MANAGER OF LANDFILL OPERATIONS

BODY OF KNOWLEDGE

SUMMARY

A *body of knowledge*, as described by SWANA, refers to "the compendium of the basic knowledge an individual must know to accomplish the work of a Manager of Landfill Operations. This *body of knowledge* includes both proven traditional practices and the innovative and advanced practices of managing a landfill, as well as empirical, esthetical, ethical, and tacit knowledge."

The body of knowledge for a Manager of Landfill Operations (MOLO) served as a base for updating and for developing additional features of the MOLO training course and certification exam. Several sources of information were used to develop the body of knowledge.

An online survey was developed to gather opinions of landfill operators, consultants, and regulators regarding what they thought were the most important aspects of the job role. A draft of the body of knowledge was developed based on the results of the survey and the expertise of the project team. The resulting body of knowledge was rigorously reviewed by the SWANA committee. The members of the project team met to finalize the body of knowledge. The project team contributed their expertise and experience pertaining to landfills design, permitting, operations, closure, and post-closure care. In addition, the literature of landfilling technology was reviewed thoroughly to develop the body of knowledge and update the existing training course materials.

BODY OF KNOWLEDGE DEVELOPMENT

The MOLO Body of Knowledge was developed using the following approach.

Step 1: *Job domains* for a manager of bioreactor landfill operations were identified.
Job domains refer to major categories of tasks that a manager of landfill operations would be required to perform as part of typical operation. For each of these job domains, specific tasks were delineated.

Step 2: The *knowledge and abilities* necessary to perform the specific tasks were delineated.

Step 3: A *knowledge statement* was created to summarize each set of *knowledge and abilities*.

Step 4: A set of *comprehensive knowledge statements* was compiled from those developed in Step 3 to form the body of knowledge.

The resulting MOLO Body of Knowledge consists of 11 comprehensive knowledge statements covering the knowledge and abilities a manager of landfill operations should have in the areas of constructing, operating, and monitoring MSW landfills. The resulting body of knowledge is presented on the following pages.

KNOWLEDGE STATEMENTS

A manager of landfill operations should have knowledge of:

1. The physical features of sanitary landfill sites and how these features interact to provide a solid waste disposal facility that incorporates the long-term protection of human health and the environment.

2. The elements of modern sanitary landfill design, operation, economics, performance and the process of obtaining regulatory permits for a landfill facility in accordance with federal, state/provincial and local requirements.

3. Techniques for disposing of waste in sanitary landfills that provide protection for human health and the environment while maximizing airspace utilization and complying with regulatory requirements, including the application of cover materials.

4. Solid waste characteristics, including problematic and/or prohibited waste materials encountered at landfills, and the appropriate techniques for their management.

5. Techniques for applying cover material to deposited waste for the control of stormwater run-on/runoff, wind-blown litter, odors, leachate discharges, vector controls, and applying other environmental controls.

6. Procedures for managing landfill leachate, stormwater, and landfill gas, and the methods for monitoring their impacts on the surrounding groundwater, surface water and air in order to comply with regulatory requirements and to protect human health and the environment.

7. The proper management of basic components and infrastructure that are required to operate a sanitary landfill site, such as staffing, equipment, facilities, roads, and other structures.

8. Requirements for properly maintaining closed landfills in accordance with federal, state/provincial, and local requirements.

9. Procedures for effectively communicating issues regarding the landfill to public and private solid waste professionals and to the public.

10. Techniques for managing other landfill activities at a sanitary landfill that include removal of freon from appliances, tire storage and processing, handling of yard trimmings and composting, recovered materials storage and processing, electronics, and other diversion activities.

11. The essential components and requirements to develop and implement an effective safety program.

JOB DOMAINS AND DOMAIN TASKS

Table 1 presents the identified job domains for a manager of landfill operations and the specific tasks identified for each job domain.

Table 1. Identified Job Domains and the Specific Tasks for a Manager of Landfill Operations

Job Domain	Specific Domain Tasks
1. Placement, grading, and compaction of waste in the landfill cell.	
	a. Understand and comply with designated filling sequence.
	b. Operate waste compaction equipment.
	c. Place and compact waste to meet necessary grading requirements.
	d. Perform density calculations.
2. Application of cover materials.	
	a. Apply daily soil cover.
	b. Apply alternative daily cover materials.
	c. Apply intermediate and final cover.
	d. Repair and maintain cover systems.
3. Screening and removal of prohibited and dangerous materials.	
	a. Understand and identify prohibited/dangerous materials.
	b. Remove and safely store/disposed of prohibited materials.
	c. Comply with required regulatory recordkeeping regarding management of prohibited/dangerous materials.
4. Maintenance of the operating landfill unit.	
	a. Provide necessary stormwater run-on and run-off control.
	b. Control blowing litter.
	c. Maintain cover soil and vegetation.
	d. Control odors.
	e. Inspect and control landfill seeps.
	f. Maintain landfill roads.
5. Operation of leachate management systems.	
	a. Operate liquids collection and removal system.
	b. Operate leachate recirculation system.
	c. Operate leachate treatment and disposal system.
	d. Maintain leachate management system components.
6. Operation of gas extraction, collection, and treatment systems.	

Job Domain	Specific Domain Tasks
	a. Monitor, operate, and maintain landfill gas extraction system.
	b. Monitor, operate, and maintain landfill gas treatment system.
7. Operation and maintenance of landfill operations outside the disposal cell.	
	a. Operate and maintain the scale house.
	b. Operate and maintain roadways and stormwater drainage systems.
	c. Protect and maintain groundwater wells and gas monitoring probes.
	d. Operate and maintain ancillary structures and facilities.
	e. Maintain site appearance.
8. Operate and maintain closed landfill units.	
	a. Perform general site maintenance and control at closed landfill sites.
	b. Operate leachate management and gas extraction systems.
	c. Comply with regulatory and permit requirements for closed landfill sites.
9. Comply with regulatory and permit requirements.	
	a. Understand regulatory and permit requirements.
	b. Operate landfill to meet regulatory and permit requirements.
	c. Maintain records and submit reports to meet regulatory and permit requirements.
	d. Coordinate compliance inspections and address concerns from inspections.

Job Domain	Specific Domain Tasks
10. Perform necessary accounting and recordkeeping.	
	a. Collect and maintain waste receipts and tonnage records.
	b. Collect and maintain other facility data.
	c. Perform basic landfill economic calculations.
11. Employ appropriate safety and contingency measures for employees, customers, and visitors.	
	a. Develop and maintain appropriate safety and contingency measures.
	b. Perform necessary recordkeeping to comply with safety and contingency requirements.
	c. Train employees and other parties on safety and contingency measures.
12. Communicate with landfill employees, customers, regulatory officials, neighbors, and others.	
	a. Effectively communicate with landfill employees.
	b. Effectively communicate with landfill customers.
	c. Effectively communicate with senior management, regulators, and consulting engineers.
	d. Effectively communicate with landfill neighbors and the general public.

KNOWLEDGE OR UNDERSTANDING NEEDED FOR DOMAIN TASKS

Topics that a MOLO should have a knowledge or understanding of were identified for each of the specific job domain tasks. In many cases, overlap occurs from task to task. The results are presented in Tables 2 through 13.

Table 2. Required Knowledge and Understanding for Job Domain 1

Job Domain 1: Placement, grading, and compaction of waste in the landfill cell.	
Specific Domain Task	**To be qualified for the given task, an individual should have an understanding or knowledge of:**
a. Understand and comply with designated filling sequence.	• The concept and objective of a filling sequence. • Factors that influence the sequence of waste filling. • Basic surveying techniques • Methods for identifying limits of waste placement.
b. Operate waste compaction equipment.	• The value of landfill air space. • Basic compaction equipment. • Compaction techniques. • The concept of waste density and what values can be achieved with modern compaction equipment. • Advances in compaction equipment.
c. Place and compact waste to meet necessary grading requirements.	• Regulatory and permit requirements for slopes. • Techniques for determining appropriate grades and slopes. • Advances in compaction equipment. • Basic surveying techniques. • Methods for identifying limits of waste placement.
d. Perform density calculations	• Waste density and its impact on disposal capacity. • Calculation of waste density. • Role of cover soil in waste density calculations.

Table 3. Required Knowledge and Understanding for Job Domain 2

Job Domain 2: Application of cover materials.	
Specific Domain Task	**To be qualified for the given task, an individual should have understanding or knowledge of:**
a. Apply daily soil cover.	• The reasons for the application of daily cover. • Regulatory requirements for daily cover application. • The impact of cover material on landfill operations and performance. • The impact of cover material selection on landfill capacity.
b. Apply alternative daily cover materials.	• The reasons for the application of daily cover. • Regulatory requirements for daily cover application. • The impact of cover material on landfill operations and performance. • Options for alternative cover materials and techniques. • The impact of cover material selection on landfill capacity.
c. Apply intermediate and final cover.	• The reasons for the application of intermediate and final cover. • Regulatory requirements for intermediate and final cover application. • The impact of cover material on landfill operations and performance.
d. Repair and maintain cover systems.	• Methods for minimizing and repairing erosion of cover material. • Causes of landfill cover failures. • The occurrence and repair of landfill seeps.

Table 4. Required Knowledge and Understanding for Job Domain 3

Job Domain 3: Screening and removal of prohibited and dangerous materials.	
Specific Domain Task	**To be qualified for the given task, an individual should have understanding or knowledge of:**
a. Understand and identify prohibited/dangerous materials.	• The possible environmental and human risks posed by toxic or dangerous chemicals disposed of at landfills. • The regulatory requirements regarding prohibited wastes from landfills. • The appearance, characteristics, and nature of frequently encountered prohibited waste materials.
b. Remove and safely store/dispose of prohibited materials.	• The possible environmental and human risks posed by toxic or dangerous chemicals disposed of at landfills. • The regulatory requirements regarding prohibited wastes from landfills. • Regulatory requirements for storing and disposing of prohibited waste materials. • Alternative disposal locations and procedures for prohibited wastes. • Regulatory requirements for reporting prohibited materials. • Requirements for spill containment protection and emergency/contingency plans.
c. Comply with required regulatory recordkeeping regarding management of prohibited/dangerous materials.	• Regulatory requirements for storing and disposing of prohibited waste materials. • Regulatory requirements for reporting prohibited materials.

Table 5. Required Knowledge and Understanding for Job Domain 4

Job Domain 4: Maintenance of the operating landfill unit.	
Specific Domain Task	**To be qualified for the given task, an individual should have understanding or knowledge of:**
a. Provide necessary stormwater run-on and run-off control.	• The importance of proper stormwater management at operating landfill units. • Techniques for controlling stormwater at operating landfill units.
b. Control blowing litter.	• Techniques for controlling windblown litter. • Methods and strategies for removal of windblown litter.
c. Maintain cover soil and vegetation.	• Regulatory requirements for intermediate and final cover application. • Erosion control products and techniques. • Methods for minimizing and repairing erosion of cover material.
d. Control odors.	• Sources of odors. • Odor control strategies and techniques.
e. Inspection and control of landfill seeps.	• Causes of seeps. • Mechanisms for addressing seeps.
f. Maintenance of landfill roads.	• Road construction techniques and materials. • Road maintenance techniques.

Table 6. Required Knowledge and Understanding for Job Domain 5

Job Domain 5: Operation of leachate management systems.	
Specific Domain Task	**To be qualified for the given task, an individual should have understanding or knowledge of:**
a. Operate liquids collection and removal system.	• The processes that result in the formation of leachate. • The importance of removing leachate from the landfill. • Landfill leachate collection designs and configurations.
b. Operate leachate recirculation system.	• Objectives of leachate recirculation. • Regulatory issues with leachate recirculation. • Techniques for recirculation leachate. • Operating leachate recirculation systems. • The concept of a bioreactor landfill. • The occurrence and repair of landfill seeps.
c. Operate leachate treatment, storage and disposal system.	• The chemical characteristics of landfill leachate. • Common monitoring parameters for landfill leachate. • Regulatory requirements for landfill leachate treatment, storage, and disposal. • Leachate treatment, storage, and disposal techniques.
d. Maintain leachate management system components.	• Maintenance issues with leachate management systems. • Techniques for inspecting, cleaning, and repairing leachate collection systems. • Maintenance of leachate flow meters.

Table 7. Required Knowledge and Understanding for Job Domain 6

Job Domain 6: Operation of gas extraction, collection, and treatment systems.	
Specific Domain Task	**To be qualified for the given task, an individual should have understanding or knowledge of:**
a. Monitor, operate, and maintain landfill gas extraction system.	• The basics of waste decomposition in landfills and biogas production. • The characteristics and risks of landfill gas. • Regulatory requirements for landfill gas. • Typical gas collection techniques. • Equipment for monitoring landfill gas. • Operating and monitoring techniques for landfill gas extraction systems. • Gas condensate, its consequences, and its management.
b. Monitor, operate, and maintain landfill gas treatment system.	• The characteristics and risks of landfill gas. • Regulatory requirements for landfill gas. • Equipment for monitoring landfill gas. • Landfill gas flares and their operation. • Options for landfill gas to energy.

Table 8. Required Knowledge and Understanding for Job Domain 7

Job Domain 7: Operation and maintenance of landfill operations outside the disposal cell.	
Specific Domain Task	**To be qualified for the given task, an individual should have understanding or knowledge of:**
a. Operate and maintain the scale house.	• Scale house functions and activities. • Basic scale house layouts.
b. Operate and maintain roadways and storm water drainage systems.	• Roadway systems at landfills.
c. Protect and maintain groundwater wells and gas monitoring probes.	• Regulatory requirements for groundwater and subsurface gas monitoring. • Typical construction of groundwater monitoring wells and subsurface gas monitoring probes.
d. Operate and maintain ancillary structures and facilities.	• Types of structures and facilities that may be located at a landfill site.
e. Maintain site appearance.	• Importance of maintaining site appearance. • The use of buffers and visual screens.
f. Manage other landfill activities	• Removal of Freon from appliances • Tire storage and processing • Handling yard trimmings and composting • Storage and processing of recovered materials (electronics) • Diversion activities

Table 9. Required Knowledge and Understanding for Job Domain 8

Job Domain 8: Operate and maintain closed landfill units.	
Specific Domain Task	**To be qualified for the given task, an individual should have understanding or knowledge of:**
a. Perform general site maintenance and control at closed landfill sites.	• Maintenance issues involved with long-term care of closed landfills. • Landfill settlement and its impact on operations.
b. Operate leachate management and gas extraction systems.	• The importance of removing leachate from the landfill. • Landfill leachate collection designs and configurations. • Regulatory requirements for landfill leachate treatment, storage, and disposal. • Leachate treatment, storage, and disposal techniques. • Maintenance issues with leachate management systems. • Operating and monitoring techniques for landfill gas extraction systems. • Gas condensate, its consequences and its management. • Regulatory requirements for landfill gas. • Landfill gas flares and their operation. • Equipment for monitoring landfill gas.
c. Comply with regulatory and permit requirements for closed landfill sites.	• Regulatory requirements for landfill closure. • Regulatory requirements for landfill post-closure care.
d. Develop post-closure use options.	• Options for post-closure use of old landfills. • Safety concerns for public use of old landfills.

Table 10. Required Knowledge and Understanding for Job Domain 9

Job Domain 9: Comply with regulatory and permit requirements.	
Specific Domain Task	**To be qualified for the given task, an individual should have understanding or knowledge of:**
a. Understand regulatory and permit requirements.	• The federal regulations pertaining to solid waste landfills. • State and local regulations pertaining to solid waste landfills. • Regulatory permits and the permitting process. • Government agencies that regulate solid waste landfills.
b. Operate landfill to meet regulatory and permit requirements.	• The federal regulations pertaining to solid waste landfills. • State and local regulations pertaining to solid waste landfills. • Typical conditions contained in a landfills operating permit.
c. Maintain records and submit reports to meet regulatory and permit requirements.	• The federal regulations pertaining to solid waste landfills. • State and local regulations pertaining to solid waste landfills. • Typical recordkeeping requirements contained in a landfills operating permit.
d. Coordinate compliance inspections and address concerns raised in inspections.	• The federal regulations pertaining to solid waste landfills. • State and local regulations pertaining to solid waste landfills. • The compliance inspection process. • Operator requirements in the compliance inspection process.

Table 11. Required Knowledge and Understanding for Job Domain 10

Job Domain 10: Perform necessary accounting and recordkeeping.	
Specific Domain Task	**To be qualified for the given task, an individual should have understanding or knowledge of:**
a. Collect and maintain waste receipts and tonnage records.	• The importance of tracking waste tonnage.
b. Collect and maintain other facility data.	• Types of information and data that are required to be maintained under the regulations. • Types of information and data helpful for a landfill operator to maintain.
c. Perform basic landfill economic calculations.	• Tipping fee calculations. • Equipment economics. • Landfill design and permitting costs. • Landfill construction costs. • Landfill operation costs. • Costs associate with closure and long-term care.

Table 12. Required Knowledge and Understanding for Job Domain 11

Job Domain 11: Employ appropriate safety and contingency measures for employees, customers and visitors.	
Specific Domain Task	**To be qualified for the given task, an individual should have understanding or knowledge of:**
a. Develop and maintain appropriate safety and contingency measures.	• Regulatory requirements for safety and contingency plans. • The basic elements of a safety plan. • Basic elements of a contingency plan.
b. Perform necessary recordkeeping to comply with safety and contingency requirements.	• Recordkeeping requirements for safety and contingency plans.
c. Provide training to employees and other parties on safety and contingency measures.	• Training requirements for safety and contingency measures.

Table 13. Required Knowledge and Understanding for Job Domain 12

Job Domain 12: Communicate with landfill employees, customers, regulatory officials, neighbors, and others.	
Specific Domain Task	**To be qualified for the given task, an individual should have understanding or knowledge of:**
a. Effectively communicate with landfill employees.	• The importance of effective communication. • Ways to communicate effectively.
b. Effectively communicate with landfill customers.	• The importance of effective communication. • Ways to communicate effectively.
c. Effectively communicate with senior management, regulators, and consulting engineers.	• The importance of effective communication. • Methods for effective communication.
d. Effectively communicate with landfill neighbors and the general public.	• The importance of effective communication. • Ways to communicate effectively.