- Technical – National Institute of Standards and Technology Specifications and Tolerances for Field Standard Weights
- Regulatory – none
- Program – Conformance to EPA approved Tribal Quality Assurance Management Plan (QAMP)

Contingency

In the event of a potential disruption to the workplan, such as equipment failures, unforeseen staff unavailability, etc. the project schedule is flexible enough for adjustments.

- If there is a scale failure a replacement scale will be ordered
- If there is a weather event the sampling can be conducted at a later date in the same quarter. There are a total of 5 samples per quarter, i.e. – 12 weeks of opportunity within a quarter to collect samples
- If the primary person collecting samples, the Recycling Coordinator isn't available, the schedule can permit adjustment to the day with corrections made similar to a weather event.
- The project oversight and management provide ample coverage so that if the Program Manager is not available for oversight and review another management

team member, e.g. – Assistant Director or Operations Manager can step in to function.

8. Quality Objectives and Criteria for Measurement (A7)

8.1 Precision

Classification

Precision can't be determined for the "identification" of the materials since there is some level of subjectivity. However, the Federal Hazardous Substances Act (FHSA) requires labeling (See Figures 3 & 4) for chemicals and hazardous substances that are sold/purchased, e.g. household products, including labeling to alert consumers to the potential hazards for projects. In labeling, a product must first be toxic, corrosive, flammable or combustible, an irritant, or a strong sensitizer, or it must generate pressure through decomposition, heat, or other means.

Figure 3 FHSA Label Example - Oxidizer

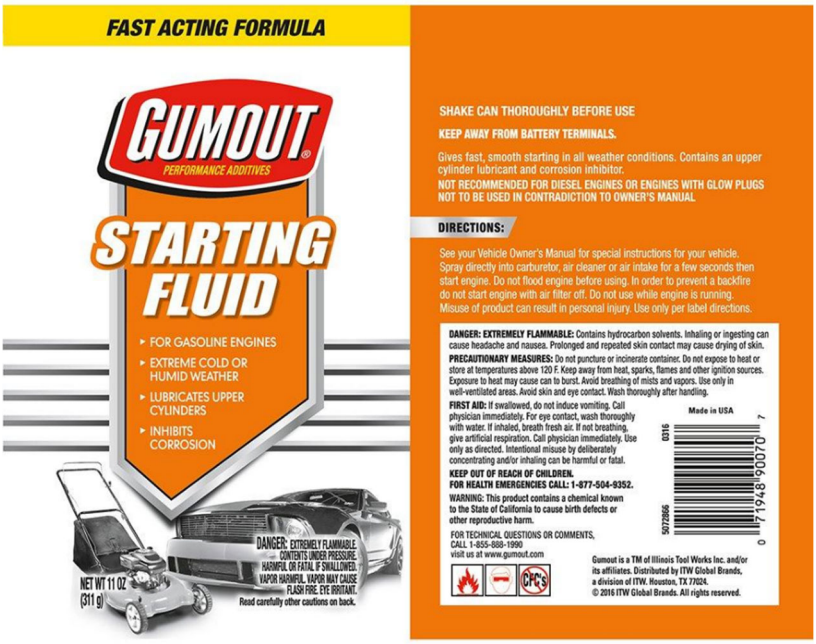


Figure 4 FHSA Label Example - flammable

Overall, the intent of the project is to sort and separate materials as being "non-hazardous or hazardous", this being the first sort. To address the subjectivity associated with "identification" of hazardous substances and materials, the project will utilize the following processes:

- Consumer product containers and materials that contain labeling information, e.g. wording and pictograms, will be utilized to classify materials as toxic, flammable, corrosive or combustible
- Products and materials not necessarily labeled, e.g. waste oil, oil filters, pesticides, herbicides will be generally identified as a "chemical" unless identity is apparently known, e.g. fluorescent bulbs. Examples of materials that might be generally categorized included: drain cleaners, oil, paint, motor oil, antifreeze, poisons, pesticides, herbicides and rodenticides, lamp ballasts, smoke detectors as well as consumer electronics.
- There may be instances where materials are placed in unlabeled containers and are suspect for a hazardous substance. In these cases, the containers will be safely set aside for assessment by a member of the Tribe's Environmental Response team for appraisal with classifier strips (Appendix D) and/or direct reading instrument, e.g. Photo Ionization Detector, Combustible Gas Indicator.

It should be noted that there is no manufacturing or industrial processing on the reservation and that the types of wastes that might be generated, EPA listed, are not

expected. This project doesn't seek to identify and classify on that level but is more focused on what might be considered characteristic wastes.

Scale

Precision can be quantified for weights using the scale.

The precision of a scale is a measure of the repeatability of an object's displayed weight for multiple weighing of the materials.

For example, if the displayed weights of the materials weights 200 lbs. are 200.20, 200.30, 200.15, 200.10, and 200.25 lb, then the average displayed weight is still 200.20 lb, but the measured values deviate by as much as 0.10 lb with respect to this average. Therefore, the precision is expressed as ±0.10 lb, meaning that the fluctuations are limited to 0.10 lb in either direction.

In a similar example, if the displayed weights are 200.20, 200.40, 200.10, 200.00 and 200.30, the average is still 200.20 lb, and the accuracy is still 0.20 lb or 0.1%. However, the deviation is larger (0.20 lb) and the precision would be ±0.20 lb, not ±0.10 lb.

Precision will be analyzed to determine the range, or difference, between the lowest and the highest measured values.

8.2 Bias

Bias is the systematic or persistent distortion of a measurement process causing errors in one direction.

There are several sources of bias:
1. Weighing of samples – addressed through calibrations
2. Sample selection – addressed through random selection
3. Selection of loads – addressed through random selection
4. Seasonality – addressed through quarterly sampling throughout the year

To reduce bias in weighing of samples the project will utilize the same weigh scale for all samples.

To address bias in sample selection, loads coming in to the transfer station will be visually inspected for "pure load" or "mixed load" and noted in sampling sheets. An example of pure load is any load of that has more than 95% of the material by weight in one component category.

Table 5 – Component Categories

Component Category	Definition
Paper	All materials containing only paper fibers
Plant Debris	Yard Waste – grass leaves, tree trimmings, house plants
Wood	Wood demolition, lumber, furniture
Plastics	All plastic containers and wrappings
Metals	Aluminum and steel containers, scrap metal
Putrescibles	Food waste and materials contaminated with food
Rock	Construction debris
Reusable goods	Books, small appliances, tools, toys
Textiles	Clothing and cloth
Chemicals (hazardous wastes)	Chemical products and containers
Soils	Potting soil and dirt
Glass	All colors of glass containers
Other	Composite materials and items deemed no longer usable

All loads will be randomly selected using a randomly selected ticket numbers (See figure 5) using MS Excel RAND, INDEX AND RANK functions. The transfer station issues unique scale ticket numbers. Approximately 6500 tickets are year are generated, or 1625 per month. At the beginning of each quarter, just prior, a starting ticket number will be obtained from the Scale House as a starting point for the quarter. For example:

Beginning ticket number = 3103397, adding 1625 = 3105022.

The next step is to generate a list of 5 random number using the MS Excel functions. RAND is utilized generate random numbers in a table associated with ticket numbers. INDEX performs the ticket number and random number association while RANK displays the associated ticket number. When utilized with the appropriate arguments it will randomly select the ticket number, without duplicates:

INDEX($B$2:$B$1627,RANK(B2, $B$2:$B$1627),1)

In this example only the first 20 ticket numbers have been shown for this function (all ticket cells aren't shown due to space limitations). The heading RDMTKT represents the ticket numbers that will be selected for load. The function can run as many times as needed, for example when a load doesn't meet the minimum weight requirement.

TICKET NO	RANDNUM	RDMTKT
3103397	0.37016599	3105022
3103398	0.84895945	3105021
3103399	0.0427822	3105020
3103400	0.95532222	3105019
3103401	0.81658556	3105018
3103402	0.2462444	
3103403	0.86782248	
3103404	0.45748974	
3103405	0.97979682	
3103406	0.87618158	
3103407	0.27743937	
3103408	0.92276643	
3103409	0.62190189	
3103410	0.93056239	
3103411	0.62961017	
3103412	0.93458473	
3103413	0.96719728	
3103414	0.25334387	
3103415	0.67280767	

Figure 5 Random number generation by scale ticket

In the event the load is not sufficient, e.g. less than 200-lbs, the next randomly selected load ticket number will be used. Based on the projected tickets and random selection the following table provides the ticket numbers that will be selected for waste characterization.

Seasonal bias will be addressed by the collection of samples on a quarterly basis to allow for variations that might be associated with product usage by season/weather.

8.3 Representativeness

Sample representativeness for this project is based on a study conducted to develop a sampling protocol for MSW (Collins, 1995). The study determined that over a range of categories of MSW components, (Putrescibles, Paper, Plant Debris, Textiles, Metals, Glass and Plastics) the number of samples to obtain acceptable confidence levels within a 1% or 2% margin of error varied. The categories didn't include hazardous waste as a specific component. The range for the number of samples was from 5 to 92 depending upon the category and confidence level/percent error.

Table 2 illustrates the number of samples that are required to obtain a representative sample for the project. Reading below, 20 samples are sufficient to achieve representativeness if you look at the table you will see that to obtain a 90% confidence level and 2%-1% error, between 10 and 32 samples will be sufficient. For 80% confidence which is acceptable for this project, the middle ground is about 20 samples.

Table 6 Confidence limits by MSW Category

Appendix A: Number of samples required by MSW component category.

Confidence Levels	*80%*		*90%*		*95%*	
	Error		Error		Error	
Category	2%	1%	2%	1%	2%	1%
Putrescibles	11	40	18	66	25	92
Paper	11	38	17	62	24	87
Plant Debris	6	19	10	32	14	45
Textiles	5	16	8	26	12	36
Metals	5	15	8	25	11	35
Glass	*	8	5	13	7	19
Plastics	*	6	*	9	*	13

* N_0 was less than five and the sample number computation did not converge.

The number of samples, based on the schedule, Section 7, Table 1, will result in 20 samples (4 quarters X 5 samples per week), producing data with a high degree of representativeness.

8.4 Comparability

This project will have some comparability to the work cited earlier (Collins, 1995) and to a similar project conducted on the Virgin Islands (Islands, January 2018-September 2019). Both projects involved the characterization of MSW components. The projects collected similar sample sizes (mass), although the Islands project collected fewer samples than did the Collins project but expected to achieve at least a 80% to 90% confidence interval.

This project expects to achieve similar results as the Collins and the Islands projects because the materials will be sampled and measured similarly.

8.5 Completeness

This project anticipates an 90% level of completeness for sample collection and stay within the 1-2% error range stated earlier. The minimum number of samples in this case is 18 total samples.

8.6 Sensitivity

This project will utilize a commercial digital scale with a capacity up to 400-lbs that measures in 0.2-lb increments, which provides a very high degree (1000 times) of sensitivity in relation to the required sample mass of 200-lbs.

9.0 Non-Direct Measurement (B9)

No secondary data will be utilized for this project.

10.0 Field Monitoring Requirements

This section describes project design and methods that will be employed for the collection of samples from waste stream entering the Tribe's Transfer Station. It includes quality control (QC) activities that will be used to assure data quality..

10.1 Monitoring Process Design (B1)

The project design consists of the collection of MSW samples and the identification of material category with particular interest in the hazardous waste (household hazardous waste and other chemicals) components (chemical category).

There is only one monitoring point and that is the Solid Waste Transfer Station tipping area at 170 County Route 43, Ft. Covington, NY. All solid waste managed by the Tribe enters this facility for temporary storage and transfer to a sanitary landfill.

Trucks/vehicles (loads) entering the facility will be randomly selected using a random numbers generator identify vehicles by license plate number. The sources of the MSW will also be recorded and kept separate. The sources that will be tracked are:

- Residential
- Commercial
- Industrial (not likely since there are no industries on the territory)
- Institutional

Temporal variability is being considered and will be managed by conducting dialing sampling once per quarter for a period of 5-days.

Load selection is probability based as is the sub-sample selection (grid) using random selection of sub-samples:

The project is the first time such sampling has occurred for the Tribe's solid waste program. Therefore, the samples aren't comparable to previous data sets for this site. The data will be establishing a baseline that will help in decision making for developing a tribal hazardous waste management plan. Similar studies were conducted for other communities including the Virgin Islands. Although, not directly comparable, there is a general interest in comparing datasets in general.

A total of 20 sample sets is needed to obtain stated data quality objectives.

Frequency of sampling is 5-days, once per quarter.

The target population, MSW is considered to be heterogenous but may include homogenous materials, e.g. pure load vs mixed load.

The QC samples required for the project are reweigh of every 10 samples to determine precision.

Sampling Design

Sampling each day will follow the same design. The operations supervisor will select a number of loads to be analyzed each day based on random selection. No prior information about the origin of the truck will be recorded during the selection process.

As a selected load enters the transfer station the operations supervisor, or team member will:

1- Interview the driver and record the following information on the data form:
- a. Recorder's name
- b. Date and time
- c. Sample number
- d. Hauler name
- e. Origin and Route
- f. Type of vehicle

2- The scale house operator will direct the designated vehicle containing the load of waste to the area secured for discharge of the load and collection of the sorting sample in one contiguous pile, that is, to avoid gaps in the discharged load to facilitate collection of the samples.

3- The recycling coordinator and operations supervisor will visually inspect the load of waste and recyclables and record anything unusual about it on the top of the data form. For example, if an oversized item, such as a water heater, composes a large weight percent of the sorting sample, the sort team will add a notation on the data sheet and weigh it, if possible.

4- The front loader will mix, and split the material, as illustrated below, each sample will be visually divided into six areas. The operations supervisor will then select one section to be the sorting sample, by rolling a dice, to eliminate or minimize biasing of the sample.

1	2	3
4	5	6

Figure 6 - Sub-sample grid

5- Based on the result of the dice, the loader operator will be directed to the area from which to pull a sample of at least 200 pounds. Should the area selected by the die be larger

than the width of one loader bucket, the dice may be rolled a second time to further identify the area for sampling. If the materials do not appear to be uniformly distributed, the sampling supervisor may ask the loader operator to mix the material before rolling the die to select the sample. Care will be taken when selecting samples to ensure the loader operator starts with the blade on the ground, and collects material through the center of the pile regardless of where the sample is initiated in the load.

6- The sampling load will be placed on a tarp. Before sampling, the team members will ensure that all parties are agreeable to this sampling process. Any changes to the QAPP sampling process will be clearly documented.

10.2 Monitoring Methods (B2)

The intent of the sampling effort is to sort all samples in their entirety. For each sample, the Recycling Coordinator will sort all materials working toward the center, until approximately 200 pounds of material has been sorted. The Recycling Coordinator with the Assistance of the Operations Manager will conduct the following activities:

1- Set up the sorting area, which includes the following:

a) Set up the customized sorting table that is flat and clean, contains walls to keep the sample material on the table, contains a 2-inch screen to filter larger items to the top for gross sorting, and a 0.5-inch screen to filter fines to be weighed then apportioned visually according to sort categories;

b) Stage the safety and sorting equipment so they are easily accessible;

c) Set up the scale in an area away from high activity on a clean, flat, level surface and the level adjusted if necessary, and weigh empty sort container on calibrated scale –tare weights of plastic sort containers will be subtracted from the gross weight during analysis;

d) Place appropriate label (See Table 5) on each container corresponding to each category and arrange the containers around the sorting table;

e) Arrange tarps for storing samples.

2- Ensure personal safety gear is provided and being used as per the written Health and Safety Plan (HASP).

3- Conduct safety and technical training prior to sampling as per HASP.

4- Transfer the sample from the tarp to the sorting table as space permits.

5- Oversee the accurate sorting of all materials that remain on the sort table's 2-inch screen into the categories. Gross weights will include wet weights in accordance with ASTM D5231-92 standard, which may impact categories that can soak up water more than others

The Supervisor will supervise sorting activity to ensure material is correctly sorted.

Specific items will be handled as follows: a) cardboard boxes that have plastic film or EPS packaging that can be easily removed will be separated from these materials and sorted as corrugated cardboard. The film will be sorted as contamination; b) cardboard that is within plastic film, such as that from a case of bottled water, will be treated as contamination, and any cardboard that is attached to wood or other contaminants will be sorted as contamination; c) all bagged materials containing recyclables or contamination will be counted, weighed and the weight recorded to provide the total number and weight of bagged recyclables and bagged contamination; the bags will then be opened. Bags that are clearly full of trash or contaminated recyclables (i.e. recyclables that have been contaminated by the trash, such as food waste) will be sorted as contamination; all other bagged materials will be sorted by type of recyclable material or as contamination, as appropriate.

6- Remove the sort table's 2-inch screen and sort all materials that remain on the sort table's ½-inch screen, except glass, as contamination. All glass remaining on the sort table's ½-inch screen will be sorted as glass.

7- Remove the sort table's ½-inch screen and sweep any remaining materials into a container, which will be weighed and recorded as contamination.

8- Weigh all sorted materials and record the weight and any visual observations of each. If a container fills up before the entire sample is sorted, the sampling supervisor will weigh the materials, record the weight, empty the container, and return it to the sorting table.

9- Pile all sorted and analyzed items on a tarp for disposal in the landfill

Data acquisition equipment consists of bound, paginated composition book and blue ink pen and field data sheets. The composition book will be reviewed daily for completeness by the Program Manager or by the Assistant Director if the Program Manager is not available. The composition book will be stored in a file cabinet in the Recycling Coordinators office.

Field equipment consists of:

- Weigh Scale – in pounds
- Tarps
- Shovels
- Rakes

Equipment will be washed with detergent and rinsed with clean water after each sampling event. The cleaning will be verified by the Operations Manager and noted in the daily composition book with the Operations Manager's initials.

Management of hazardous substances for worker protection and safety is addressed in the Health and Safety Plan (HASP) developed for this project.

10.3 Field Quality Control (QC) (B5)

The weigh scale will be checked for proper operation at the start of each sampling day to ensure usability. The scale will be tared before each weighing operation. For purposes of precision calculation, the first and 10th sample will be weighed twice and weights recorded and used in the calculation.

Transfer station team members and recycling coordinator will remain on site until all sorting and clean up tasks are completed. Completeness entails complete and total removal of waste from the study area; ensuring that all equipment gets cleaned up; finalizing and saving all data entered into electronic forms, recording of notes in electronic forms, and uploading of all pictures into project folder. In addition, project team will ensure that weighing equipment will be calibrated and maintained according to the specifications of the scale user manual.

The team will review the number of samples sorted every day to adjust the schedule as needed for ensuring completeness.

11.0 Analytical Requirements

11.1 Analytical Methods (B4)

Weighing of MSW and its components will be performed using a bulk-weighing scale. Weighing scales are supported by load cells that generate an electrical signal proportional to the weight they support. A device called a "Scale Indicator" supplies power to the load cells, sums their output, and produces a digital signal which represents the combined weight. The weight of the empty scale (the TARE weight) is measured and expressed as a "0" or zero weight. After tare weight, materials are loaded onto the scale providing a weight of the materials.

After the sorting event, the Program Manager will calculate material category total weights and determine the composition found in the waste audit according to proportion of total for each sort category, as well as the confidence intervals following ASTM's Standard Test Method for Determination of the Composition of Unprocessed Municipal Solid Waste; Designation D 5231-92 (Reapproved 2016). Individual sample data will also be provided in an appendix to the final technical memorandums. Any individual samples mutually agreed upon by team members to be outliers in the data set will be removed from the study

results. Outliers will be determined as being significantly out of line with other samples, if the total weight is far out of line with the 200lb expectation, or if sort notes taken during the study show a clear explanation that is agreed to be especially unusual by stakeholders. For example, if an unusually-sized item such as a water heater composes a majority of the sample weight or spans several sample zones, then the randomly selected sample will be removed from the study results. Explanation for the sample rejection will be noted along with weight of problem item(s).

Table 7 – Example sample record

Recorder's name	**Date & time**	**Sample number**	**Hauler name**	**Origin & route Generator**	**Type of vehicle**

11.2 Analytical Quality Control (B5)

After a sorting event, the project analyst will calculate material category total weights and determine the composition found in the waste audit according to proportion of total for each sort category. Individual sample data will also be provided in an appendix to the final technical report.

Any individual samples mutually agreed upon by team members to be outliers in the data set will be removed from the study results. Outliers will be determined as being significantly out of line with other samples, if the total weight is far out of line with the 200-lb expectation, or if sort notes taken show an unusually-sized item composes a majority of the sample weight or spans several sample zones, then the randomly selected sample will be removed from the study results. Explanation for the sample rejection will be noted along with weight of problem item(s).

Following the sorting event, materials will be disposed of accordingly:

- Municipal Solid Waste – emptied into transfer station storage bins for landfill disposal
- Hazardous substance – collected and placed in overpack containers according to characteristics (corrosives, flammables, toxic, combustible) and disposed of through a qualified contractor

12.0 Sample Handling and Custody Requirements (B3)

There are no particular sample handling and custody requirements for this project as samples will collected and weighed on site. Data will be entered into data collection sheets. Project details will be maintained in a bound composition book. Data sheets and composition book will be stored at the transfer station in a locked filing cabinet.

13.0 Testing, Inspection, Maintenance and Calibration Requirements

13.1 Instrument/Equipment Testing, Inspection and Maintenance (B6)

List of equipment requiring inspection:

1. Electric weigh scale daily tests and maintenance.

A. Each day inspection will be recorded by entering specific testing data.
B. The electric scale has to be set in a leveled neat area for testing and precise measurements.
C. Weigh expected item weight for precision.

Table 7 Equipment Data Schedule

Item#	Equipment	Date & Time	Testing	Inspection	Maintain	Disactivate
1	Electric scale	Record date and time	Calibration as per manufacturer's instructions. Taring Precision test	Inspect for damage	Clean the scale after each event	Disconnect power line or batteries.
#						

2. Critical parts and spares.

A. Electric scale will be turned off turning the switch off and then disconnecting the power cord.
B. If the scale is found to be unusable, it will be replaced with a similar scale.

13.2 Instrument/Equipment Calibration and Frequency (B7)

Equipment requiring calibration:

1. Brecknell, LPS-400 Series, Postal and Parcel Shipping Scales

Calibration Description

A three-point calibration is required to provide the most accurate results.

Calibration point P0 = no weight on the scale
Calibration point P1 = a test weight that is 12.5%-100% of full capacity
Calibration point P2 = a test weight that is 25%-100% of full capacity

If two certified test weights are not available, one weight can be used, provided that it is than 25% of full capacity. Instructions for both procedures are below are in Appendix A. The project will utilize #4, 50-lb weight standards to establish a 50-lb, 100-lb and 200-lb three-point calibration.

Calibrations will be conducted daily prior to sampling. Calibrations will be recorded in the project log book. Calibration curves will be developed, e.g. linear regression to demonstrate linearity. The curves will be developed in MS Excel.

Calibration records will include the equipment Make, Model and serial number of the scale which will be entered for each calibration performed and recorded in the project log book and in the associated MS calibration curves. The weight standards will be recorded in the log book.

The calibration sheet is in Appendix B.

Maintenance

Required equipment maintenance and frequency includes:

General Operation

- Avoid lengthy exposure to extreme heat or cold. Your scale works best when operated at normal room temperature. Always allow the scale to reach room temperature before use.
- Allow sufficient warm up time. Turn the scale on and wait for a few minutes if possible, to give the internal components a chance to stabilize before weighing.
- Do no operate near an in use cell phone, radio, computer or other electronic device. These devices emit RF and can cause unstable readings.

- If your scale ever performs poorly, try moving the scale to a different room or location.

Daily

- Wipe down the outside with a clean cloth, moistened with water and a small amount of mild detergent
- Spray the cloth when using a cleaning fluid and not the scale
- Calibration if used
- Cleaning will be recorded by the Recycling Coordinator in the composition notebook, verified and initialed by the Operations Manager

Routine

- IMPORTANT: This equipment must be routinely checked for proper operation and calibration.
- Application and usage will determine the frequency of calibration required for
- safe operation.
- Always turn off the machine and isolate from the power supply before starting any routine maintenance to avoid the possibility of electric shock.

13.3 Inspection/Acceptance of Supplies and Consumables (B8)

There are no acceptance criteria for supplies and consumables used in this project.

Acceptance criteria for the scale includes equipment complete as per packing slip:

Name	Quantity
LPS Series scale with indicator	1
Communication cable	1
Indicator bracket	1
User Manual	1

The following items will be needed for daily use:

Table 9 Equipment and Supplies

Items	Number
First Aid Kit	1
Emergency response guidebook	1
32 gal. trash can	3
5 gal. bucket	5
Push broom	1

Dustpan	1
Shovel	1
Pick up tool extender Reacher 36 in.	1
Folding tables	2
Metal rake	1
Safety glasses	1
Tarp 10'x12'	2
Rope	1
Duct Tape	1
Work gloves	1
Glove liners latex (box)	1
Protective Coveralls	1
Hand sanitizer	1
Hand wipes	1
Face masks (box)	1
Steel toe boots pair	1
Hard hats	1
Traffic vest	1

14.0 Data Management (B10)

Data will be managed by the Management Team, See Section 4, Table 1:

- Recording field notes – A permanently bound, paginated, "Composition" type notebook will be utilized for recording field notes that includes the date, times of samples collected. This is the responsibility of the Recycling Coordinator and will be reviewed/checked by the Project Manager or the Assistant Director.

- Scale Management – A notebook will be retained that includes the purchase order, invoice, manufacturer's literature and maintenance and calibration information. This will be recorded by the Recycling Coordinator and verified by the Operations Manager.

- Data Transcription and Storage – Data will be manually transcribed from field log into the spreadsheet. The transcription will be error checked for typographic errors and transposing of numbers. Corrections will be made as needed. Data will be

compiled into a single MS Excel Spreadsheet with multiple tabs as necessary with appropriate Column Headings to properly identify data, conforming to standard conventions , e.g. – date, text, numeric (including decimal point). This is the responsibility of the Recycling Coordinator and will be reviewed/checked by the Project Manager or the Assistant Director.

- Data Transformation – Data will be analyzed utilizing MS Excel functions for statistical analysis. This is the responsibility of the Recycling Coordinator and will be reviewed/checked by the Project Manager or the Assistant Director.

- Data Access – Electronic data will be stored and accessible by program staff in the Environment Division's Shared directory under a unique folder name dedicated to this project. This is the responsibility of the Recycling Coordinator and will be reviewed/checked by the Project Manager or the Assistant Director.

15.0 Assessments/Oversight (C1)

To ensure that the QAPP is being followed a review of the Recycling Coordinator and other Transfer Station Staff involved with the project, (e.g. – Scale House Operator) will be conducted by the Solid Waste Program Manager to ensure proficiency in random sampling, field sampling protocols and sorting and separation of wastes. The review will be conducted prior to project initiation and sampling.

A pre-sampling briefing meeting will be held to ensure the team understands one another's roles and responsibilities. A scale system check will be performed to ensure proper function of the scale and its operation. This initial "pre-check" will identify potential problems to be corrected before sample collection.

Periodically, no less than one sample event per week, additional checks will be performed by the Solid Waste Program Manager including review of the field log book, spreadsheet, inspection of sorting and separating and weighing operations.

Deviations or problems will be noted and addressed directly with the Recycling Coordinator and/or other team member for immediate correction. Assessments will be conducted using a checklist that reflects the protocols and sampling procedures which will become a part of the project documentation.

Corrective actions will be made verbally and memorialized in the form of a memo outlining the actions needed and taken. The corrective actions will become part of the project report package.

16.0 Data Review, Verification, Validation and Usability

16.1 Data Review, Verification and Validation (D1 and D2)

Table 8 - Data Review Table

Field	Lab	Office
Monitoring performed as per SOPs and QAPP	No lab analysis required	Data entry and transcription errors
Samples properly collected in the field	NA	Calculation/reduction errors
Deviations from QAPP/SOP documented	NA	NA

The Solid Waste Program Manager will be responsible for conducting data review including checks listed in Table . The TQAO will be responsible for performing data validation.

Calculations will be performed using MS Excel spreadsheet for performing calculations. The spreadsheet will be fed known data to check calculations prior to running with actual data.

Data that appears to be in error will be checked against field data sheets and field logs.

Data Acceptance/Rejection

Table 9 Data Acceptance/Rejection

Data Acceptance Criteria	Data Rejection Criteria
Loads selected randomly	Loads not randomly selected
Samples selected randomly	Samples not selected randomly
Sample weights taken with calibrated scale	Material Categorization not according to classification
	Sample weights taken with uncalibrated scale
Data reviewed and verified	Data not reviewed or verified
Composition notebook information is legible	Incomplete or missing composition notebook information

16.2 Reconciliation with User Requirements (D3)

The results of project, validated data, will be reviewed to determine that the data is usable for the intent of making hazardous waste management decisions for Tribe. The review will consist of a review of the achievement of stated data quality objectives including

completeness and representativeness as well as accuracy of field notes and following of protocols in sampling and measurement.

17.0 Reporting, Documents and Records (A9 and C2)

Documents and records, including field notebooks, spreadsheets will utilize document control notation that is consistent in project name, revision, number, date and pagination to ensure tracking and referencing are consistent from the development of the QAPP to final report. Persons receiving copies of reports include:

- Grant Jonathan, EPA Region 2 Project Officer
- Alexis Stabulas, EPA Region 2 Project Manager
- Tony David, Saint Regis Mohawk Environment Division, Director
- Angela Benedict, Saint Regis Mohawk Environment Division, TQAO

The notation will conform to the notation found in the footer found in this QAPP document.

Field notebooks and field data sheets will be kept in a file cabinet at the Solid Waste Transfer Station. Electronic files, e.g. spreadsheet, will be maintained on the Tribe's fileserver in the Environment Division Share Directory. Records that will be kept in the electronic file directory include:

- QAPP
- Sampling data and records
- Assessment/Oversight Checklists and Corrective Actions
- Scale information, serial number, manufacturer's instructions and calibration records
- Data reconciliation assessment
- Project Report

Records will be retained permanently, as per the Tribe's Record Management Schedule (St. Regis Mohawk Tribe, 2010).

References

Collins, A. R. (1995). A Sampling Protocl for Composting, Recycling, and Re-use of Municipal Solid Waste. *Journal of the Air & Waste Management Asociation. Volume 45*, 864-870.

Islands, U. o. (January 2018-September 2019). *Quality Assurance Program Plan, Finding Treasure in Trash: Quantifying the Recycling and Waste Diversion Potential of Virgin Islands.* St. Thomas, US Virgin Islands: University of Virgin Islands.

St. Regis Mohawk Tribe. (2010, January). St. Regis Mohawk Tribe, Records Retention & Disposition Schedule, 1st Edition. Hogansburg, NY.

Appendix A - LPS Series Postal and Parcel Shipping Scales User Instructions

Appendix B – Scale Calibration Form

Equipment ID/Name:
Manufacturer:
Model Number:
Serial Number:
Standards:

No	Date	Calibration Type	Result	Next Calibration Due	Notes	Calibrated By	Signature

Appendix C – Data Entry Sheet

MSW Chemicals Component and Sub-categories

Hazardous Substances Composition Data Sheet

Day/Date:_____ Vehicle Type: _____
Time: _____ Recorded by: _____
Ticket Number: _____ Verified by: _____
Weather: _____

COMPONENT and SUB-CATEGORY	**WEIGHT IN POUNDS**			**PERCENT TOTAL**
	GROSS	**TARE**		
TOXIC				
FLAMMABLE				
CORROSIVE				
REACTIVE				
OTHER				
Motor Oil				
Oil Filter				
Pesticide*				
Fluorescent				
Lamp Ballast				
Paint,				
Antifreeze				
Smoke Detector				
Electronic Waste				

*Includes herbicide, rodenticide and fungicide

TOTALS _____
NOTES: _____
_____
_____

MATERIAL DISPOSAL _____
RESPONSE ACTIONS IF ANY _____

Appendix D – Spilfyter Classifier

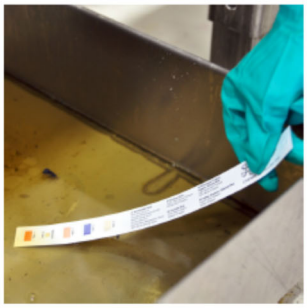
LIQUID SAFETY SOLUTIONS
By FyterTech Nonwovens

570010

Spilfyter Chemical Classifier Strips (10ct)

Features:

- The First Step in Spill Control: IDENTIFY THE SPILL– Chemical and Wastewater Classifier Products are the perfect method for distinguishing risks in unknown spilled liquids
- Classifier Strips quickly assist the responder in classifying the spill for proper treatment
- Recommended for all Emergency Response Team
- SDS Not Required - Spilfyter™ Classifier Strips are not classified as hazardous according to GHS or OSHA regulations. This product is an "Article" as defined in OSHA Hazard Communication Standard (23CFR 1910.1200(c), and therefore is outside the scope of the GHS standard and does not require an SDS.



Specifications:

Brand	Spilfyter
Product Category	Neutralizers & Classifiers
Product Type	Classifiers
Package Count	10
UPC	810042423121

Logistics:

Shipping Height (in)	0.25
Shipping Length (in)	12
Shipping Width (in)	10
Cube	0.0173
Shipping Weight (lb)	0.16
NMFC	178120
Shipping Class	70

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MSW CHARACTERIZATION METHODOLOGY

INTRODUCTION

This fact sheet and these data tables are the most recent in a series of reports and data tables sponsored by the U.S. Environmental Protection Agency to characterize municipal solid waste (MSW) in the United States. Together with the previous reports, this fact sheet and data tables provide a historical database for a 46-year characterization (by weight) of the materials and products in MSW. For brevity, the fact sheet and data tables are both implied when data tables are referred to in this methodology.

Management of the nation's municipal solid waste (MSW) continues to be a high priority for communities in the 21st century. The concept of integrated solid waste management—source reduction of wastes before they enter the waste stream, recovery of generated wastes for recycling (including composting), and environmentally sound disposal through combustion facilities and landfills that meet current standards—is being used by communities as they plan for the future.

This methods description provides background on integrated waste management and the 2006 data tables, followed by a brief overview of the methodology. Next is a section on the variety of uses for the information in these data tables. Then, more detail on the methodology is provided.

BACKGROUND

The Solid Waste Management Hierarchy

EPA's 1989 Agenda for Action endorsed the concept of integrated waste management, by which municipal solid waste is reduced or managed through several different practices, which can be tailored to fit a particular community's needs. The components of the hierarchy are:

- Source reduction (or waste prevention), including reuse of products and on-site (or backyard) composting of yard trimmings.

- Recycling, including off-site (or community) composting.

- Combustion with energy recovery.

- Disposal through landfilling or combustion without energy recovery.

As done in previous versions of this report, combustion with energy recovery is shown as discards in the tables and figures.

Overview of the Methodology

Readers should note that this report characterizes the municipal solid waste stream of *the nation as a whole*. Data in this report can be used at the national level. It can also be used to address state, regional, and local situations, where more detailed data are not available or would be too expensive to gather. More detail on uses for this information in this report for both national and local uses is provided later in this chapter.

At the state or local level, recycling rates often are developed by counting and weighing all the recyclables collected, and then aggregating these data to yield a state or local recycling rate. At the national level, we use instead a *materials flow methodology*, which relies heavily on a mass balance approach. Using data gathered from industry associations, key businesses, and similar industry sources, and supported by government data from sources such as the Department of Commerce and the U.S. Census Bureau, we estimate tons of materials and products generated, recycled, or discarded. Other sources of data, such as waste characterizations and surveys performed by governments, industry, or the press, supplement these data.

To estimate MSW generation, production data are adjusted by imports and exports from the United States, where necessary. Allowances are made for the average lifespans of different products. Information on amounts of disposed MSW managed by combustion comes from industry sources as well. MSW not managed by recycling (including composting) or combustion is assumed to be landfilled.

In any estimation of MSW generation, it is important to define what is and is not included in municipal solid waste. EPA includes those materials that historically have been handled in the municipal solid waste stream–those materials from municipal sources, sent to municipal landfills. In this report, MSW includes wastes such as product packaging, newspapers, office and classroom papers, bottles and cans, boxes, wood pallets, food scraps, grass clippings, clothing, furniture, appliances, automobile tires, consumer electronics, and batteries.

A common error in using this report is to assume that *all* nonhazardous wastes are included. As shown later in this methods description, municipal solid waste as defined here does *not* include construction and demolition debris, biosolids (sewage sludges), industrial process wastes, or a number of other wastes that, in some cases, may go to a municipal waste landfill. These materials, over time, have tended to be handled separately and are not included in the totals in these data tables. EPA has addressed several of these materials separately, for instance, in *Biosolids Generation, Use, and Disposal in the United States*, EPA530-R-99-009, September

1999, and *Characterization of Building-Related Construction and Demolition Debris in the United States*, EPA530-R-98-010, May 1998. Recycling (including composting) is encouraged for these materials as well.

In addition, the source of municipal solid waste is important. EPA's figures include municipal solid waste from homes, institutions such as schools and prisons, commercial sources such as restaurants and small businesses, and occasional industrial sources. MSW does not include wastes of other types or from other sources, including automobile bodies, municipal sludges, combustion ash, and industrial process wastes that might also be disposed in municipal waste landfills or combustion units.

HOW THESE DATA TABLES CAN BE USED

Nationwide. The data in this tables provide a nationwide picture of municipal solid waste generation and management. The historical perspective is particularly useful in establishing trends and highlighting the changes that have occurred over the years, both in types of wastes generated and in the ways they are managed. This perspective on MSW and its management is useful in assessing national solid waste management needs and policy. The consistency in methodology and scope aids in the use of the data tables for reporting over time. The data tables are, however, of equal or greater value as a solid waste management planning tool for state and local governments and private firms.

Local or state level. At the local or state level, the data in these data tables can be used to develop approximate (but quick) estimates of MSW generation in a defined area. That is, the data on generation of MSW per person nationally may be used to estimate generation in a city or other local area based on the population in that area. This can be of value when a "ballpark" estimate of MSW generation in an area is needed. For example, communities may use such an estimate to determine the potential viability of regional versus single community solid waste management facilities. This information can help define solid waste management planning areas and the planning needed in those areas. However, for communities making decisions where knowledge of the amount and composition of MSW is crucial, (e.g., where a solid waste management facility is being sited), local estimates of the waste stream should be made.

Another useful feature of these data tables for local planning is the information provided on MSW trends. Changes over time in total MSW generation and the mix of MSW materials can affect the need for and use of various waste management alternatives. Observing trends in MSW generation can help in planning an integrated waste management system that includes facilities sized and designed for years of service.

While the national average data are useful as a checkpoint against local MSW characterization data, any differences between local and national data should be examined carefully. There are many regional variations that require each community to examine its own waste management needs. Such factors as local and regional availability of suitable landfill space, proximity of markets for recovered materials, population density, commercial and

industrial activity, and climatic and groundwater variations all may motivate each community to make its own plans.

Specific reasons for regional differences may include:

- Variations in climate and local waste management practices, which greatly influence generation of yard trimmings. For instance, yard trimmings exhibit strong seasonal variations in most regions of the country. Also, the level of backyard composting in a region will affect generation of yard trimmings.

- Differences in the scope of waste streams. That is, a local landfill may be receiving construction and demolition wastes in addition to MSW, but these data tables address MSW only.

- Variance in the per capita generation of some products, such as newspapers and telephone directories, depending upon the average size of the publications. Typically, rural areas will generate less of these products on a per person basis than urban areas.

- Level of commercial activity in a community. This will influence the generation rate of some products, such as office paper, corrugated boxes, wood pallets, and food scraps from restaurants.

- Variations in economic activity, which affect waste generation in both the residential and the commercial sectors.

- Local and state regulations and practices. Deposit laws, bans on landfilling of specific products, and variable rate pricing for waste collection are examples of practices that can influence a local waste stream.

While caution should be used in applying the data in these tables, for some areas, the national breakdown of MSW by material may be the only such data available for use in comparing and planning waste management alternatives. Planning a curbside recycling program, for example, requires an estimate of household recyclables that may be recovered. If resources

are not available to adequately estimate these materials by other means, local planners may turn to the national data. This is useful in areas that may have typical MSW generation or in areas where appropriate adjustments in the data can be made to account for local conditions.

In summary, the data in this report can be used in local planning to:

- Develop approximate estimates of total MSW generation in an area.
- Check locally developed MSW data for accuracy and consistency.
- Account for trends in total MSW generation and the generation of individual components.
- Help set goals and measure progress in source reduction and recycling (including composting).

CHARACTERIZATION OF MUNICIPAL SOLID WASTE: IN PERSPECTIVE

The Two Methodologies for Characterizing MSW: Site-Specific Versus Materials Flow

There are two basic approaches to estimating quantities of municipal solid waste at the local, state, or national levels—site-specific and materials flow. These data tables are based on the materials flow approach.

Site-specific studies. In the first methodology, which is site-specific, sampling, sorting, and weighing the individual components of the waste stream could be used. This methodology is useful in defining a local waste stream, especially if large numbers of samples are taken over several seasons. Results of sampling also increase the body of knowledge about variations due to climatic and seasonal changes, population density, regional differences, and the like. In addition, quantities of MSW components such as food scraps and yard trimmings can only be estimated through sampling and weighing studies.

A disadvantage of sampling studies based on a limited number of samples is that they may be skewed and misleading if, for example, atypical circumstances were experienced during the sampling. These circumstances could include an unusually wet or dry season, delivery of some unusual wastes during the sampling period, or errors in the sampling methodology. Any errors of this kind will be greatly magnified when a limited number of samples are taken to represent a community's entire waste stream for a year. Magnification of errors could be even more serious if a limited number of samples was relied upon for making the national estimates of MSW. Also, extensive sampling would be prohibitively expensive for making the national estimates. An additional disadvantage of sampling studies is that they do not provide information about trends unless performed in a consistent manner over a long period of time.

Of course, at the state or local level, sampling may not be necessary—many states and localities count all materials recovered for recycling, and many weigh all wastes being disposed to generate state or local recycling rates from the "ground up." To use these figures at the national level would require all states to perform these studies, and perform them in a consistent manner conducive to developing a national summary, which so far has not been practical.

Materials flow. The second approach to quantifying and characterizing the municipal solid waste stream–the methodology used for this report–utilizes a materials flow approach to estimate the waste stream on a nationwide basis. In the late 1960s and early 1970s, EPA's Office of Solid Waste and its predecessors at the Public Health Service sponsored work that began to develop this methodology. These data tables represent the latest version of this database that has been evolving for over 30 years.

The materials flow methodology is based on production data (by weight) for the materials and products in the waste stream. To estimate generation data, specific adjustments are made to the production data for each material and product category. Adjustments are made for imports and exports and for diversions from MSW (e.g., for building materials made of plastic and

paperboard that become construction and demolition debris.) Adjustments are also made for the lifetimes of products. Finally, food scraps, yard trimmings, and a small amount of miscellaneous inorganic wastes are accounted for by compiling data from a variety of waste sampling studies.

One problem with the materials flow methodology is that product residues associated with other items in MSW (usually containers) are not accounted for. These residues would include, for example, food left in a jar, detergent left in a box or bottle, and dried paint in a can. Some household hazardous wastes, (e.g., pesticide left in a can) are also included among these product residues.

Municipal Solid Waste Defined in Greater Detail

As stated earlier, EPA includes those materials that historically have been handled in the municipal solid waste stream–those materials from municipal sources, sent to municipal landfills. In these data tables, MSW includes wastes such as product packaging, newspapers, office and classroom paper, bottles and cans, boxes, wood pallets, food scraps, grass clippings, clothing, furniture, appliances, automobile tires, consumer electronics, and batteries. For purposes of analysis, these products and materials are often grouped in these data tables into the following categories: durable goods, nondurable goods, containers and packaging, food scraps and yard trimmings, and miscellaneous inorganic wastes.

Municipal solid wastes characterized in these data tables come from residential, commercial, institutional, or industrial sources. Some examples of the types of MSW that come from each of the broad categories of sources are:

Sources and Examples	Example Products
Residential (single-and multi-family homes)	Newspapers, clothing, disposable tableware, food packaging, cans and bottles, food scraps, yard trimmings
Commercial (office buildings, retail and wholesale establishments, restaurants)	Corrugated boxes, food scraps, office papers, disposable tableware, paper napkins, yard trimmings
Institutional (schools, libraries, hospitals, prisons)	Cafeteria and restroom trash can wastes, office papers, classroom wastes, yard trimmings
Industrial (packaging and administrative; *not* process wastes)	Corrugated boxes, plastic film, wood pallets, lunchroom wastes, office papers.

The materials flow methodology used in these data tables does not readily lend itself to the quantification of wastes according to their sources. For example, corrugated boxes may be unpacked and discarded from residences, commercial establishments such as grocery stores and offices, institutions such as schools, or factories. Similarly, office papers are mostly generated in offices, but they also are generated in residences and institutions. The methodology estimates

only the total quantity of products generated, not their places of disposal or recovery for recycling.

Other Subtitle D Wastes

Some people assume that "municipal solid waste" must include everything that is landfilled in Subtitle D landfills. (Subtitle D of the Resource Conservation and Recovery Act deals with wastes other than the hazardous wastes covered under Subtitle C.) As shown in Figure 1, however, RCRA Subtitle D includes many kinds of wastes. It has been common practice to landfill wastes such as municipal sludges, nonhazardous industrial wastes, residue from automobile salvage operations, and construction and demolition debris along with MSW, but these other kinds of wastes are not included in the estimates presented in these data tables.

Figure 1: Municipal Solid Waste in the Universe of Subtitle D Wastes

Subtitle D Wastes	
The Subtitle D Waste included in these data tables is Municipal Solid Waste, which includes:	
Containers and packaging such as soft drink bottles and corrugated boxes Durable goods such as furniture and appliances Nondurable goods such as newspapers, trash bags, and clothing Other wastes such as food scraps and yard trimmings.	
Subtitle D Wastes not included in these data tables are:	
Municipal sludges	Agricultural wastes
Industrial nonhazardous wastes	Oil and gas wastes
Construction and demolition debris	Mining wastes

Figure 1-A: Definition of Terms

The materials flow methodology produces an estimate of total municipal solid waste generation in the United States, by material categories and by product categories.

The term ***generation*** as used in these data tables refers to the weight of materials and products as they enter the waste management system from residential, commercial, institutional, and industrial sources and before materials recovery or combustion takes place. Preconsumer (industrial) scrap is not included in the generation estimates. Source reduction activities (e.g., backyard composting of yard trimmings) take place *ahead of* generation.

Source reduction activities reduce the amount or toxicity of wastes before they enter the municipal solid waste management system. Reuse is a source reduction activity involving the recovery or reapplication of a package, used product, or material in a manner that retains its original form or identity. Reuse of products such as refillable glass bottles, reusable plastic food storage containers, or refurbished wood pallets is considered to be source reduction, not recycling.

Recovery of materials as estimated in these data tables includes products and yard trimmings removed from the waste stream for the purpose of recycling (including composting). For recovered products, recovery equals reported purchases of postconsumer recovered material (e.g., glass cullet, old newspapers) plus net exports (if any) of the material. Thus, recovery of old corrugated containers (OCC) is the sum of OCC purchases by paper mills plus net exports of OCC. If recovery as reported by a data source includes converting or fabrication (preconsumer) scrap, the preconsumer scrap is *not* counted towards the recovery estimates in these data tables. Imported secondary materials are also not counted in recovery estimates in this report. For some materials, additional uses, such as glass used for highway construction or newspapers used to make insulation, are added into the recovery totals.

Combustion of MSW with energy recovery, often called "waste-to-energy," is estimated in these data tables. Combustion of separated materials–wood and rubber from tires–is included in the estimates of combustion with energy recovery in these data tables.

Discards include MSW remaining after recovery for recycling (including composting). These discards presumably would be combusted without energy recovery or landfilled, although some MSW is littered, stored or disposed onsite, or burned onsite, particularly in rural areas. No good estimates for these other disposal practices are available, but the total amounts of MSW involved are presumed to be small.

Materials and Products Not Included in These Estimates

As noted earlier, other Subtitle D wastes (illustrated in Figure 1) are not included in these estimates, even though some may be managed along with MSW (e.g., by combustion or landfilling). Household hazardous wastes, while generated as MSW with other residential wastes, are not identified separately in these data tables. Transportation parts and equipment (including automobiles and trucks) are not included in the wastes characterized in these data tables.

Certain other materials associated with products in MSW are often not accounted for because the appropriate data series have not yet been developed. These include, for example,

inks and other pigments and some additives associated with packaging materials. Considerable additional research would be required to estimate these materials, which constitute a relatively small percentage of the waste stream.

Some adjustments are made in these data tables to account for packaging of imported goods, but there is little available documentation of these amounts.

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A Sampling Protocol for Composting, Recycling, and Re-use of Municipal Solid Waste

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ABSTRACT

This article reports on development of a protocol for characterizing municipal solid waste (MSW). This protocol is similar to that recommended by the American Society for Testing and Materials but includes a distinction between pure and mixed loads of MSW. Thirteen component categories were used with a focus on material feed stock for composting, recycling, and reuse. The required number of samples was determined to achieve a 80%, 90%, and 95% statistical accuracy for characterizing MSW categories at 1% and 2% sampling error. This study found that a maximum of 25 randomly collected samples of 200 pounds will reflect each component category of mixed load MSW with at least a 95% confidence level and 2% error. This protocol was successfully tested in Monongalia County, West Virginia, to provide a "snapshot" MSW characterization during early summer.

INTRODUCTION

Municipal solid waste (MSW) management has recently become a significant issue for many communities.[1] The U.S. Environmental Protection Agency (EPA) has recommended a solid waste management hierarchy which emphasizes source reduction, recycling, and composting.[2] However, to adequately plan for the integration of composting, recycling, and reuse into solid waste management, the amounts and categories of MSW must be known. Waste categorization data are the vital underpinnings of integrated MSW management. With adequate data, informed decisions about recycling and composting capacities can be made, undue financial risks can be prevented, and progress towards meeting national or local waste reduction goals can be evaluated.[2]

The EPA[2] has noted that important data gaps exist for characterizing the MSW stream. Savage et al.[3] indicated that quantitative and qualitative determination of MSW is frequently neglected in the solid waste management planning process. According to Diaz et al.,[4] a lack of solid waste characterization has substantially limited opportunities for material recycling and caused integrated waste management systems to fail when designed with insufficient and/or inappropriate quantity and composition data.

There are two basic approaches to MSW characterization: (1) the material flows approach, pioneered by Franklin & Associates and the EPA[5,6] in the late 1960s and early 1970s and (2) the site specific sampling—the sorting and weighing of MSW by category.[7] The material flows approach assumes that by analyzing what products are sold, predictions can be made as to what has been thrown away to make room for new products. While research indicates that characterization percentages from this approach can approximate local percentages,[7] this approach fails to account for the potentially wide variation in MSW composition by geographic location, season, and generator.[8]

Site specific sampling and categorization of MSW provides more suitable data for local MSW planning.[9] This approach may involve: (1) a single sampling of the waste stream;[10] (2) characterization of numerous samples over a period of time to account for seasonal variation;[9,11,12] or (3) landfill excavation.[13] Wide variations in local conditions and differences in the types of solid waste sampled make it difficult to obtain national averages from the second approach.[14]

The purpose of this study is to establish a standardized MSW sampling protocol. This protocol will enable local

IMPLICATIONS

It is impractical to separate, measure, weigh, and analyze the composition of all municipal solid waste (MSW) materials generated from multiple sources. To balance the resources available with the need for accurate results, a reliable and standardized sampling protocol was developed in this study to enable local planners to find reliable and valid results for evaluating MSW composition. This protocol is unique in making a distinction between pure and mixed loads of MSW, and was satisfactory to use, as there was little disruption to the operation of the landfill where it was tested.

planners to find reliable and valid results for MSW composition. The protocol includes collecting a consistent number of samples, sample weight, MSW component categories, and a procedure for determining MSW characterization. No consensus exists in the literature for a standard sampling and sorting methodology of solid waste.[8] Prior research on MSW characterization has emphasized incineration and/or recycling.[15,16] For this study, a sampling protocol was developed and the number of samples was determined to achieve a 80%, 90%, and 95% statistical accuracy for characterizing MSW with an emphasis on feed stock material for alternative MSW management - composting, recycling, and reuse. This protocol was tested in Monongalia County, West Virginia.

SAMPLING PROTOCOL

Data was collected from MSW received at the Monongalia County Landfill during a two-week period in June and July of 1992. This landfill was located at Laurel Point in the western end of Monongalia County, West Virginia, on State Route 19. Prior to its closure in September 1993, the Monongalia County Landfill serviced all of Monongalia County and occasionally accepted loads from neighboring Preston County.

The Monongalia County Landfill was the appropriate place to conduct a MSW characterization study for Monongalia County, since the majority of Monongalia County's MSW was taken to this location. During the time of this study, there was a curbside recycling program in the county's largest city (Morgantown), which collected only small amounts of glass and aluminum because household participation rates were under 20%.[17]

Component Categories

The criteria for component categories needed to be simple, broad, and based upon MSW separation into feed stock materials for composting, recycling, and reuse markets. MSW component categories from prior characterization studies were examined.[14-17] The 12 Knapp[18] component categories, with the addition of an "other" category, were selected for this study (Table 1). Knapp developed these categories while operating a facility for reuse, recycling, and composting of MSW in Berkeley, CA. While it is possible to subdivide the Knapp categories into specific commodity markets, the 12 component categories were regarded as homogeneous in the sense that materials in each category have similar equipment requirements for handling and processing either in reuse, composting, or recycling facilities.

Sampling Technique

Sampling was conducted in two phases, each lasting one week. The first phase was to develop the protocol, and the second phase was to test the protocol. A week-long sampling period was used to reduce bias in sampling by either the type of generator (residential, apartment buildings, commercial) or geographic area in the county area, given that all trash collection was on a weekly basis. During Phase 1, it was observed that roughly two-thirds by weight of all MSW entering the landfill was comprised of mixed load MSW. Mixed load MSW was generated from numerous sources and the component categories were mixed together in compactor trucks. The other one-third of MSW arrived in open vehicles and contained primarily one component category, called a pure load. Pure loads were generated by a single source, either in the commercial sector or during special events.

Table 1. MSW component categories developed by Knapp[18] and used in this study.

Component Category	Definition
1. paper	all materials containing only paper fibers
2. plant debris	yard waste - grass, leaves, tree trimmings, house plants
3. wood	wood demolition, lumber, furniture
4. plastics	all plastic containers and wrappings
5. metals	aluminum and steel containers, scrap metal
6. putrescibles	food waste and materials contaminated with food
7. rock, etc.	construction debris
8. reusable goods	books, small appliances, tools, toys
9. textiles	clothing and cloth
10. chemicals	chemical products and containers
11. soils	potting soil and dirt
12. glass	all colors of glass containers
13. other	composite materials and items deemed no longer usable

Pure load MSW vehicles were identified by visual inspection and by obtaining information about the load's origin from the landfill supervisor and weighmaster. After removal of contaminants, their percentage by weight was determined. Pure load MSW was found to have more than 95% of the material by weight in one category. This definition was used during phase 2.

The procedure developed for this study followed recommendations by Constantine et al.[21] and Savage et al.[3] Worker safety precautions were based on American Society for Testing and Materials (ASTM) standards, with each worker being issued long sleeve clothes, a hard hat, safety glasses, leather gloves, and steel-toe boots. The composition of mixed load MSW in compactor trucks was determined by the following procedure:

1. Compactor trucks were randomly selected for analysis over the entire week.
2. The contents of each selected truck were emptied onto a study site adjacent to the tipping area of the landfill.
3. Because compactor trucks were measured by volume (cubic yards), the material was raked into a uniform thickness of three feet deep.
4. A grid was placed over the material, forming adjacent cubic yard cells. The cells were numbered,

beginning with the back left cell, and continued in sequence horizontally to the right as the load was dumped from the truck.

5. Each cell was brought to a sorting table—a 4' x 8' sheet of plywood with 2" x 6" x 8' rails resting at waist-height on saw horses and 55 gallon drums.
6. Material was sorted into 13 categories using 50 or 20 gallon containers. The sorting procedure was conducted by four to six people. When the containers were full or the job complete, containers were weighed on portable scales and the net weight was recorded. Cells were encoded by category using JMP IN software on an Apple Macintosh.

NUMBER OF SAMPLES

Phase 1 data were used to determine the number of samples to achieve confidence levels (80%, 90%, and 95%) at both 1% and 2% sampling error. Component category data were expressed as percentages and were assumed to follow a multinomial distribution. Individual percentages do not generally follow a normal distribution except when they are between 30% and 70%.[15] Only the paper category came close to falling within this range. Therefore, a normalization transformation was computed for all categories using the function: Y = 2*arcsin $\sqrt{X}$, where X is the original percentage value of a category expressed as a decimal, and Y is the transformed value of X.

The number of samples required for the protocol was determined by:

$$n = \frac{t^2 * s^2}{d^2} \quad (1)$$

where n = number of samples, t = the student's t statistic, s = the transformed standard deviations for the component categories, and d = the absolute value of:

$$2*\arcsin\sqrt{X} - 2*\arcsin\sqrt{X + \Delta}$$

and

$$2*\arcsin\sqrt{X} - 2*\arcsin\sqrt{X - \Delta}$$

X was the mean category component percentage expressed as a decimal and Δ is 0.01 for 1% error and 0.02 for 2% error. The number of samples was determined by initially computing a N_o for both + and - Δ with a t statistic of ∞ degrees of freedom. The number of samples was then recomputed using a new t statistic based on N_o-1 degrees of freedom. This process was continued until convergence (see ASTM[16] for an example of this process) and the larger of the two numbers was selected as the number of samples. By using a normalization transformation, the number of samples computed in (1) did not require an assumption of a normal distribution for percentages like the calculation recommended by the ASTM.[16] Phase 1 data were used to estimate both the mean and standard deviation of each component category.

Sample Weight

Phase 1 data indicated that there was more difference within a compactor truck load of mixed MSW than between loads, so that samples need not be taken from each load entering the landfill. Therefore, the decision was made to sample in weight rather than volume measurements during Phase 2. A sample weight of 200 pounds was used based on prior research,[15] personal conversations with consultants in the field, and Phase I results. The 200-pound samples were collected in four 50-pound units in order to determine if smaller sample weights were possible. Sampling accuracy comparisons were made between 50-, 100-, and 200-pound sample units based on partial correlation coefficients.

During Phase 2, daily samples were chosen randomly based on an average daily tipping of 500 cubic yards (20 compactor trucks times an average size of 25 yards). As in Phase 1, daily sampling was conducted over a one week period to reduce generator and geographic bias. When a compactor truck arrived with an identified random sample, mixed load MSW was put in a pile and four random samples of 50 pounds were selected. Such small samples from compactor trucks were possible because bulky items such as white goods and furniture were not collected in compactor trucks. The sorting procedure for the component categories remained the same as Phase 1.

MSW Characterization

During Phase 2, transportation vehicles were recorded by type of vehicle, source of material, weight, and time of arrival. The percentage of the waste stream handled by each type of truck was computed and a tally sheet was used to keep a running total of the MSW entering the landfill. Phase 2 data were used to estimate: (1) MSW generation rates per capita; (2) a breakdown of MSW arriving in pure and mixed loads; and (3) quantities and percentages for the 13 component categories of the MSW stream for Monongalia County.

RESULTS

During Phase 1, a total of 79 cubic yards of mixed load MSW was sorted. The Knapp component categories worked well, as few problems arose during the sorting process regarding categorization of waste materials. Mixed load MSW weighed from 71 to 328 pounds in a cubic yard, with a mean of 184.7 pounds. This variation was primarily due to the differing compaction ratios of the hauling vehicles.

The maximum number of samples for mixed load MSW was determined from Phase 1 data based on the assumption that component categories are of equal importance in MSW characterization. In every instance, the putrescibles category required the largest number of samples to achieve the three confidence levels at both errors. Thus, the putrescibles category was used to establish the maximum number of samples for confidence levels (80%, 90%, 95%) at each error (1%, 2%) (Table 2). The number of required samples for the other major component categories are shown in Appendix A.

Table 2. Number of samples required to estimate putrescibles category percentage based on Phase I data.

Confidence level	Error	Sample weight*	No. of samples
80%	2%	200 lb.	11
	1%		40
90%	2%	200 lb.	18
	1%		66
95%	2%	200 lb.	25
	1%		92

* Sample weight was based on the average of a cubic yard of MSW being approximately 200 pounds.

Appendix A: Number of samples required by MSW component category.

Confidence Levels	80%		90%		95%	
	Error		Error		Error	
Category	2%	1%	2%	1%	2%	1%
Putrescibles	11	40	18	66	25	92
Paper	11	38	17	62	24	87
Plant Debris	6	19	10	32	14	45
Textiles	5	16	8	26	12	36
Metals	5	15	8	25	11	35
Glass	*	8	5	13	7	19
Plastics	*	6	*	9	*	13

* N_0 was less than five and the sample number computation did not converge.

The maximum number of samples ranged from a high of 92 (to achieve a 95% confidence interval at 1% error) to a low of 11 (to achieve a 80% confidence interval at 2% error). The 18 samples required to achieve a minimum 90% confidence interval at 2% error was similar to the 20 samples estimated by Clarruth and Klee.[15]

During Phase 2, approximately 1,120 tons of MSW were received at the landfill. This weekly tonnage for the population served by the Monongalia County landfill gave a per capita daily discard rate of 4.24 pounds, based upon the 1990 census population. This generation rate was slightly below both the EPA per capita estimate in 1992 (4.3 pounds) and the West Virginia Solid Waste Management Board (WVSWMB) estimate of 4.82 pounds.[22] Waste generation sources were divided into four groups: (1) residential, (2) commercial, (3) institutional, and (4) industrial. Residential waste made up almost half of the MSW in Monongalia County, with about one-third of the MSW generated by the commercial sector (Table 3).

Mixed load MSW accounted for 74.27% of the 1,120 tons and pure loads accounted for 25.73%. The one-quarter of MSW which arrived as pure loads at the Monongalia County landfill was noteworthy, *because it meant that 288 tons of material were ready to be processed into composting, recycling, or reuse programs!* If these programs were available, Monongalia County could meet West Virginia's waste reduction goal of 20% by 1994[23] with no change in current collection patterns.

Over six tons (12,120.5 pounds) of mixed load MSW was sorted into categories during Phase 2, equal to fifty-seven 200-pound samples. Based on the putrescibles category, the 57 samples taken would predict category mean percentages for mixed load MSW at a 95% level of confidence with a better than 2% error. For smaller sample weights, only the paper and putrescibles categories exhibited correlations above 0.80 between percentages for the 100-and 200-pound samples. Thus, it was decided that the sample weight should remain at 200 pounds to evaluate MSW category percentages.

Mean percentages for pure and mixed load MSW were determined at a 95% confidence interval for the larger component categories (Table 4). A complete MSW stream characterization was determined by multiplying the mixed load MSW category percentages by the 832 tons of mixed load MSW received and then adding the pure load weights for each category (Table 4).

Phase 2 data provided a "snapshot" characterization for MSW in Monongalia County during the early summer season. Substantial seasonal variation of some MSW categories, particularly plant debris, has been documented elsewhere[8] so that ideally, more than one waste stream characterization should be conducted to document MSW in Monongalia County.

In this study, paper accounted for the largest portion of MSW by weight (30.6%). Institutions such as West Virginia University produced a high percentage of paper along with newspapers and magazines from residents and office paper from commercial accounts. Because samples were taken from mixed load MSW, small amounts of moisture increased the weight of the paper category. Based on the investigator's judgment, however, moisture did not substantially alter this category's percentage compared to the others.

The second largest MSW category was putrescibles (22.1%). Prior to this study, the putrescibles category was expected to make up a small percentage of the waste stream. However, with mixed load MSW, small amounts of food waste contaminated primarily paper and some plastic products. These contaminated materials were categorized as putrescibles because recycling would be infeasible. If all MSW was source-separated, then the paper and plastic categories would make up slightly higher percentages by weight of the Monongalia County waste stream.

Wood and plastic were both slightly over 10% of MSW by weight; however, they arrived at the landfill in different ways. Nearly 40% by weight of the pure load MSW consisted of wood from demolition, lumber, or furniture sources. However, wood was only a small percentage of mixed load MSW (1.4%), consisting of generally small pieces of broken

Table 3. Source of MSW as determined during Phase II of this study.

Sources	*Weight (Tons)*	*% By Weight*
Residential	538.12	48.7
Commercial	332.27	30.1
Industrial	120.81	10.9
Institutional	114.39	10.3

furniture. Plastics were found primarily in mixed load MSW (13%) with minimal amounts in pure loads (2.6%).

Textiles, metals, plant debris, and glass were between 4% and 6% of the total MSW by weight (Table 4). Textiles were 7% of mixed load MSW, but were not present in many of the samples. This category was found in a limited number of samples when a change in living situation occurred (e.g., death of a family member or moving from one home to another). The metals category was about half aluminum and half steel, with some large, odd pieces of copper. Only small amounts of plant debris (primarily grass clippings in plastic bags) was found, since this study was conducted during early summer. Glass consisted primarily of clear, brown, and green containers.

Chemicals, soils, rock/concrete, and reusable goods were found in such small quantities that sampling in separate component categories was probably not warranted. These four categories could easily be included in the other category with little loss of information about alternatives to landfill disposal. Rock/concrete and reusable goods were uncommon in mixed load MSW either because collectors refused to pick them up or (in the case of reusable goods) they were taken to charitable organizations rather than to the landfill.

Table 5. Comparison of MSW component category mean percentage with other studies.

Component Categories	*EPA*[24]	*WV-SWMB*[22]	*Knapp*[18]	*Monongalia County*
Plant debris	*	—	25%	5.3%
Putrescibles	—	—	5%	22.1%
Yard and food	24.6%	9.9%	—	—
Paper	37.5%	29.7%	25%	30.6%
Metals	8.3%	5.2%	5%	5.7%
Glass	6.7%	5.3%	5%	4.1%
Plastic	8.3%	12.2%	7%	10.4%
Textiles	—	3.6%	3%	5.8%
Chemicals	—	—	2%	0.1%
Wood	—	14.4%	10%	10.7%
Soils	—	—	3%	0.9%
Rock/Concrete	—	5.9%	5%	2.3%
Reusable	—	—	5%	0.4%
Other	14.6%	13.7%	—	1.6%

* A blank space means this category was not used in the study.

Category percentages from Table 4 were compared with other waste stream characterizations generated by material flows, short-term landfill sampling, and professional experience (Table 5). The data developed from this study were not meant to validate these studies, but to produce valid and reliable data so that category differences were as important as

Table 4. Summary of the Monongalia County MSW stream by percentage in Knapp component categories entering the landfill during Phase 2.

Component Category	*Means For Mixed Load MSW (%)*	*95% CI For Mixed Load MSW (%)*	*Pure Load MSW (%)#*	*All MSW (Tons)*	*Total MSW (%)*	*95% CI For Total MSW (%)*
Plant	6.7	5.9-7.6	1.4	59.81	5.3	4.7-6.0
Putres.	25.7	24.6-26.8	11.9	248.08	22.1	21.3-23.0
Paper	33.9	33.6-34.3	21.1	342.95	30.6	30.4-30.8
Metals	4.9	4.3-5.5	8.1	64.20	5.7	5.3-6.2
Glass	5.5	5.0-6.0	0	45.76	4.1	3.7-4.5
Plastic	13.0	12.5-13.5	2.6	116.35	10.4	10.0-10.7
Textiles	7.0	6.2-7.8	2.4	65.12	5.8	5.2-6.4
Chemicals	0.1	*	0.1	10.4	0.1	*
Wood	1.4	*	37.5	119.81	10.7	*
Soil	0.7	*	1.4	9.88	0.9	*
Rock	0.4	*	7.6	25.25	2.3	*
Reusable	0.3	*	0.7	4.36	0.4	*
Other	0.4	*	5.0	17.53	1.6	*
TOTAL				1120.1		

* Confidence levels were not computed for this component category.

Population sample for Phase 2.

the similarities. Overall, plant debris and putrescibles, taken together, were similar to EPA and Knapp estimates for compostable organic materials, although the plant debris category from this study was low because sampling took place in summer. The paper category was similar to the WV-SWMB estimate and fell between the EPA and Knapp extremes. The metal and glass categories were consistent with both the WV-SWMB and Knapp percentages, while the wood category was very close to the Knapp percentage. The percentages for plastics and textiles were surprisingly high compared to the Knapp estimates. However, chemicals, soils, rock/concrete, and reusable goods were much less than the Knapp estimates. These differences were attributed to the short sampling time frame of this study versus the annualized Knapp estimates.

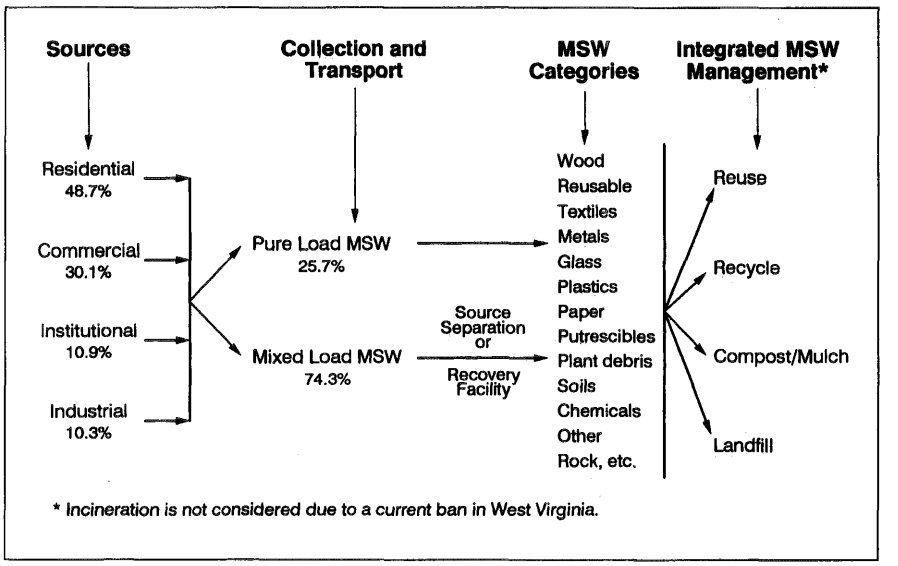

Figure 1. Integrated MSW management in Monongalia Couonty, West Virginia.

SUMMARY AND CONCLUSIONS

It is impractical to separate, measure, weigh, and analyze the composition of all MSW materials generated from a multitude of sources. To balance the resources available with the need for accurate results, a reliable and standardized sampling protocol for MSW was developed in this study. This protocol proved satisfactory to use, as no difficulties were encountered by the workers and there was little disruption to the operation of the landfill. An unique feature of the protocol developed in this study was its distinction between pure and mixed load MSW.

For mixed load MSW, the results of this study show that sample weights smaller than 200 pounds did not accurately represent 200-pound samples. This result confirmed a previous recommendation of 200 pounds.[15] The maximum number of samples was determined to achieve a 80%, 90%, and 95% statistical accuracy for characterization of MSW, given 1% and 2% sampling error for component category percentages. The maximum number of samples recommended ranged from 11 to 92 based on the category requiring the largest number of samples (putrescibles). A maximum of 25 samples was required to obtain a confidence level of 95% at a 2% margin of error.

The mixed load MSW sampling procedure developed in Phase 1 and used during Phase 2 was similar to the procedure recommended by the ASTM.[16] Selection of samples from piles of mixed load MSW was altered to allow for 50-pound samples rather than the 200-pound sample weight in the ASTM recommendations.

This protocol was successfully tested on a MSW characterization for Monongalia County, West Virginia. One result of this characterization was that a surprisingly high percentage of MSW (25%) which entered the Monongalia landfill was in the form of a pure load. No other study has produced data showing that as much as one-quarter of MSW can be reused, recycled, or composted with no change in the method of collection or transport.

Figure 1 summarizes MSW generation, collection, and integrated MSW management for Monongalia County, West Virginia. The MSW component categories provide potential feed stock for resource recovery facilities that utilize management techniques of composting/mulching, reusable goods exchange, and processing of recyclable materials. Previous MSW characterization studies have found up to 70% of MSW could be either recycled or composted,[25] but do not consider material reuse opportunities available, particularly for paper, textiles, and wood categories.

Actual MSW management strategies for reuse, recycle, compost, and landfill should be based on a combination of criteria including market availability; net cost of material collection, transport, handling and processing; and desirability of the end product. Landfill disposal costs provide economic incentives for an integrated MSW management strategy. With cost being the dominant problem in MSW management,[26] it is important to identify those component categories most likely to generate landfill disposal savings which exceed the costs associated with reuse, recycling, or composting. The sampling protocol evaluated in this study can be utilized for integrated MSW management both: (1) prior to development for facility sizing and equipment needs; and (2) after initiation to track landfill diversions from alternative strategies.

ACKNOWLEDGMENTS

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NC 28804-3362. This research was conducted in Monongalia County, West Virginia as part of John Martin's Ph.D. dissertation at West Virginia University, Morgantown, WV 26506.

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About the Authors

Dr. John H. Martin (corresponding author) is Former Projects Committee Chairman of the West Virginia Solid Waste Management Board in Charleston, WV. His current address is 91 Fenner Avenue, Asheville, NC, 28804-3362. Alan R. Collins and Robert G. Diener, P.E. are Associate Professor and Professor, respectively, in the Division of Resource Management at West Virginia University in Morgantown, WV.

Saint Regis Mohawk Tribe
Solid Waste Program
Municipal Solid Waste Characterization Study
Health and Safety Plan (HASP)

Approvals – Prior to project start:

Les Benedict	9/28/21
Project Coordinator	Date
Lisa M. Furnace	9/28/21
Program Manager	Date
Russell D Phillips	9-29-2021
Operations Supervisor	Date
Adrian McDonald	9/28/21
Tribal HSO	Date

EMERGENCY CONTACTS

If there is an escape of any flammable, toxic, or corrosive gas or liquid or endangers life, health, or property, staff shall immediately call **911** and take immediate action to protect the public and property.

If there is an injury requiring medical attention, staff shall immediately call **911** and take appropriate action to ensure site safety and then assist the injured person(s) until help arrives.

Emergency Services (Police/Fire Department/Ambulance): 911
Poison Control Center: (800) 222-1222
CHEMTREC: (800) 424-9300
National Response Center: (800) 424-8802

Facility Address:

179 County Route 43
Ft. Covington, NY 12937

Organizational Emergency Contact List				
Contact	**Name**	**Organization**	**Phone**	**Cell**
Operations Manager	Russell Phillips	Saint Regis Mohawk Tribe, Transfer Station	518-358-4632 X-1600	
Program Manager	Lisa Furnace	Saint Regis Mohawk Tribe, Transfer Station	518-358-4632 X-1602	
Assistant Director	Les Benedict	Saint Regis Mohawk Tribe, Environment Division	518-358-5937 X-5065	315-816-6188
Tribal Health and Safety Manager	Adrian McDonald	Saint Regis Mohawk Tribe Office of Emergency Management and Safety	518-358-2272 X 2292	
Tribal Security	Katrina Jacobs or Derek Comins	Saint Regis Mohawk Tribe Office of Emergency Management and Safety	518-358-2272 X 2210 X2230	

Contents

General Statement

Health and Safety Requirements

- Project staff will be briefed on the contents of the plan prior to commencing work.

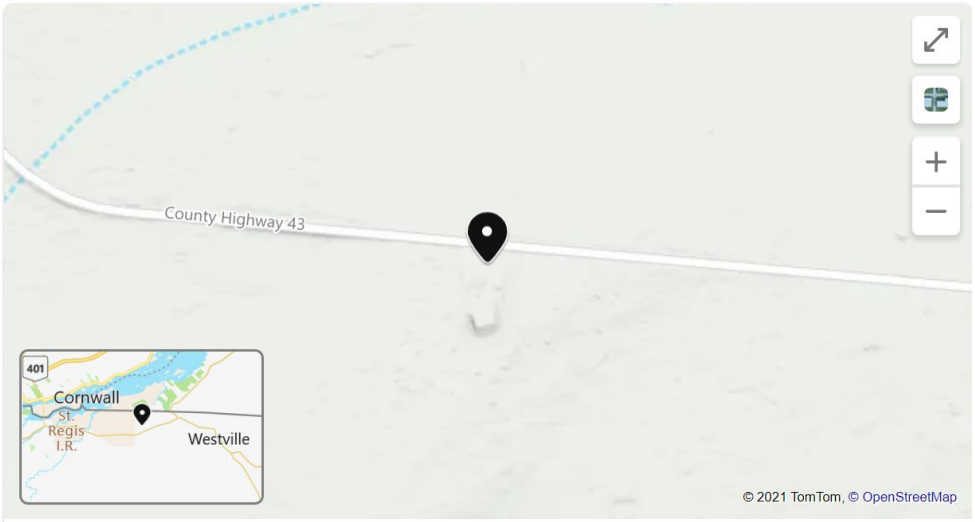
- The Transfer Station will maintain its facilities and equipment in proper working order to ensure that the risks to employees are minimized and that the required personal protective
- equipment (PPE) is made available as required in this HASP.

- Activities conducted by Transfer Station staff will operate within the practices and procedures outline in this HASP.

This HASP addresses the potential hazards associated with planned field activities at the Transfer Station in association with a waste characterization study It presents the *minimum* health and safety requirements for establishing and maintaining a safe working environment during the course of work.

Site Description and Background

The Solid Waste Program, Transfer Station is located at 179 County Route 43, Ft. Covington, NY. It consists of a building and equipment that provide for the transfer of Municipal Solid Waste (MSW) for the Saint Regis Mohawk Tribal community.



The facility operates on a 5-day a week schedule, accepting MSW and materials for recycling from residential and commercial customers. It also operates MSW collection services for a limited number of customers. It provides services for all Tribally owned facilities.

Upon entering the facility users approach a weigh scale where loads are weighed and prior to dumping. Depending upon material, users may be directed to various drop off bins such as:

- Municipal solid waste (MSW)
- Mixed recyclables
- White goods/appliances/Freon containing materials
- Electronic waste (e-waste)
- Scrap metal
- Tires
- Mattresses, and
- Compact fluorescent (CFL) bulbs

The Transfer Station ships its MSW to the County of Franklin Solid Waste Authority permitted landfill in Westville, NY. The landfill is approximately 10-miles away.

The Tribe has an interest in determining the content of MSW entering the transfer station for a number of reasons:

(1) To determine if recyclable content meets targets established for NYS permitted landfills
(2) To determine the content and characteristics of hazardous substances entering the waste stream
(3) To improve overall services to the community based on MSW content
(4) To protect the financial interests of the Tribe by ensuring hazardous substances are properly managed

In order to understand its MSW waste stream, the Tribe will conduct an MSW waste characterization for a period of 12-months by sorting and weighing loads entering the Transfer Station and inspecting the content and recording/documenting its findings. The study will analyze data and report to the Environment Division, Tribal Leadership and to the USEPA the results of the study.

The process of sorting and weighing by Transfer Station staff carries with it some potential work place hazards that are to be recognized, understood and planned for to ensure staff safety. Explained in greater detail in this HASP, are the plans for ensuring worker safety while the study is being conducted.

Element 1 – Organizational Structure

This section describes the lines of authority, responsibility and communication as they relate to health and safety at the Transfer Station and the implementation of the MSW characterization study. It describes the general functions and responsibilities of supervisors and workers, as well as a specific chain of command.

Key Project Personnel and Responsibilities

The key project team members are identified below:

Project Coordinator: Les Benedict, Assistant Director
Project Manager: Lisa Furnace, Solid Waste Program Manager
Tribal Health and Safety Officer (THSO: Adrian McDonald
Operations Supervisor: Russell Phillips
Recycling Coordinator: David Casales
Scale House Operator: Rolland Morris, Corey Oakes

Organizational Chart

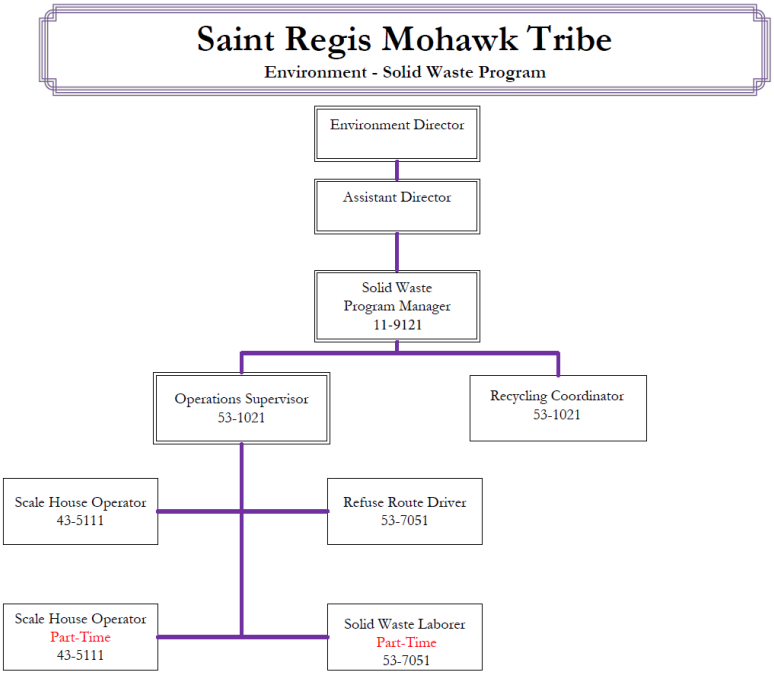


Figure 1 Organizational chart

The responsibilities of key project by personnel are:

Project Coordinator

The Project Coordinator has overall responsibility for ensuring policies and procedures are in place and have been communicated with personnel. Other responsibilities include:

- Ensuring communication between project staff
- Informing all project staff of project changes or other developments
- Maintaining communication between the Program Manager, Operations Supervisor and the THSO

Solid Waste Program Manager

The Project Manager has the ultimate responsibility for the health and safety of personnel at the Site.

The Project Manager is responsible for:

- Ensuring that project personnel review and understand the requirements of this HASP
- Keeping the THSO and Operations Supervisor informed of project developments
- Keeping on-site personnel informed of the expected hazards and appropriate protective measures at the Site
- Providing the resources necessary for maintaining a safe and health work environment for personnel
- Authority to stop work if needed

Operations Supervisor

The Site or Operations Supervisor and is responsible for the directing of all MSW operations at the Transfer Station. All Operations staff report directly to the Operations Supervisor unless otherwise noted. The operations Supervisor is directly responsible for:

- Ensuring daily pre-work and/or tailgate-safety meetings are held prior to initiating work activity and as necessary ensuring that all staff are apprised of site hazards
- Ensuring that all work activities conducted are consistent with this HASP
- Verifying all job hazard analyses and ensuring that ongoing hazard analysis is conducted at the transfer station
- Updating the site control plan as needed
- Granting site workers site and zone access approval
- Directing how work zones are established
- Notified when any hazardous-substance spill occurs
- Notified if emergency assistance is needed
- Responsible for lock-out, tag-out
- Monitoring site activities as they pertain the health and safety for this project

- Stopping unsafe acts that pose an immediate or imminent health and safety hazard to anyone on site
- Ensuring all elements of the HASP are followed and correctly implemented
- Ensuring all staff are apprised of their responsibilities and are fulfilling their requirements
- Updating the Health and Safety Officer as to changes or work progress reports that relate to health and safety functions
- Authority to stop work as needed

Site Health and Safety Supervisor (Health and Safety Officer or HSO)

The Tribal HSO[1] is responsible to the employer and has the authority and knowledge necessary to implement the site safety and health plan and verify compliance with applicable safety and health requirements of the Tribe.

- Assessing various safety hazards, and determining the likelihood of an accident occurring
- Conducting safety orientations and periodic safety meetings and formal training sessions of safety related topics
- Creating, maintaining and communicating safety-related policies and procedures
- Ensuring safety-related policies and procedures are followed
- Enforcement of safety policies and procedures
- Making decisions regarding appropriate discipline for infractions
- Proactively involved in ensuring that proper practices are observed on the workplace
- Perform safety inspections in locations including job sites, offices and company vehicles.
- Observe working conditions, equipment and employee behaviors to identify safety problems and take corrective action
- Ensure that all safety equipment is properly maintained.
- Conduct periodic facility fire inspections, getting fire extinguishers charged regularly, verifying that first aid kits are properly stocked and ensuring that company vehicles and equipment are serviced following an appropriate schedule
- Lead occupational accident and occupational illness investigations
- Report on investigation factual statements of what occurred, conclusions and recommendations for corrective or preventive actions
- Authority to stop work as needed

[1] Refer to Saint Regis Mohawk Tribe, Safety Policy, September 2015 for greater detail.

Recycling Coordinator

The recycling coordinator is primarily responsible for task completion, collection of samples. For the purpose of working safely and to protect their-self and co-workers, responsibilities include:

- Abiding by the HASP and Tribal safety policies
- Attending necessary safety training and meetings
- Apply safe work practices on the job
- Report to work alert, rested and in good physical condition
- Learning and understanding safety policies
- Following safe work instructions in performing their work
- Requesting help if there is uncertainty with working safely
- Wearing all required PPE
- Taking precautions to protect theirself and others when they see safety hazards or unsafe conditions
- Making recommendations for improving safety conditions
- Reporting any near-miss, incident or injury immediately to the Operations Supervisor
- Operating equipment only after receiving appropriate training
- Always using the proper tool, equipment or process for the job
- Ceasing work immediately upon directive from supervisor(s) and THSO

Scale House Operator(s)

The Scale House Operator(s) are primarily responsible for task completion, collection of samples. For the purpose of working safely and to protect their-self and co-workers, responsibilities include:

- Abiding by the HASP and Tribal safety policies
- Attending necessary safety training and meetings
- Apply safe work practices on the job
- Report to work alert, rested and in good physical condition
- Learning and understanding safety policies
- Following safe work instructions in performing their work
- Requesting help if there is uncertainty with working safely
- Wearing all required PPE
- Taking precautions to protect theirself and others when they see safety hazards or unsafe conditions
- Making recommendations for improving safety conditions
- Reporting any near-miss, incident or injury immediately to the Operations Supervisor
- Operating equipment only after receiving appropriate training
- Always using the proper tool, equipment or process for the job
- Ceasing work immediately upon directive from supervisor(s) and THSO

Contact Summary Table

Table 1 Contact Summary

Contact Name	Title	R&R	E-mail	Phone/cell
Lisa Furnace	SW Program Manager	Overall Project Management	lisa.furnace@srmt-nsn.gov	518-358-4632 X1601
Russell Phillips	SW Operations Supervisor	Job Safety Analysis	russell.phillips@srmt-nsn.gov	518-358-4632 X1600
Adrian McDonald	Tribal HSO	Job Safety Analysis Review	adrian.mcdonald@srmt-nsn.gov	518-358-2272 X2292
David Casales	Recycling Coordinator	Sample Collection	david.casales@srmt-nsn.gov	518-358-4632 X1602
Les Benedict	Assistant Director	Principle Investigator	les.benedict@srmt-nsn.gov	518-358-5937 X5065

Element 2 – Planned Site Activities

Scheduled work tasks/planned activities consist of the following:

Task No. 1 – Sorting and screening of the MSW received at the transfer station. This task involves emptying MSW loads onto a floor or other flat surface to for weighing and identification of MSW components.

Task No. 2 – Disposing of MSW following sorting, screening and weighing.

Task No. 3 – Management of spilled hazardous substances as needed.

Element 3 - Hazard Analysis

Site Description

The Transfer Station is a staging area for the temporary disposal of solid waste prior to transfer to a landfill. It is an active area for vehicles, heavy equipment and operational staff. Transfer station employees work in close proximity to various hazards including:

- Equipment with moving parts
- Compactors/balers
- Hydraulics
- Electrical circuits

- Heights
- Slippery surfaces
- Uneven terrain
- Hazardous substances

Physical Hazards

The following potential physical hazards may be encountered during scheduled activities at the Site:

- Slips, Trips, and Falls
- Heavy Equipment
- Heat Stress
- Cold Stress
- Noise
- Electrical Sources
- Underground and Overhead Utilities
- Materials and Equipment Handling
- Biological Hazards
- Elevated Work Platforms
- Fire/Explosion
- Lightning/Electrical Storms
- Traffic
- Dust Control
- Work Area Illumination
- Compressed Gas Cylinders
- Hand Tools
- Ladders

General Safe Work Practices

General safe work practices to be implemented onsite include the following:

- Workers will thoroughly clean their hands, faces, and other potentially contaminated areas before smoking, eating, or leaving the Site
- Respiratory devices may not be worn with beards or long sideburns, or under other
- conditions that prevent a proper seal
- Accidents and/or injuries associated with work at the Site will be immediately reported to the OS. If necessary, an incident report will be initiated by the OS;
- Periodic safety briefings will be held to discuss current site conditions, field tasks being performed, planned modifications, and work concerns
- Site conditions may include uneven, unstable, or slippery work surfaces. Substantial care and personal observation is required of each employee to prevent injuries from slips, trips, and falls

- Workers will maintain good housekeeping practices during field activities to maintain a safe working environment. The work site will be kept free of debris, waste, and trash
- The "buddy system" will be used whenever appropriate;
- To prevent head injury, American National Standards Institute (ANSI) approved hard hats will be worn at all times while the worker is in an area where overhead obstructions or falling objects may be encountered
- To prevent eye injuries, workers must wear ANSI-approved safety glasses during field activities
- To provide for worker safety, an ANSI-approved high visibility safety vest shall be worn at all times during field activities
- Site workers will wear other appropriate PPE (in addition to the PPE described above) required to perform work safely.

Heavy Equipment

Equipment, including earth-moving equipment, or other heavy machinery, will be operated in compliance with the manufacturer's instructions, specifications, and limitations, as well as any applicable regulations. The operator shall have received appropriate training to ensure safe operation of any equipment used. The operator is responsible for inspecting the equipment daily to verify that it is functioning properly and safely.

Damaged/deteriorated equipment will be removed from the Site or will be repaired prior to use on the Site.

Operation of equipment at the Site for the activities outlined in Section 3 poses potential physical hazards. The following precautions should be observed whenever heavy equipment is in use:

- PPE, including steel-toed boots, safety glasses, hard hats and vests must be worn
- Personnel must be aware of the location and operation of heavy equipment and take precautions to avoid getting in the way of its operation. Workers must never assume that the equipment operator sees them; eye contact and hand signals should be used to inform the operator of intent
- Personnel should not walk directly in back of, or to the side of, heavy equipment without the operator's knowledge
- Nonessential personnel are not allowed in the work area, and appropriate warning signs will be posted to warn unapproved visitors not to enter the work area(s)

Heat Stress

Adverse climate conditions, primarily heat, are important considerations in planning and conducting site operations. Heat-related illnesses range from heat fatigue to heat stroke, with heat stroke being the most serious condition. The CDC Heat-Related Illnesses chart is attached . The effects of ambient temperature can cause physical discomfort, loss of

efficiency, and personal injury, and can increase the probability of accidents. In particular, protective clothing that decreases the body's ventilation can be an important factor leading to heat-related illnesses.

To reduce the possibility of heat-related illness, staff should drink plenty of fluids and establish a work schedule that will provide sufficient rest periods for cooling down. Personnel shall maintain an adequate supply of non-caffeinated drinking fluids on site for personal hydration. Workers should be aware of signs and symptoms of heat-related illnesses, as well as first aid for these conditions.

Cold Stress

Workers performing activities during winter and spring months may encounter extremely cold temperatures, as well as conditions of snow and ice, making activities in the field difficult. Adequate cold weather gear, especially head and foot wear, is required under these conditions. Workers should be aware of signs and symptoms of hypothermia and frostbite, as well as first aid for these conditions (OSHA Cold Weather Card attached).

Noise

Noise may result primarily from the operation of mechanical equipment. The use of heavy equipment may generate noise above the OSHA permissible exposure limits of 90 dBA for an eight-hour time-weighted average. Workers will wear appropriate hearing protection when operating or working near heavy equipment. If loud noise is present or normal conversation becomes difficult, hearing protection in the form of ear plugs, or equivalent, will be required.

Materials and Equipment Handling Procedures

The movement and handling of equipment and materials on the Site pose a risk to workers in the form of muscle strains and minor injuries. These injuries can be avoided by using safe handling practices, proper lifting techniques, and proper personal safety equipment such as steel-toed boots and sturdy work gloves. Where practical, mechanical devices will be utilized to assist in the movement of equipment and materials. Workers will not attempt to move heavy objects by themselves without using appropriate mechanical aids.

Biological Hazards

If any biological hazards are identified at the Site, workers in the area will immediately notify Operations Supervisor and THSO.

Bacteria, Viruses and Fungi

MSW received at the material which could contain bacteria and other pathogenic organisms. Examples of these types of hazards are:

- Human blood and blood products. This includes items that have been contaminated with blood and other body fluids or tissues that contain visible blood.
- Animal waste
- Diapers
- Human body fluids
- Microbiological wastes
- Pathological waste
- Sharps waste
- Spoiled foods

Insects and Spiders

Nearly all work sites contain ticks, venomous insects and spiders are generally reclusive, and the greatest potential for exposure arises when personnel are sorting materials. Caution should be exercised when working.

Rodents and Fur-Bearing Animals

Fur-bearing animals. Animals may potentially carry the rabies virus or ticks that may transmit Lyme disease to humans. Avoid contact. Do not attempt to feed or touch.

Dead and live animals can spread diseases such as Rat Bite Fever and Rabies.

- Avoid contact with wild or stray animals;
- Avoid contact with rats or rat-contaminated buildings. If you can't avoid contact, wear protective gloves, protective clothing, and respirator and wash your hands regularly

Traffic

Vehicular traffic presents opportunities for serious injury to persons or property. Traffic may consist of street traffic or motor vehicles operated by facility employees or visitors to the Site. Workers and other pedestrians are clearly at risk during periods of heavy traffic. Risk from motor vehicle operations may be minimized by good operating practices and alertness, and care on the part of workers and pedestrians.

Site personnel will wear high-visibility safety vests whenever activities are conducted in areas of heavy traffic. Work vehicles will be arranged to be used as a barrier between site workers and nearby traffic. If required by local ordinances or site location, a traffic control plan will be developed and implemented.

Training Program

Staff involved with the project should have at minimum training as identified:

HAZWOPER Awareness Level - required
OSHA 10 General Industry - recommended
PPE Use - required
First Aid CPR - recommended
Blood Borne Pathogens - recommended

Medical Surveillance Program

Not required.

Site Control Program

Site Map

Site Access Procedures and Site Security

Site access and security will be managed by the Operations Supervisor to ensure the safety of customers and workers.

Specific work zones for sorting and weighing of MSW will be identified through the use of traffic cones, marker tape/rope and signage.

Internal and External Communications

Communications for the project will be limited to internal, within the confines of the Transfer Station. No extraordinary communications means are necessary except that explicit verbal communication between the Recycling Coordinator and Transfer Station staff will be required to identify work areas and restrictions for equipment operation and vehicle traffic until it is explicitly stated and noted otherwise.

Medical Assistance

Dial 911 or call for emergency medical assistance if the worker experiences any of the following signs or symptoms:

- Difficulty breathing
- Swelling of the lips or throat
- Faintness
- Confusion
- Rapid heartbeat
- Hives or; and
- Nausea, stomach cramps, and vomiting

A sting anywhere in the mouth warrants immediate medical attention. That's because stings in the mucous membranes of the mouth can quickly cause severe swelling that may block the airway.

While Waiting for Emergency Transportation:

- Have the person lie down
- Watch for and treat signs of shock
- If the person is unconscious and breathing, lay the person on his or her side to allow drainage from the mouth
- If there's no pulse, trained personnel should begin cardiopulmonary resuscitation (CPR) and
- Check to see if the person is carrying an allergy kit containing injectable epinephrine and follow instructions on the kit.

Personal Protective Equipment (PPE)

The project will utilize Level D PPE.

1. To protect their workers even from what it describes as "nuisance contamination." At this level, contact with skin, eyes or lungs clearly wouldn't be lethal, but it's important to avoid any unexpected exposure even when there is "no known hazard".
2. Take Home Exposures – Chemicals from your work can come home on your skin, hair, clothes and shoes. When you go home, these chemicals can get onto your floors, your furniture, or in your car where your family members or pets can be exposed. We call this take-home exposure.
    a. Solid waste workers may regularly expose their families to potential health risks
    b. Home washing machines are not designed to handle contaminated clothing
    c. Risk of compromising protective workwear
    d. Reduce the risk of spread of infectious agents, i.e. – viruses, bacteria
3. A lot of different chemicals are accidentally brought home from work and can make family members sick. These include lead, pesticides, beryllium, and asbestos.
4. Uniforms protect employees and establish organizational recognition.
    a. Promotes Team Unity
    b. Establishes "branding" and recognition, leading to better customer service.
    c. Positive image

At Level D, each worker will consist of:

- Uniform and/or Coveralls
- Boots or shoes with chemical-resistant steel toes and shanks
- There is no respirator requirement, and the rest of the items are optional and should be provided **based on your safety assessment**. This includes gloves, disposable chemical-resistant outer boots, safety glasses or splash goggles, hard hats, escape masks and face shields.

When Level D applies: There are no known hazards in the workplace. Chemical splashes or immersions while performing the work are unlikely, as is inhalation of any chemicals or particulate

Training In The Use of PPE

Personal Protective Equipment (PPE) is any safety equipment workers wear to prevent injury in the workplace when engineering and administrative controls fail to eliminate the hazard.

Training is required by OSHA regulations contained in 29CFR 1910.132-140. The topics that are required are:

- When PPE is necessary
- What PPE is necessary

- How to properly don, doff, adjust and wear PPE
- The limitations of PPE
- The proper care, maintenance, useful life, and disposal of the PPE

Respiratory Protection

Not applicable

Environmental Monitoring

Environmental Monitoring isn't required for this project. Staff will be required to maintain an awareness of potential hazards and risks including leakage of hazardous substances. Staff are required to be trained to the Hazardous Materials Awareness level with proficiency in identifying hazardous materials/substances, their risks, protective actions and making the appropriate response, e.g. notification.

Spill Containment Program

Potential for Spills and Controls

There is some potential for encountering spills of hazardous substances found in the waste stream from improper disposal.

All staff responding to spills must have appropriate training and wear PPE appropriate for the situation. If a hazardous material spill occurs, properly trained and equipped site personnel should locate the source of the spill and determine the hazard to the health and safety of site workers and the public. Attempt to stop or reduce the flow if it can be done without risk to personnel. Isolate the spill area and do not allow entry by unauthorized personnel. De-energize sources of ignition within 100 feet of the spill, including vehicle engines. Should a spill be of the nature or extent that it cannot be safely contained, or poses an imminent threat to human health or the environment, an emergency cleanup contractor will be called out as soon as possible. Spill containment measures listed below are examples of responses to spills.

Right or rotate containers to stop the flow of liquids. This step may be accomplished as soon as the spill or leak occurs, providing it is safe to do so;

- Sorbent pads, booms, or adjacent soil may be used to dike or berm materials, subject to flow, and to solidify liquids;
- Sorbent pads, soil, or booms, if used, shall be placed in appropriate containers after use, pending disposal; and
- Contaminated tools and equipment shall be collected for subsequent cleaning or disposal.

Decontamination

Decontamination isn't normally associated with Level D PPE but clothing may become contaminated with substances (nuisance and chemical) while sorting materials. Ordinarily, good hygiene, hand washing with soap and water is appropriate. Uniforms will be professional washed by the uniform supplier. Some equipment, e.g. gloves may be considered as disposable and don't warrant decontamination and will be properly disposed of in waste containers.

Staff inadvertently contaminated by accidental spills will be decontaminated by emergency decontamination using water and detergent/soap or other means appropriate the substance involved if identified.

Surfaces and materials contaminated by accidental spills will be decontaminated by a qualified contractor.

Contingency

In the event of an emergency, site personnel will signal distress with three blasts of a horn (a vehicle horn will be sufficient), or other predetermined signal. Communication signals, such as hand signals, must be established where communication equipment is not feasible or in areas of loud noise.

Injury/Illness

If an exposure or injury occurs, work will be temporarily halted until an assessment can be made of whether it is safe to continue work.

In the event of an injury, the extent and nature of the victim's injuries will be assessed and first aid will be rendered as appropriate. If necessary, the individual may be transported to a nearby medical center. The mode of transportation and the eventual destination will be based on the nature and extent of the injury.

In the event of a life-threatening emergency, the injured person will be given immediate first aid and emergency medical services will be contacted by dialing 911. The individual rendering first aid will follow directions given by emergency medical personnel via telephone and will wear appropriate PPE to prevent direct contact with potential blood-borne pathogens.

Fire

In the event of fire, personnel should contact the local fire department immediately by dialing 911. When representatives of the fire department arrive, the Operations Supervisor or designated representative, will advise the commanding officer of the location, nature,

and identification of hazardous materials on site. Only trained, experienced fire fighters should attempt to extinguish substantial fires at the Site. Site personnel should not attempt to fight fires, unless it is safe to do so, and they are properly trained and appropriately equipped to do so.

Smoking is not permitted on the premises.

Hazardous Material Spill

Any hazardous substances or materials, discovered intact or if spilled will be handled by a qualified staff person for disposal by a contractor. Staff are required to report spills to the Environment Division office immediately after securing the site from access by others.

Nearest Hospitals:

Alice Hyde Medical Center
133 Park Street
Malone, NY 12953
518-483-3000

Massena Memorial Hospital
1 Hospital Drive
Massena, NY 13662
315-769-3790

Workplace Hazard Assessment Form

Use this form to help identify the Personal Protective Equipment (PPE) required within each work location. Multiple forms may be used, as needed, to include all work areas or job functions.

Department:	**Section/Shop:**
Work Location(s):	
Job Functions/Activities:	

Type of Hazards Present (check all that apply)	**Describe Hazards**	**Personal Protective Equipment** (check all applicable and describe the specific PPE required e.g., splash goggles, face shields, nitrile gloves, hard hat, etc.)
☐ **Impact** (e.g. falling or flying objects, sand, dirt, dust, particulate, etc.)		Eye/face ☐ Hand ☐ Head ☐ Clothing ☐ Foot/leg
	Do hazards prohibit working alone? Yes No	☐ Other
☐ **Cuts/Penetration** (e.g. cuts, punctures, lacerations, etc.)		☐ Eye/face ☐ Hand ☐ Head ☐ Clothing ☐ Foot/leg
	Do hazards prohibit working alone? Yes No	☐ Other
☐ **Pinch/Crush/Roll Over** (e.g., moving machine parts, falling/rolling heavy equipment, etc.)	☐ ☐	☐ Eye/face ☐ Hand ☐ Head ☐ Clothing ☐ Foot/leg
	Do hazards prohibit working alone? Yes No	☐ Other
☐ **Chemical** (e.g. pouring, mixing, splash hazards, washing/cleaning, etc.) ☐ Flammable ☐ Reactive ☐ Toxic ☐ Asphyxiant ☐ Corrosive ☐ Other		☐ Eye/face ☐ Hand ☐ Head ☐ Clothing ☐ Foot/leg
	Do hazards prohibit working alone? Yes No ☐ ☐	☐ Other (e.g., Respiratory- Contact EH&S for direction) ☐ ☐
☐ **Biological** (e.g. infectious materials, human or animal tissue, blood or body fluids, biological toxins, etc.)		☐ Eye/face ☐ Hand ☐ Head ☐ Clothing ☐ Foot/leg
	Do hazards prohibit working alone? Yes ☐ No ☐	Other

☐ **Thermal (Hot/Cold)** (e.g. torching, hot sparks, welding, working on steam systems, working with steam systems, working with cryogenic gases, etc.)		☐ Eye/face ☐ Hand ☐ Head ☐ Clothing ☐ Foot/leg
	Do hazards prohibit working alone? Yes ☐ No ☐	☐ Other
☐ **Electrical** (e.g. exposed electrical conductors, energized parts, electrical switch gear, etc.)		☐ Eye/face ☐ Hand ☐ Head ☐ Clothing ☐ Foot/leg
	Do hazards prohibit working alone? Yes ☐ No ☐	☐ Other (e.g., Hearing- Contact EH&S for direction)
☐ **Harmful Dust/Mists/Fumes/Vapor** (e.g., grinding, drilling, sanding, welding, brazing, soldering, working with silica dust, nanomaterials, animal bedding, allergens, etc.)		☐ Eye/face ☐ Hand ☐ Head ☐ Clothing ☐ Foot/leg ☐ Respiratory (Contact EH&S for direction)
	Do hazards prohibit working alone? Yes ☐ No ☐	☐ Other
☐ **Light (Optical) Radiation** (e.g. laser, UV light, optical, etc.)		☐ Eye/face
	Do hazards prohibit working alone? Yes ☐ No ☐	☐ Other
☐ **Ionizing Radiation** (e.g., X-rays, radioisotopes, etc.)		☐ Eye/face ☐ Hand ☐ Head ☐ Clothing ☐ Foot/leg
	Do hazards prohibit working alone? Yes ☐ No ☐	☐ Other
☐ **Noise** (e.g. continuous noise, impact noise, intermittent noise, etc.)		☐ Hearing (Contact EHS for direction)
	Do hazards prohibit working alone? Yes ☐ No ☐	
☐ **Other** (e.g. slippery walking surfaces, working from heights, vibration, etc.)		Eye/face Hand Head Clothing Foot/leg
	Do hazards prohibit working alone? Yes No	Other
NONE (check if no apparent hazards exist)		

Assessment Completed By:	**Title:**	**Unit:**	**Phone:**
Signature:	**Date:**	**Email:**	

Heat-Related Illnesses Chart

OSHA Cold Weather Card

HEAT-RELATED ILLNESSES

WHAT TO LOOK FOR	WHAT TO DO

HEAT STROKE

- High body temperature (103°F or higher)
- Hot, red, dry, or damp skin
- Fast, strong pulse
- Headache
- Dizziness
- Nausea
- Confusion
- Losing consciousness (passing out)

- Call 911 right away-heat stroke is a medical emergency
- Move the person to a cooler place
- Help lower the person's temperature with cool cloths or a cool bath
- Do not give the person anything to drink

HEAT EXHAUSTION

- Heavy sweating
- Cold, pale, and clammy skin
- Fast, weak pulse
- Nausea or vomiting
- Muscle cramps
- Tiredness or weakness
- Dizziness
- Headache
- Fainting (passing out)

- Move to a cool place
- Loosen your clothes
- Put cool, wet cloths on your body or take a cool bath
- Sip water

Get medical help right away if:

- You are throwing up
- Your symptoms get worse
- Your symptoms last longer than 1 hour

HEAT CRAMPS

- Heavy sweating during intense exercise
- Muscle pain or spasms

- Stop physical activity and move to a cool place
- Drink water or a sports drink
- Wait for cramps to go away before you do any more physical activity

Get medical help right away if:

- Cramps last longer than 1 hour
- You're on a low-sodium diet
- You have heart problems

SUNBURN

- Painful, red, and warm skin
- Blisters on the skin

- Stay out of the sun until your sunburn heals
- Put cool cloths on sunburned areas or take a cool bath
- Put moisturizing lotion on sunburned areas
- Do not break blisters

HEAT RASH

- Red clusters of small blisters that look like pimples on the skin (usually on the neck, chest, groin, or in elbow creases)

- Stay in a cool, dry place
- Keep the rash dry
- Use powder (like baby powder) to soothe the rash

CS280226

OSHA® QUICK CARD™

Protecting Workers from Cold Stress

Cold temperatures and increased wind speed (wind chill) cause heat to leave the body more quickly, putting workers at risk of cold stress. Anyone working in the cold may be at risk, e.g., workers in freezers, outdoor agriculture and construction.

Common Types of Cold Stress

Hypothermia

- Normal body temperature (98.6°F) drops to 95°F or less.
- **Mild Symptoms:** alert but shivering.
- **Moderate to Severe Symptoms:** shivering stops; confusion; slurred speech; heart rate/breathing slow; loss of consciousness; death.

Frostbite

- Body tissues freeze, e.g., hands and feet. Can occur at temperatures above freezing, due to wind chill. May result in amputation.
- **Symptoms**: numbness, reddened skin develops gray/white patches, feels firm/hard, and may blister.

Trench Foot (also known as Immersion Foot)

- Non-freezing injury to the foot, caused by lengthy exposure to wet and cold environment. Can occur at air temperature as high as 60°F, if feet are constantly wet.
- **Symptoms**: redness, swelling, numbness, and blisters.

Risk Factors

- Dressing improperly, wet clothing/skin, and exhaustion.

For Prevention, Your Employer Should:

- Train you on cold stress hazards and prevention.
- Provide engineering controls, e.g., radiant heaters.
- Gradually introduce workers to the cold; monitor workers; schedule breaks in warm areas.

For more information:

OSHA® Occupational Safety and Health Administration

U.S. Department of Labor

www.osha.gov (800) 321-OSHA (6742)

OSHA 3156-02R 2014

OSHA® QUICK CARD™

How to Protect Yourself and Others

- Know the symptoms; monitor yourself and co-workers.
- Drink warm, sweetened fluids (no alcohol).
- Dress properly:
  - Layers of loose-fitting, insulating clothes
  - Insulated jacket, gloves, and a hat (waterproof, if necessary)
  - Insulated and waterproof boots

What to Do When a Worker Suffers from Cold Stress

For Hypothermia:

- Call 911 immediately in an emergency.
- To prevent further heat loss:
  - Move the worker to a warm place.
  - Change to dry clothes.
  - Cover the body (including the head and neck) with blankets, and with something to block the cold (e.g., tarp, garbage bag). Do **not** cover the face.
- If medical help is more than 30 minutes away:
  - Give warm, sweetened drinks if alert (no alcohol).
  - Apply heat packs to the armpits, sides of chest, neck, and groin. Call 911 for additional rewarming instructions.

For Frostbite:

- Follow the recommendations "**For Hypothermia**".
- Do not rub the frostbitten area.
- Avoid walking on frostbitten feet.
- Do not apply snow/water. Do not break blisters.
- Loosely cover and protect the area from contact.
- Do not try to rewarm the area unless directed by medical personnel.

For Trench (Immersion) Foot:

- Remove wet shoes/socks; air dry (in warm area); keep affected feet elevated and avoid walking. Get medical attention.

For more information:

OSHA® Occupational Safety and Health Administration

U.S. Department of Labor

www.osha.gov (800) 321-OSHA (6742)