JOB DEMANDS ANALYSIS

Company: Greater Vancouver Regional District **Location:** Lion's Gate

Job Title: Sewer – Wastewater Mechanic **Classification:**Regular Duty

Purpose of Activities

The purpose of the duties of the Sewer Plant Mechanic is to carry out repairs and maintenance of equipment in the wastewater plant.

Tools and Equipment

The labourer will use the following tools and equipment to perform their duties:

- Gloves.
- Safety Hat
- Safety Boots.
- Safety Vest.
- Shovels, rakes, broom and other hand tools.
- Wheelbarrow.

Usual Methods

The job varies substantially from day to day as they may be involved in smaller routine maintenance tasks or the installation or removal of pumps or engines. They also spend large blocks of time in the repair shop disassembling, repairing and rebuilding a variety of mechanical pieces. They would spend no more than 30 minutes a day engaged in seated paperwork related duties such as estimating part requirements. They can be seated for brief periods of time when working at benches. They are working with a variety of tools throughout the day ranging up to a 48" pipe wrench. Many of the larger tools are made from aluminum which significantly reduces their weight and improves their ease of handling considerably. However, they may have to use large, heavily leveraged tools such as a pipe wrench in very awkward positions. These positions can include extended kneeling or crouching in addition to reaching and considerable spinal flexion. Almost all of the pumps and engines are positioned at knee level from the floor. In order to work on these, the workers' are required to kneel or crouch for long periods of time.

They can be required to assist in lifting or guiding heavy sections of pipe or other related materials. Much of the day can be spent walking in the plant, climbing ladders and scaffolding, working around large obstructions and kneeling with large tools. Many of these tasks are accomplished with the use of a variety of rigging systems to assist in lifting and holding loads.

Administrative Issues

Typically they work an eight - hour day from Monday to Friday. Most of the work is conducted indoors (outdoors as well) and can include exposure to raw sewage and the risk of dangerous gases (such as H2S). They have assistance of labourers for some heavy tasks.

Activity Demand Variables

These variables are tasks that must be carried out by the employee and are implicitly or explicitly required as objectives of the job.

- Work in some confined spaces.
- Walk over concrete and stairs.
- Climb up and down ladders.
- Carry out some tasks under unpredictable outdoor conditions that often include steady rainfall.
- Exposure to sewage.
- Awkward machines located close to the floor or overhead

Worker Decision Variables

These variables are the sub-routines and cognitive/physical decisions made by the worker in carrying out the objectives of the job.

- Choose postures for carrying out duties (e.g. lifting using hips and maintaining neutral spine, creative energy saving techniques).
- Planning of lifts and routes for carrying (limited).

Accommodative Considerations

1. Individual with spinal related problems may have difficulty with the crouched and stooped postures as well as with lifting activities.
2. Upper extremity problems including the hand and wrist would be difficult to accommodate because of constant gripping and tool manipulation with force.

3. Individuals recovering from systemic illness should be carefully screened before entering this activity.
4. Individuals who do not cope well in outdoor work environments or confined spaces would have difficulty with this position.
5. There is a serious learning curve associated with the tasks.

Prepared By: Greg Hart, Kinesiologist March, 1999

Summary of Stresses

Metabolic Stresses

These stresses can be highly variable with the majority of power being supplied through the aerobic energy system in reasonably fit individuals. Duties such as walking, sitting, crouching and kneeling would predominantly draw energy from this system. There is no prolonged elevated aerobic requirements such as would be evident in an Outside Postal Worker. Many activities require high levels of force production from a variety of muscle groups to pull on wrenches, to lift and move parts or to climb ladders. The power for these requirements would be primarily derived from the anaerobic metabolism and can be drawn upon frequently through the day for brief (usually less than 45 seconds) periods of time.

Structural Stresses

There are a number of high risk exposures to the physical structures of the body in this job. Some are related to movement and some are related to postures.

Spine

There is obvious exposure to most of the spine, but more specifically to the lumbar and thoracic regions. This exposure can come from several different possibilities. The first is high anterior disc compression from flexed postures that can include supporting high loads great distances from the body in awkward locations. The second possibility is that of prolonged strain on the spinal ligaments from working in a kneeling position. This increases instability of the structures over time. A third possibility is a sudden shearing force when lifting or moving a heavy object or when a wrench pops off of a bolt. The last aspect is rotating motions which can occur in combination with the previous factors. This exposes the facet joints of the spine to damage as well as weakening the disc fibre integrity. If proper lifting technique is observed when lifting is required in comfortable spaces, the risk to the spine will be minimal even if the loads are high. There is severe postural stress in carrying the toolbox which can weigh up to 35 kilograms. Since it is a one arm carry, the opposite side of the body is forced to compensate for the uneven loading, placing severe lateral compression on the spine and possibly interfering with normal neuromuscular spinal control if it occurs frequently enough.

Shoulder and Upper Extremity

The shoulder joint has to contend with sustained flexed and abducted postures under occasionally high load. The result is considerable joint instability with high joint

compression and ligament strain in addition to probable temporary supraspinatus impingement from time to time.

The muscles of the forearm and wrist are required to produce frequent and often constant moderate to maximal grip forces. This combined with the often pronated or deviated position of the joint can lead to carpal tunnel stress and tedinitis even previous to that. The elbows would be at particularly high risk of developing epicondylitis from the constant mechanical strain on the muscles and tendons that originate there.

Knee and Ankle

The knee absorbs considerable compressive stress in kneeling and crouching postures. Kneeling can place high loads against the patella (kneecap) when it is unsupported and the knee joint is 'open'. Crouching loads the ligaments in the joint past the critical stress limits of the connective tissue and can contribute to increased joint laxity over time. Anterior knee pain and the development of patello-femoral syndrome are likely in these individuals. Arthritic changes can also be expected in most workers.

The ankle joint is required to stabilize the body in balanced positions on ladders and pipes and in all joint directions. It is particularly vulnerable on the lateral aspect to sudden inversion of the foot on uneven surfaces.

INTERVENTIONS

1. Recommendations that could be implemented to increase productivity and lessen the risk of injury are listed below:

2. Every effort should be made to provide tools that are light and easy to use because of the awkward positions frequently encountered in the job. In addition care should be taken to improve grip sizes to as close to individual optimal sizes to maximize force transfer and reduce forearm flexor strain.

3. Mechanical assists should be utilized wherever possible to reduce dangerous loading in awkward spaces. Continued education in rigging techniques is vital.

4. Educate employees relative to creative movement technique to help limit exposures to unmanageable physiological stress.

5. Splitting tools across two boxes would balance the load on the spine substantially when carrying the toolbox(es). One in each hand.

6. Providing a small dolly will be helpful in transporting tools over large distances.

7. Provide gloves that offer the required protection with minimal interference in sensation.

8. Adjustable lift tables should be supplied in the Repair Shop so that the equipment is always being worked on at the appropriate level. This would remove a considerable amount of kneeling and forward spinal flexion from the job. It would also improve force transfers to the tools from the body, decreasing the strain on the workers' elbows.

9. Knee pads should be provided to all workers to reduce heating and compression of the knee joint.

10. Active whole body conditioning would be the best protection against injury as the nature of the job places many unmanageable stresses on many structures. Ensuring that the tissue is strong and flexible and that energy delivery is efficient would be a critical recommendation.

11. The final recommendation involves moving from the sedentary activities of sitting or standing to a labour intensive task. Time should be taken to put the muscles and joints of the torso, hip and shoulder region through a full range of motion and to increase muscle and joint temperatures. This insures adequate preparation of body structures to effectively and safely participate in the required activities.

Referral: Keith Arkell	Organization: GVRD								Title: Wastewater Mechanic
Dept.: Engineering	Division: Sewers								Contact: Iain Sellars
			FREQUENCY*						Date: March, 1999
PHYSICAL DEMANDS	REQD	SIDE	Sel 1	Low 2	Mod 3	High 4	Max. Weight (kg)	Usual Weight (kg)	COMMENTS
STRENGTH	Lifting - Floor to Knuckle		B			X		75	20	Tool kit, fittings, pumps, motors, pipe
	Lifting - Knuckle to Waist		B			X		75	10	Motors, toolkit, pipe, come-along
	Lifting - Waist to Shoulder		B			X		35	5	Fittings, rigging equipment and tools
	Lifting - Over Head		D			X		20	arm+	Fittings, rigging equipment and tools
	Carrying - With Handles		B			X		30	30	Toolbox (one arm) < 1000 metres
	Carrying - Without Handles		D			X		35	5	Parts < 50 metres
	Pushing - Upper Extremity		B				X	55	20	Wrenches and tools, chains on rigging
	Pushing - Hip/Leg Assist		B			X		100	40	Wrenches, motors (some suspended)
	Pulling - Upper Extremity		B				X	55	20	Wrenches, parts, comealong
	Pulling - Hip/Leg Assist		B			X		100	40	Chain on come-along or on wrenches
	Reach - Shoulder or Above		D		X			arm +	arm +	Overhead repairs and installations
	Reach - Sho. or Above extnd		D		X			arm +	arm+	Sustained in awkward locations
	Reach - Below Shoulder		B				X	35	arm+	Accessing tools, around fittings etc.
	Reach - Bel. Shoulder extnd		B			X		35	low	Reaching around large equipment
	Handling		B				X	max.	mod	Tools, parts, pipe, hoses. .
	Gripping		B				X	max.	high	Tools (especially wrenches), parts
	Fine Finger Movements		B			X		high	low	Small bolts/nuts, cleaning +adjustment
ENRG	Aerobic (percent)						70	Walking, light climbing, standing, low level tool work		
	Anaerobic (percent)					30		Full body exertion in lifting, pull/pushing, climbing		
	High Energy Expenditure					X		Const. moving with freq. full body activity		
	Low Energy Expenditure				X			Walking, desk work, travelling		
POSTURE+MOBILITY	Neck - Static Flexion						X	Most repair tasks (sustained up to 10 min/time)		
	Neck - Static Neutral						X	While walking, standing		
	Neck - Static Extension				X			Can be prolonged when working overhead		
	Neck - Rotation		B				X	Normal movement and see around objects		
	Throwing		D		X			Chains or cables over pipes for rigging (< 5 m)		
	Sitting				X			Infrequent, when in travelling, on break or desk work		
	Standing						X	Almost always and on concrete surfaces		
	Walking						X	Almost always over concrete, grass, metal pipes		
	Running/Jumping				X			Over obstructions, on/off ladders (< 1m)		
	Climbing - Arms and Legs				X			Ladders and scaffolding		
	Climbing - Legs Only					X		Stairs and step up onto raised areas		
	Bending/Stooping						X	Working on almost all tasks in shop and plant		
	Crouching						X	Most tasks are close to ground level		
	Kneeling						X	Tasks at ground level, very prolonged at times		
	Crawling			X				Into and out of confined spaces		
	Twisting				X			Working around some awkward equip., in/out con. space		
	Balancing				X			On ladders and pipes		
GENERAL	Traveling				X			Around plant in truck, bike, occ. to Fish Crk./lift stations		
	Work Alone					X		Dependent on job		
	Interact with Public			X				Rare except on tours or driving off-site		
	Operate Equip/Machinery					X		Valves, motors, welding equip., rigging, SCBA		
	Irregular/Extended Hours			X				In emergencies		

* Frequency Legend 1 = Seldom; Not Daily 2 = Low Daily Activity; < 1hr
3 = Moderate Demand; Repetition 1 - 3 hrs daily 4 = High Frequency Demand; Repetition > 3 hrs daily

The following shading denotes a HIGH RISK TASK: Modifications should be considered

REQD is marked with an X if the particular demand or category is relevant to the purpose of the job.

SIDE refers to the side or limb required to execute a task. If it is marked **E**, it indicates either side, the most common choice is listed first. **D** refers to dominant and **B** to both sides.

Referral:	Organization:	Title: see 1st page header
Dept.:	Division:	Contact:
	FREQUENCY*	Date:

	PHYSICAL DEMANDS	REQD	SIDE	Sel. 1	Low 2	Mod. 3	High 4	COMMENTS
	Hearing - Conversations	■	B				X	Communicating with co-workers
P	Hearing - Other Sounds	■	B				X	Pumps, motors, alarms etc
E	Vision - Far	■					X	Most tasks
R	Vision - Near	■				X		Small, detailed adjustments
C	Vision - Colour	■					X	Pipes, motor wiring are colour coded
E	Vision - Depth	■					X	Judging distance, often in poorly lit areas
P	Perception - Spatial	■					X	Need to understand relative object position
T	Perception - Form	■				X		Differentiate between fittings and tools with small diff.
I	Feeling (Tactile)	■					X	Grip adjustment through gloves
O	Reading	■			X			Work orders, signs
N	Writing	■			X			Minor notations and reporting
	Speech	■					X	Communicating with co-workers
	Inside Work	■					X	Buildings, tunnels, occ. digester, underground
	Outside Work	■			X			Moving between buildings, outside repairs, lift stations
	Hot Conditions >25 deg. C	■				X		Depending on the part of the plant, varies
	Cold Conditions <10 deg.C	■		X				Outside work during winter
	Humid	■		X				Occasionally
W	Dust	■			X			Plant is very clean, just in some confined areas
O	Vapor Fumes	■				X		Exhaust, sewage (H2S,Meth.)
R	Hazardous Machines	■				X		Pumps, motors, crane, fans, mechanical skimmers etc.
K	Proximity to Moving Object	■			X			Forklift, floor scrubber, overhead crane, trucks, bikes
	Noise	■					X	Varies to above 110Db (protection req'd)
E	Electrical Hazard	■			X			Working with motors
N	Sharp Tools	■			X			Cutting tools, exposed metal and fragments
V	Radiant/Thermal Energy	■					X	Motors, pipes, pumps, welding equip.
I	Slippery Conditions	■				X		Working in wet areas, near leaks etc.
R	Vibration and Related	■			X			Hose, hammer
O	Chemical Irritants	■				X		Cleaners
N	Organic Substances	■					X	Raw or partially processed sewage
M	Medical Waste			X				Possible at headworks
E	Blood Products			X				Unlikely, although technically possible
N	Congested Worksite	■				X		Many confined areas - training req'd
T	Lighting - Direct						X	Overhead incandescent, daylight
	Lighting - Indirect	■					X	Reflected light
	Lighting - Adjustable				X			Portable lighting
	Lighting - Fluorescent					X		Some fixtures in different work areas
	Lighting - Incandescent						X	Overhead
	Lighting - Shadows etc.	■					X	Everywhere due to obstructions

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For detailed descriptions of each of the different categories, please refer to the reference guide or inquire with Human Effort at 1-888-4EFFORT