

TASK ANALYSIS WORKSHEET

Company: The Corporation of Delta Department: Construction
 Job Title: Labourer (crew of 4 + backhoe driver & foreman) Date: July 18 & 19, 2002

Job Summary:	Tasks & Description of Activities	Frequency	Duration
<p>Job Summary: Water pipe Installation (Hwy 10). Laying 12 inch (30.5 cm) x 6 meter long blue plastic pipe. On average, 4-5 pipes are installed per hour (33 to 40 per day). Job tasks are similar for sewer pipe installation. The 12 inch pipe is lifted, transported and lowered by the backhoe. Pipes 8 inch (20 cm) or less are lifted and handled by hand, therefore, physical demands related to forces (shoveling, lifting, pushing, and pulling) will increase when using 8 inch (20 cm) pipe or less. The Excavator (contractor) digs the ditch approximately two pipe lengths ahead of the labourer(s). A protective cage or shoring was not used in this job as the ditch depth was less than 1 meter. Other associated construction tasks included: loading/unloading trucks, installation of blow-out valves, new hydrants and water meters, installation of protective fencing (unusual task), and use of tamping machine (not observed).</p> <p>Note: <i>Backhoe and Excavator (small) job assessment are performed separately</i></p>	<p>1. Pipe preparation for pick-up (1 Worker)</p> <ul style="list-style-type: none"> • Roll (6 meter) pipe into position • Number the pipe (with pen) • Position hoist strap around pipe • Attach hoist strap to backhoe • Walk behind backhoe guiding the pipe at one end to prevent swinging or dragging <p>2. Install air valve saddles at specific locations</p> <ul style="list-style-type: none"> ▪ Attach saddle fitting ▪ Secure with wrench <p>3. Measuring ditch depth (1 Worker)</p> <ul style="list-style-type: none"> • Measuring stick • Laser positioning (auditory signals) • Constant vigilance of ditch depth 	<p>5 times an hour (average)</p> <p>average 2 x day</p> <p>Continuous (430 minutes/shift)</p>	<ul style="list-style-type: none"> ▪ 3 minutes per pipe ▪ 15 minutes each hour ▪ 25% of shift ▪ 10 – 15 minutes ▪ 20 to 30 min. per shift ▪ 7% shift ▪ >66% of shift

Department/Work Area: Engineering Operations, Construction **Occupation:** Labourer
Specific Location: Highway 10, Water Line Installation **Contact Name:**
Assessed By: B. De Jong **Assessment Date:** July 18th & 19th, 2002

Description of work area: Grassy area alongside a two lane highway. Ditch dug to approximately 2 feet deep. Roadside flat with 10-15 degree shoulder slope. Weather sunny, dry, temp. 20-25 degrees Celsius.
Hours of Work/Shift Schedule: 7:00 a.m. to 2:30 p.m. (when shift hours are extended to 10 hours it will increase the task duration)
MSI signs / symptoms noted: back, neck, shoulder and knee

Tasks for Ergonomics Risk Assessment (from Task Analysis worksheet):		Frequency / Duration of Task:
1. Pipe Preparation (for pick-up)		3 minutes per pipe
2. Install Air Valve Saddles		20-30 min. / shift
3. Measuring ditch depth		> 66% of shift
4. Ditch Preparation and Pipe Laying		2 minutes per pipe
5. Hose		5 minutes duration
6. Compacter		25-56% of shift

Task	Risk Factors	Freq/Dur	Mag/Range	Assessment	Assessment/Observations/Comments
1. Pipe Preparation	Awkward Posture: <ul style="list-style-type: none"> ▪ Back flexion ▪ Neck extension ▪ Shoulder flexion ▪ Shoulder abduction & rotation ▪ Knee bending when squatting 	3 minute duration 25% / shift	Dynamic (<30 sec.) <ul style="list-style-type: none"> ▪ Back flexion 45 - 90° ▪ Neck extension 20° ▪ Shoulder flexion 90-120° ▪ Shoulder abduction 45° 	Assessment	<ul style="list-style-type: none"> ▪ Forward bending of back to roll pipe (20" from ground), write # on pipe, attach hoist strap around pipe and to shackle strap to backhoe. ▪ Bending neck back or upward to visualize shackle hook on backhoe. ▪ Reaching forward with both arms to attach hoist strap and secure to backhoe. ▪ Reaching to side (usually left) to guide pipe results in moving the shoulder away from the body and rotation. ▪ Walking a variety of distances along side the backhoe on uneven ground. <p>The dynamic nature and frequency and duration of the tasks do not exceed ergonomic guidelines. Exposed to risk of slips/trips or falls.</p>

Identification	Task	Risk Factors	Freq/Dur	Mag/Range	Assessment	Assessment/Observations/Comments	
	Pipe Preparation continued...	Force: <ul style="list-style-type: none"> ▪ Pushing pipe (rolling on ground) ▪ Lifting one end of pipe to position 	< 1 hr. per day	Push force: 20kg. initial Lift weight: 17 kg.	Assessment	<ul style="list-style-type: none"> ▪ 20 kg. initial push force required to roll pipe. This is within recommended guidelines (Snook) of 33 kg. for hands 25" from ground, 1 push every 5-30 min., <2.1 meter distance. ▪ Weight limit for this task is 32kg. lifted near the body from below the knee height with no twisting. The 17kg. lift is within recommended guidelines (Worksheet B). Not considered repetitive work.	
		Repetition: <ul style="list-style-type: none"> ▪ Performs a variety of movements 	< 2 hr per day				
		Grip Force: <ul style="list-style-type: none"> ▪ Grasp hoist strap ▪ Grasp end of pipe 	< 2 hr. per day	<ul style="list-style-type: none"> ▪ Power grip ▪ Pinch grip 			<ul style="list-style-type: none"> ▪ Pinch grip an object weighing > 1 kg. with wrist extended. ▪ Power grip an object weighing > 5 kg. with wrist extended. The dynamic nature and frequency and duration of the task do not indicate this as high risk for grip force.
	2. Install air valve saddles	Awkward Posture: <ul style="list-style-type: none"> ▪ Back flexion ▪ Neck flexion ▪ Shoulder flexion ▪ Shoulder abduction & rotation ▪ Knee bending when kneeling or squatting 	10 – 15 min. for 20 to 30 min. / shift	Static (>30 sec.) <ul style="list-style-type: none"> ▪ Back flexion 30° ▪ Neck flexion 45° ▪ Wrist flexion 45° ▪ Shoulder flexion 45-90° ▪ Shoulder abduction >45° 		<ul style="list-style-type: none"> ▪ Sits on end of pipe or squats or kneels on ground beside pipe. ▪ Static neck and back flexion ▪ Static shoulder flexion ▪ Dynamic shoulder abduction and rotation when using wrench. ▪ Wrist flexion with power grip on wrench. Grip force not indicated as a risk due to the low frequency and duration. The frequency and duration of the tasks does not exceed ergonomic guidelines. Able to pause and change position as required.	

Task	Risk Factors	Freq/Dur	Mag/Range	Assessment	Assessment/Observations/Comments
3. Measuring Ditch Depth	Awkward posture: <ul style="list-style-type: none"> ▪ Neck flexion & extension ▪ Shoulder flexion ▪ Knee bending when climbing 	Continuous > 66% shift	Static (>30 sec.) <ul style="list-style-type: none"> ▪ Standing ▪ Neck flexion 30° ▪ Neck extension 30° ▪ Shoulder flexion 45° 		<ul style="list-style-type: none"> ▪ Stands holding measuring stick away from body with alternate hands. ▪ Occasionally moves laser guide (every hour) ▪ Looking downward at pipe bed. ▪ Looking upward at excavator and signals with alternate hands. ▪ Climbing in and out of ditch on uneven ground. Physical effort would be considered high (Eastman Kodak) for standing > 50% of shift and the effort of using visual or auditory requirements with restricted head and neck posture. May lead to overall physical and mental fatigue. Exposed to risk of slips/trips or falls.
4. Pipe Laying	Awkward Posture: <ul style="list-style-type: none"> ▪ Neck flexion (static) ▪ Neck extension (dynamic) ▪ Back flexion (static) ▪ Back twisting (dynamic) ▪ Shoulder flexion (dynamic) ▪ Shoulder abduction ▪ Wrist flexion ▪ Knee bending when climbing 	<ul style="list-style-type: none"> ▪ 2 min. duration ▪ 17% shift 	<ul style="list-style-type: none"> ▪ Neck flexion 30° ▪ Neck extension 45° ▪ Back flexion 90° ▪ Back rotation 30 to 50° ▪ Shoulder flexion 90° ▪ Shoulder abduction 90° ▪ Wrist flexion >30° 		<ul style="list-style-type: none"> ▪ Excavator or backhoe drops specified amount of gravel into ditch and levels it. ▪ Uses shovel to scrape or spread gravel into place. ▪ Shoulder flexion and abduction and back flexion and twisting occur during this process. ▪ Uses brush to clean out pipe end already in ditch, applies lubricant with brush results in back bending, shoulder reaching, wrist bending. ▪ Directs backhoe to lower pipe results in neck bending back, shoulder reaching. ▪ Applies lubricant results in shoulder reaching, wrist bending ▪ Back and neck bending while directing excavator to push pipes together. ▪ Back and neck bending and shoulder reaching forward and to the side to remove hoist strap and hand to co-worker. ▪ Climbing in and out of ditch on uneven ground. Physical effort would be considered high (Eastman Kodak) for standing > 50% of shift and the effort of using visual or auditory requirements with restricted head and neck posture. In addition to other awkward postures (shoulder and back) may lead to overall physical and mental fatigue. Exposed to risk of slips/trips or falls.

Task	Risk Factors	Freq/Dur	Mag/Range	Assessment	Assessment/Observations/Comments
Pipe Laying continued...	Force: <ul style="list-style-type: none"> ▪ Shoveling gravel ▪ Power grip 	< 30 sec. duration every 5 to 10 min. < 2 hr. shift	Weight could vary from <1 to 50 kg. (PJDC–GVRD)		<ul style="list-style-type: none"> ▪ Shovel dirt and gravel for short durations. Uses scraping motion (push and pull of gravel) to smooth pipe bed. ▪ Power grip with wrists bent upward and downward. May experience local muscle fatigue, including postural fatigue from forward bending. The risk decreases when the height the shovel is raised is minimal. Recovery time of 5 to 10 min., and the short duration time the task is performed will minimize the risk (Eastman Kodak). If increased shoveling occurs and in combination with awkward postures may exceed ergonomic guidelines.
5. Hose	Repetition: <ul style="list-style-type: none"> ▪ Performs a variety of movements Awkward Posture: <ul style="list-style-type: none"> ▪ Back flexion ▪ Neck flexion ▪ Shoulder flexion ▪ Ulnar deviation ▪ Back twisting 	Pauses between movements < 2 hr per day Varies Every 5 minutes for duration of 5 min. 38% shift	Static: <ul style="list-style-type: none"> ▪ Back flexion 15° ▪ Neck flexion 15° ▪ Shoulder flexion 30-45° ▪ Wrist deviation 30° ▪ Back twisting up to 45° One coil = 5 kg. Pull force 14 kg. (300 feet of wet hose)	Not considered Repetitive Work	<ul style="list-style-type: none"> ▪ Holds hose under one arm and moves legs back and forth while spraying, frequent trunk rotation. ▪ Wrists bend to side while grasping hose. ▪ Activity shared between workers. Shoulders may be at risk of injury. The back may be at risk of injury when twisting motion is used. Exposed to risk of slips/trips or falls.
	Force: <ul style="list-style-type: none"> ▪ Lifting hose ▪ Pulling hose 	Lifts up to 12 x per hour (once every 5 min.)			<ul style="list-style-type: none"> • The weight of empty coiled hose is within the recommended weigh limit. (27.2 kg. if a twist occurs, WCB, worksheet B). ▪ Pull force: the limit value of a 15.2 meter pull (drag) of hose, every 30 min. at a 64 cm hand height is 19 kg. (sustained) and 29 kg. (initial). The 14 kg. pull force measured is within the recommended limit values (Snook).

Task	Risk Factors	Freq/Dur	Mag/Range	Assessment	Assessment/Observations/Comments
<p>Hose continued...</p>	<p>Grip Force:</p> <ul style="list-style-type: none"> ▪ Power grip 	<p>Varies Every 5 minutes for duration of 5 min. 38% shift</p>	<p>Power grip with wrist deviation.</p>	<p style="text-align: center;">Assessment</p>	<ul style="list-style-type: none"> ▪ Unable to measure grip force required when water pressure at full force. ▪ Water cold <p>May be at risk of arm and wrist injury due to grip force with a bent wrist. Risk may be compounded by cold water temperatures.</p>
	<p>Repetition:</p> <ul style="list-style-type: none"> ▪ Performs a variety of movements 	<p>Varies Every 5 minutes for duration of 5 min. 38% shift</p>	<p>Performed with wrists bent.</p>		<ul style="list-style-type: none"> ▪ May perform the task with little or no variation with wrists deviated or bent for more than 2 hours per day. <p>Considered repetitive work if performed by one person.</p>
	<p>Contact Stress:</p> <ul style="list-style-type: none"> ▪ Grasp hose with bare hands. 	<p>Varies Every 5 minutes for duration of 5 min. 38% shift</p>	<p>Power grip Cold water</p>		<ul style="list-style-type: none"> ▪ May experience contact stress on palms of hand. Increased discomfort with cold water.

Task	Risk Factors	Freq/Dur	Mag/Range	Assessment				Assessment/Observations/Comments
<p>6. Driving Compacter</p> <p>Note: the seat measurements are within recommended guidelines for industrial vehicles (Humanscale)</p>	<p>Awkward Postures:</p> <ul style="list-style-type: none"> ▪ Shoulder flexion (rt.) ▪ Neck rotation ▪ Neck flexion ▪ Back rotation ▪ Back flexion 	<ul style="list-style-type: none"> ▪ 15-30 minutes (average) ▪ 25 – 56% shift 	<p>Static:</p> <ul style="list-style-type: none"> ▪ Reach of 13 to 16 inches ▪ Neck rotation > 45° ▪ Neck flexion up to 30° ▪ Back flexion 20° ▪ Back rotation up to 45° <p>Dynamic:</p> <ul style="list-style-type: none"> ▪ Back rotation up to 30° 					<ul style="list-style-type: none"> ▪ This task may require more constant work based on the job requirements. ▪ The reach to the right hand control ranges from 13 to 16 inches based on the range of seat adjustment (Bodyspace). This is within recommended guidelines of a 14 to 16 inch reach to the primary hand control or wheel (Humanscale). ▪ The seat has air compression to reduce jarring to the spine. ▪ The seat does not have adjustable lumbar support or height adjustment for individual heights. ▪ Good visual field, however, the job task requires focused visual viewing of the ground which requires static neck (>60° viewing range) and back bending and rotation. <p>May experience neck and upper and lower back fatigue or pain. This may be exacerbated by jarring movements and vibration.</p>
	<p>Vibration:</p> <ul style="list-style-type: none"> ▪ Whole Body 	<ul style="list-style-type: none"> ▪ 15-30 minutes (on average) ▪ 25– 56% shift 	<p>Unable to measure</p>					<ul style="list-style-type: none"> ▪ Vibration can occur at many different frequencies and in different directions. The effects depend on factors such as the nature, duration of exposure, posture, work-rest ratios and individual susceptibility. <p>Low back pain has been associated with whole-body vibration.</p>
	<p>Grip force:</p> <ul style="list-style-type: none"> ▪ Right hand power grip 	<ul style="list-style-type: none"> ▪ 15-30 minutes (on average) ▪ 25– 56% shift 	<p>Power Grip</p>					<p>The hand controls (ball) meet recommended guidelines for hand grip.</p>
	<p>Repetition</p>	<ul style="list-style-type: none"> ▪ 15-30 minutes (on average) ▪ 25– 56% shift 						<p>Would be considered repetitive if performed for >50% of shift.</p>

SUMMARY

In review of the Corporation of Delta's musculoskeletal injury (MSI) analyses (2001); Construction experienced 4.17% of the MSI WCB claims over a 3 year period. A 75% increase in MSI's was noted for the year 2000. The Labourer and Pipe layer accounted for 90% of the Construction MSI's. Lifting, stretching and twisting accounted for 50% of the injuries followed by fall/slip, repetitive strain, caught in between, struck by or struck against each at 10% apiece. Of these injuries the back (30%), neck (20%), hand/wrist (20%), arm (10%), ankle (10%), and groin (10%) were affected.

In general the risk factors for the Construction crew are related to static and dynamic awkward postures (back, neck, shoulder, wrist), forces related to lifting, shoveling and grasping (back, neck, shoulder, hand/wrist) and climbing or balancing on uneven ground (knee, hip, ankle). The injuries noted for Construction are comparable to the risk factors identified.

New crew members who have not acclimatized to the physical demands of work may be at an increased risk of injury. All crew members are at a higher risk of injury in the morning hours when they may not be physically prepared or warmed up prior to performing physically demanding work. This was demonstrated in the Corporation of Delta's musculoskeletal injury (MSI) analyses (2001) report where 55% of MSI WCB claims occurred in the AM.

The level of risk should be re-evaluated in conjunction with increased frequency and duration of the job tasks. Therefore if the shift duration extends the risks may increase or if job tasks with identified risk factors increase in frequency and duration e.g. Hose or Compactor work, the risk of injury may increase.

CONTROLS

Recommendations for control of identified risk factors will focus on methods to minimize risk. The Construction Labourer position performs heavy physical labor in varying climates and conditions. This assessment only reviewed the water line construction project; however, other tasks or jobs appear to be similar in nature in regards to required body positions and forces, e.g. installing blow out valve, installing hydrant, use of cutting saw etc. and can be evaluated using this report as a guide. Note: the Tamper was not in use during this assessment; body postures, force and vibration risks will be present during the use of this machine. Duration and repetition of use will need to be considered.

*Control Priority Note: 1 = recommended for implementation to reduce risk factors; 2 = optional, for consideration as a means of reducing risk factors; 3 = not for immediate action but for future consideration as appropriate.

Risk Factor	Recommended Controls	Control Priority*	Responsible Person	Status
Endurance for physically demanding work	Maintain an increased level of fitness focusing on cardiovascular and muscular endurance and muscular flexibility. This is especially important for new crew members who may not be acclimatized to the demands of work.	2	Employee	
Preparation for all physically demanding work	Develop a physical warm up program and train workers (through the use of certified fitness instructors) specific to the demands of the job. Workers should perform this warm up prior to the start of the day and before resuming work following >30 min. breaks. The duration of the warm up is less than 10 min. Micro stretches should also be performed following static, awkward postures e.g. neck bending.	2	Superintendent / Safety Dept.	
Awkward Postures and Force related to pipe laying activities	Utilize the backhoe where ever possible to lift pipes or other heavy parts or equipment (e.g. cages). When lighter weight pipes are being handled, workers should ask co-workers for assistance. The length and weight of the pipe creates an unstable load to be handled by one person.	1	Superintendent	
Tool and equipment	Ensure all tools and equipment are in good shape and repair. Static forces will increase if tools and equipment require more work or repetition of work due to poor maintenance including cleaning. Evaluate tools and equipment when being replaced to ensure the weight and design (e.g. grip) will reduce the workload (e.g. shovels, hammers, mallets, wrenches).	1 3	Superintendent	
Awkward and Static Postures	Consider job rotation every two hours for the Pipe Preparation, Ditch Measuring, Pipe Laying, Hose and Compactor positions. For example, the dynamic nature of the Pipe Preparation tasks can offset some of the static requirement of the Pipe Laying or Measuring tasks providing a distribution of workload and a break from static loading and fatigue.	1	Superintendent	

Risk Factor	Recommended Controls	Control Priority*	Responsible Person	Status
Vibration	<p>Ensure that regular compactor maintenance is done to reduce vibration and shock from jolting. The seat compression function is an important design that may require ongoing maintenance.</p> <p>Evaluate any new compactors being purchases as to seat design and vibration reduction. All manufacturers are required to perform vibration testing and provide an assessment by WCB and ISO standards.</p>	2	Superintendent	
Overall risk factors	<p>Provide education related to identified risk factors and methods of working to reduce risk e.g. neutral joint positions, leg position, reduction of twisting etc.</p>	3	Superintendent	
		1	Superintendent	

References:

- GVRD Job Demand Analysis for Pipe layers – Sewers – Construction (The Corporation of Delta), 1999
- Humanscale (1990) Body Measurement, Hand Grip, Human Strength and Seating Guide
- Eastman Kodak (1986), Ergonomic Design for People at Work, Volume 1 and 2
- Steven Pheasant, Bodyspace (1996), Anthropometry, Ergonomics and the Design of Work,
- WCB of BC, Worksheet A, Risk Identification and Worksheet B, Risk Assessment.
- NIOSH Lifting Guidelines (1991)
- Snook Push / Pull Guidelines

Prepared by: Brenda De Jong, August 23, 2002