LAKEWAY MUNICIPAL UTILITY DISTRICT

SAFETY MANUAL

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Preface and Credits

This Safety Manual has relied heavily on "Safety and Health in Waste Water Systems" prepared by Water Environment Federation and "Chlorine Safety Manual" prepared by New York State Emergency Response Commission.

This manual has been prepared for Lakeway Municipal Utility District (hereinafter referred to the District) and intended to cover all operations of District facilities; water pumping, treating, distribution, and wastewater collection, treating and recycling.

Preamble

This manual is intended to set forth practices and procedures for the safe operation of all District equipment and facilities. Every condition or circumstance cannot be identified or anticipated, therefore, this manual needs to be updated frequently as regular safety inspections, and/or the occurrence of an accident identifies a new danger.

Safety of District employees is the primary objective. Protection of the public and protection of contractors and other people working for the District or just working in the vicinity of District facilities is an important part of the District safety program.

The General Manager of the District shall have the primary responsibility for the safe operation of all District facilities with this manual, as frequently updated, as a guide.

It is anticipated that the General Manager will designate one of the District supervisors to function as the Safety Liaison, in addition to that supervisor's other responsibilities.

It is important to understand that each and every employee has a primary responsibility to consciously work in a safe manner, be aware of the dangers and comply with the established safe working practices.

District Directors have the same safety responsibilities as an employee during those periods when they are participating in District activities.

Before a contractor or an individual starts to work on any District facility, they should be made aware of the District's safety requirements and specifically advised of the safety precautions in the particular area or activity, where they will be working.

For ease of utilizing this manual, it has been divided into Sections I through IX.

Section I
Safety and Health in Operations

COMMON WASTEWATER FACILITY HAZARDS

Facilities have been safely designed, built, and operated to maintain discharge compliance with the Clean Water Act and applicable state and local laws. To have a safe facility, management, supervisors, and workers should know and understand:

- Necessary plant routines and associated hazards;
- Emergency shut down corrective procedures;
- Safe execution of routines;
- Activities that must be reported;
- Timing of reports;
- The form in which reports should be made; and
- Analysis of reports against stated objectives.

People who work around any collection system or wastewater facility are exposed to many hazards:

- Infectious diseases
  - Pathogen inhalation or
  - Contact with skin, eyes, burns, cuts, scrapes, and mouth
- Physical injury
  - Falls
  - Slips
  - Moving machinery
  - Lack of physical safeguards
  - Improper lifting, pushing, and pulling
  - Repetitive action; or
  - Contact with chemicals and gases
- Confined spaces
  - Limited access/egress
  - Poor ventilation, or
  - Not intended for worker occupancy
- Oxygen-deficient spaces
  - Limited ventilation
  - Toxic gas production
  - Chemical reactions, or
  - High heat and humidity
- Toxic, corrosive, or harmful chemicals, gases and vapors
  - Chemicals
  - Chemical reactions
  - Methane and Hydrogen Sulfide gas
  - Laboratories, or
  - Lack of ventilation
- Explosive gas mixtures
  - Methane gas
  - Oxygen-and hydrogen-enriched areas
  - Lack of ventilation, or
  - Ignition source
- Fires
  - Improper material and chemical storage with ignition source

- Electrical shock
  - Faulty equipment
  - Improper grounding
  - Unqualified servicing
  - Poor insulation, or
  - Short circuits
- Noise
  - Equipment
  - Amplification in confined space, or
  - Explosions
- Dust, fumes, and mists
  - Chemical reactions
  - Transfer to mix tanks
  - Laboratory, or
  - Drying operations.

The following discussions about various facilities that comprise collection systems and wastewater treatment plants list common and specific hazards for each unit and present typical procedures and recommended precautions.

WASTEWATER COLLECTION SYSTEMS

Pipes, manholes, and traps are confined spaces, which have many hazards. In addition to wastewater, pipes may also carry many gases. Methane, carbon monoxide, and carbon dioxide may be present in harmful concentrations, and depending on pH and temperature, wastewater bacteria can reduce sulfate, which will generate toxic and potentially explosive hydrogen sulfide gas. The areas over collection lines and near manholes can collapse. Be aware of these hazards and follow the proper precautions and procedures when working.

Adequate equipment for work crews in confined spaces includes:

- Two fresh air blowers (one for backup) and large-diameter flexible hoses for manhole ventilation;
- Atmosphere testing equipment for testing and monitoring to guard against oxygen deficiency and explosive and toxic gases;
- Harnesses and individual life lines for each person going underground and for standby personnel;
- A self-contained breathing apparatus (SCBA) for each person going underground and for standby personnel;
- Protective clothing, including rubber boots, gloves, rain gear, hard hats, and face shields or goggles;
- Explosion proof lights;
- Communications equipment;
- A first aid kit;
- Barricades, traffic cones, and warning signs;
- Miscellaneous tools, including shovels, pike poles, chain jacks, pry bars, and manhole hooks; and
- Portable ladders and tripod-type lifting equipment with parachute type harnesses.

All workers should know how to use all equipment and have a confined space entry permit signed by the District supervisors authorizing entry if a confined space will be entered.

Before entering a manhole, use the following precautions:

- Adequately ventilate the area and test for oxygen sufficiency, toxic gas, and combustible gas from top to bottom. Check temperature and humidity for safe levels.
- Obtain confined space entry permit.
- Erect barricades, guardrails, and traffic cones and signs to protect workers, equipment, and traffic. Place vehicles between traffic and manhole. Brightly illuminate area at night. Provide flagman, if possible.
- Use proper tools to remove manhole covers, and lid using leg strength. Lay covers flat on the ground at least 3 ft. from the opening.
- Wear approved personal protection equipment and enter only if confined space entry requirements are met.
- Be aware that cockroaches, spiders, snakes, toads, frogs, lizards, rats, ants, and stinging insects may be found inside and outside of the manholes.

On entering a manhole:

- Use portable ladders to avoid loose, corroded, and broken steps and keep firm footing and a handhold at all times.
- Be alert, stay in communication, get the job done, and get out.
- Descend using an adequately supported safety harness in good condition, with at least two people handling the lifeline.
- Use only explosion proof portable lights and nonsparking tools and continue gas monitoring while workers are below ground.

On exiting a manhole:

- Clean up all tools and equipment and put them back in their proper places.
- Remove traffic control devices only after all work is completed and the manhole cover replaced.
- Change out of contaminated clothes and wash hands, face, and any other exposed body parts.

Because wastewater collection systems are designed and constructed to operate by gravity flow, they are often located at depths greater than 5 ft. When excavating deeper than 5 ft for repairs, OSHA 29 CFR 1910 requires cave-in protection. The excavation should be adequately sloped and/or braced and shored and excavated materials placed at least 3 ft. away from the edge of the trench. Also, proper traffic control, rescue plans, and equipment operations are needed to fully protect equipment, workers, and the public.

WET AND DRY WELLS

Wet wells, which receive wastewater from force mains and/or gravity flow pipes, can be used with any treatment unit in which the contents of one unit must be lifted or pumped to another unit. To take the proper safety precautions, consider the characteristics and properties of the contents that flow into the wet well. It is important to identify the nature of the wastewater and its potential hazards. Undesirable materials should be removed or the flow diverted, if possible, until the dangers pass. Evacuate personnel if necessary.

All wet wells are confined spaces and should be treated accordingly. Ventilation requirements vary according to the well's area and depth. Relatively large amounts of organic material may settle and decompose, producing dangerous gases, and additional dissolved gases may be released from flow agitation as wastewater enters the well.

Continuously ventilate enclosed wet wells to prevent excessive accumulation of gases in the upper level. This type of ventilation consists of a pipe positioned to deter small rodents from gaining entry and screened to keep out larger insects. Check the screen periodically. All conduit and pipe entrances should have gas-tight seals.

Provide adequate guardrails and safety chains around all pits, wells, and floor openings.

Operators should be aware that wastewater might rise rapidly during inflow or pump failure. See "Wastewater Collection Systems" for additional precautions and guidelines.

PUMPING STATIONS

In the wastewater collection system, many pumps are all submersible pumps located in wet wells. When checking or working on any of these pumps, the previous precautions for wet wells should be applied.

Pumps may become clogged, bearings may need replacement, or other maintenance may be needed. When pumps are pulled, use a chain and hoist rated for handling the load plus a safety factor. Place a block of wood or other suitable support under the pumps or motors in case the hoist, chain, or eyes fail. Never place hands, feet, or other body parts under suspended equipment.

Rotating equipment can cause injuries to workers wearing rings, jewelry, long hair and beards, or loose, baggy clothing. Sleeves may also tangle in moving parts. All employees should be aware of these hazards.

Before performing any work, the electrical controls should be locked out and tagged so the pump or other equipment cannot be turned on accidentally.

SCREENS

Bar screens are located on the inlet of each of the treatment plants. Gas may accumulate in the area of these screens causing an explosive, flammable, or oxygen-deficient atmosphere.

Mechanically cleaned screens have moving mechanisms and devices such as motors, reduction gears, endless chains or cables, and rakes with teeth. Comminutors incorporate a rotating blade that cuts and shreds the solid material, eliminating the need to remove it from the wastewater flow. Large objects can jam mechanical screens. Disable all moving equipment before working around them. Lock out and tag electrical equipment and physically block off the drive mechanism.

CONTACT MIXING, CLARIFICATION, AERATION, AND DIGESTER

Clarification, aeration, and filter facilities are open tanks and flow channels with pipes, conduits, and walkways.

Good housekeeping is essential to prevent tripping, slipping, and falling. Handrails and kick plates help avoid falling into open tanks or kicking tools and material into the tanks or lower structure. Wear safety lines and life vests when working around these facilities. Install lifelines, rings, pike poles, and jackets at each tank to facilitate rescue and to prevent drowning. Wash all areas frequently and remove greasy deposits.

Ensure safer footing on walkways by removing trip hazards such as tools and debris. Place ladders properly and secure them in position. To reduce the chance of slipping, keep walkways and stairways rough in cold weather, remove ice frequently, if it is present, and wear nonslip boots.

Make sure there is adequate light in the area for night work. Carefully maintain valves, moving or rotating equipment, instrumentation, and other equipment to ensure safety.

Oils and grease may accumulate. Remove these materials safely and dispose of them accordingly.

AERATION FACILITIES. Mechanical aerators or compressed air aerates wastewater. Aeration may splash greasy material and foam on walkways and algae slime can form. Remove it frequently so walk areas are safe. Do not leave tools and other items where they may create a safety hazard. Falls into an aeration tank may result in drowning because the turbulence causes air saturation of the mixed liquid, which reduces the buoyancy of a human body. If possible, stop aeration while working over any aeration tank. If it is necessary to work over or in an aeration tank, wear a lifeline or life jacket. Have standby help in the immediate area with harnesses, life jackets, and lifelines. Because of reduced buoyancy, workers in aerated tanks may need special life jackets.

Walkways have handrails and kick plates. Remove handrails only one section at a time—the minimum necessary for the immediate job—and replace them as soon as the job is complete. All areas should be well illuminated for night work.

Aeration equipment may produce high noise levels, but noise exposure should not exceed an eight-hour time-weighted average of 85 decibels (db). Wear ear protectors when working around blowers that can damage hearing. Wear dust protection when changing or cleaning air filters.

If air header and diffuser piping is heavy, use a hoist with adequate supports to remove and lift sections of pipe. Rest the supports in a location that is durable, strong, and will not move or bend. Wear hard hats with chin straps.

DISINFECTION

Treated wastewater is disinfected with chlorine. (See chlorine section of safety manual.)

SLUDGE PROCESSING

Sludge processing involves a number of safety hazards: decomposition produces combustible gases; gas production may rupture pumps, pipes, and enclosed tanks; and chemicals added to condition the sludge might be dangerous to workers.

SLUDGE HANDLING. Pumps and conveyor belts transport sludge. Pumps are located above ground, but still have a positive suction head. Provide adequate natural and mechanical ventilation in these areas. Take precautions against electrical hazards.

Dried sludge may cause a dust problem. At a minimum, wear goggles, dust masks, and gloves to handle dried sludge.

Digested and partially digested sludge may emit methane, hydrogen sulfide, and other gases—a concern in the buildings that house sludge operations. Excessive pressure may build up in pipes and pumps when valves isolate sludge. Also, pump seals can fail because of pressure or grit-induced wear.

CHEMICAL TREATMENT. Hydrocarbons. Hydrocarbons found around treatment plants include lubricating oils, greases, aerosol sprays, pesticides, herbicides, insecticides, chemical reagents used in the laboratory, gasoline, diesel fuel, butane, propane, methanol, and methane. Hydrocarbons may be liquid or gaseous compounds with fumes and vapors. Many hydrocarbons are flammable, combustible, or otherwise harmful. Consider them dangerous. Do not inhale hydrocarbons, allow them to touch the skin or other body parts, or store them near acids, caustics, or chlorine compounds. The District's operation will not encounter enough of these various substances to be a problem, however, there is the possibility that one or more of the previously named substances could enter the wastewater collection system in quantities presenting a problem. Label them properly and post MSDSs nearby. Use only in strict accordance with manufacturer's instructions and dispose of spent containers in an environmentally safe manner.

DEWATERING. District sludge is normally dewatered in a belt filter press before disposal. If necessary, dewatering can be done in drying beds whenever the belt filter press is out of service, or if other materials such as grit can be sun dried.

Drying Beds. Drying beds are composed of sand or other porous material on which sludge is dried through drainage and evaporation. Usually aerobically digested sludge or grit is applied to drying beds. The dried sludge is removed either by hand or by mechanical means.

Personnel handling or working around wet or dried sludge should wear rubber boots and gloves. Immediately wash wet or dried sludge off skin with disinfecting soap and water. Sludge flows to beds by gravity, pumping or dumping and filtrate is returned by gravity. Do not smoke in these areas, particularly if applying partially digested sludge.

Filter and Belt Presses. Belt filter press operates by placing sludge on a porous belt or screen material that moves through a series of rollers, squeezing the water out.

Maintain positive ventilation in the press area. Presses may splash water and sludge, so personnel in the area should wear personal protective equipment and clean up spills and splashes immediately. Wash sludge off skin with disinfecting soap and water. Keep work areas and walkways as clean as possible and free from grease, sludge, oil, and chemical deposits.

Use protective guards and devices for belts, gears, and other exposed moving parts whenever equipment is operating. Avoid wearing loose clothing. Lock out and tag electrical and mechanical equipment for maintenance and repairs.

AEROBIC DIGESTION. All District wastewater facilities utilize aerobic digestion process.

SEPTAGE HANDLING

Septic tank sludge, also called septage, is sometimes disposed of by dumping it in the wastewater system or transporting it to a wastewater facility. The District does not normally handle any septic tank sludge. However, there may be a time when such material is handled. Because it is anaerobic, combustible gases may be present, so transport trucks and on-site storage tanks could be explosion hazards. Toxic materials, grease, and other materials may also present hazards. Wear goggles, gloves, and other protective clothing when exposed to septage.

LAKES AND STREAMS

No treated effluent is delivered by the District into any streams or lakes. Since District facilities are located near Lake Travis and several small streams, an accidental collection system rupture or break, wastewater conceivably could flow into the lake or stream. Accidental wastewater spills need to be handled immediately to prevent flow into streams or lake, and to mitigate any health hazards to the public. Practice good personal hygiene after working around such areas.

The District has three ponds for storage of treated water from the wastewater system (I-4, I-5 & I-6).

Keep life jackets at M-1. The plastic liner may make it very difficult for someone who has fallen in to get out, so wear life jackets when working around the pond, or whenever in a boat on the pond.

A boat is located on or in the immediate vicinity of all ponds. In addition to rescues, the boat is useful for sampling, removing vegetation, spreading chemicals, and servicing the intake barge.

SAMPLING IN AND AROUND TREATING FACILITIES

Samples may be taken from wastewater and sludge flows at various points in the wastewater treatment process, including manholes, open channels, enclosed tanks, sample ports on pressurized pipes. The hazards are the same for sampling at these locations as they are for maintenance and operations, with the exception of sampling from or in the treated waste at the ponds or at various points on the irrigation systems. Sampling from pressurized pipes may result in splashing; beware of infection. Wear protective clothing, gloves, and goggles. Wear proper protection, such as life jackets, for work near or on the ponds. Beware of concentrating on the proper sampling method to the exclusion of the sampling location's hazards, such as slippery surfaces and electrical cables.

AIRBORNE HAZARDS

Surround or enclose facilities that pose airborne hazards, because they are hazardous not only to operators but also to the public living downwind of the facilities.

(See chlorine section of this safety manual for precautions and procedures for chlorine leaks.)

Explosions may propel chemicals as well as objects into the atmosphere. To reduce the chances of an explosion, observe all precautions, such as eliminating ignition sources and requiring positive pressure ventilation, which minimizes the risk of combustible concentrations of gases.

LABORATORY OPERATIONS

The District does not have a complete analytical laboratory, however there are a few tests run by the District classified as laboratory work. Even though laboratory functions are very limited, they need to comply with OSHA's Chemical Hazard Plan (CHP); the Hazard Communication Act; the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA); and SARA rules and regulations, as well as any additional rules and procedures states and municipalities may require. Hazards abound in the laboratory, so observe the following precautions when working there:

- Allow only authorized, properly trained persons to conduct those laboratory type tests.

- When handling toxic or dangerous chemicals and samples, wear gloves and aprons suitable for the chemicals to be handled. Always wear safety glasses. Label all chemicals in accordance with the Hazard Communication Act and Chemical Hazard Plan. Record the date that chemicals are opened and safely dispose of expired or questionable chemicals.
- Safely dispose of broken or cracked glassware.
- Keep all work areas and equipment clean. Avoid clutter and store every unused item where it belongs.
- Always add acid slowly to water; never add water to acid.
- Use a clean, dry pipette bulb to pipette chemicals or samples. Safely dispose of contaminated pipette bulbs.
- Never store, prepare, or eat food near the laboratory facilities or equipment.
- Be aware of locations of eye wash, shower, and spill neutralization facilities to wash out chemical spills, and inspect and test them regularly.
- Clean up and neutralize a spill immediately.
- Keep electrical meters and instruments away from sinks and water.
- If you must work alone, arrange to notify someone frequently of your safety by telephone or other means.
- Know where emergency telephones and telephone numbers are located. Minimum listings include the poison control center, emergency medical services, supervisor, and fire department.

BUILDING AND GROUNDS

Entrances and exits are marked and warning signs and yellow paint in prominent areas identify head clearance and step-up and step-down hazards. Lighting systems need regular maintenance such as replacing lights that burn out. Use caution when opening doors, especially ones that open outward. Hold on to handrails when walking up or down stairs. Nonslip surfaces on floors, catwalks, walkways, ladders, and scaffolds are installed where practical. Periodically check and maintain them. Report damaged sidewalks, stairs, and ladders.

Replace gratings and manhole covers as soon as possible after removing them. Cover or backfill open pits and trenches as soon as practical. Be careful mowing and trimming vegetation, and remove grass and vegetation that may hide hazards. Prevent leaves, rubbish, or debris from accumulating. Remove snow and ice when present from walkways, parking lots, sidewalks, and stairways.

Use appropriate traffic-control devices and signs on plant or public areas, such as barricades and cones at construction sites. Clearances for overhead wires and piping are posted. Most process piping is marked or color-coded to identify the contents of the pipe and direction of flow.

All valves will be marked and labeled so they are easy to locate and shut down in an emergency. Fire hoses are placed at strategic and easily accessible locations. Fire extinguishers are located near all electrical control panels and other fire hazards.

All plant water outlets will be marked potable or non-potable water (NPW - do not use for drinking, rinsing or watering humans or animals). Use a different size, type, or color for plant water hoses, couplings, and nozzles so no one inadvertently connects them to potable or fire-suppression outlets.

SECURITY

District facilities will be fenced where there is a potential danger to the public and particularly to children. At any fence location, the employees need to keep gates closed and locked when District people are not at the site and able to monitor any third party entering the area.

GENERAL SECURITY. Provide the following general security measures at all facilities:

- Erect and maintain intruder-resistant fences.
- Post appropriate warning signs on fences, doors, and buildings.
- Ask nearby residents or neighborhood watch groups to report loitering or other questionable behavior.
- Use the local police department for additional surveillance or other security services.
- Implement adequate fire and emergency procedures, including installing and maintaining fire alarms and fire-suppression equipment near every potential fire hazard, developing evacuation procedures and plans, and conducting fire and emergency drills regularly.

UNAUTHORIZED ENTRY. To curtail unauthorized entry into an area:

- Install locks on doors and/or gates. Distribute nonduplicating keys for keyed locks and maintain a key assignment log, or consider using combination locks or electronic locks with programmable entry codes, which can be changed as needed. Install panic hardware to override locks in emergencies.
- The District Office and Field Office have fire sensors and detectors that tie into local alarms and annunciators and also link to automatic dialers to report unauthorized entry to central office security personnel.

WASTEWATER COLLECTION SYSTEM PROTECTION. Collection system protection includes bolting down manhole covers, surrounding lift stations with intruder-resistant fencing and locked gates, locking dry wells, using tamperproof locks on lift station control panels and electrical feed and boxes, and installing security systems to report unauthorized entries.

WARNING DEVICES. The District has additional warning devices some local and some with remote alarms, such as flashing lights, sirens, or horns that activate when specific events occur. Use available devices and instrumentation to monitor detection of unauthorized entry; excessive levels of combustible gas concentrations; temperature; leaks; oxygen deficiency; and critical levels, flows, or pressures.

Section II
Safety in Maintenance

Maintenance involves activities as diverse as lubricating a bearing or running diagnostics on a complete system. To keep the facilities operating at design standards, workers troubleshoot, diagnose, and test equipment, often needing to remove guards, override safety circuits, and work close to hazardous locations to do so. Maintenance personnel often perform field repairs on site in locations that may be remote, exposed to the elements, or confined. Tasks may follow regular, predictable schedules, or may be the unexpected result of emergencies. Demands for returning equipment to service may require temporary repairs and substitutions.

The following sections discuss many of the options, considerations, and practices used to decrease the hazards and risks associated with water/wastewater industry maintenance. This material is not intended to be all-inclusive. Maintenance requires skilled individuals, professional judgment, and an appreciation of the hazards and potential solutions. This section will provide direction for some of these solutions.

ISOLATING EQUIPMENT AND LOCKING OUT

Properly isolating, or locking out and tagging equipment are ways to reduce the chance that equipment will accidentally operate during maintenance or repair work. Appropriate controls are physically locked and marked with a written tag that describes why the equipment is locked out of service.

One of the safest means of isolating equipment is for the maintenance employee to install a key-operated, tamperproof locking device on the valve, power disconnect, or control. If more than one worker will be involved, each employee working on the system should apply an individual lock with its unique key or combination or some other positive procedure that will prevent the item being returned to service until such time as all the maintenance is complete.

Physically restrain rotating machine parts or parts with stored energy, or position them in a zero mechanical state, removing any stored energy and preventing movement by gravity, wind, spring release, or water flow.

Many pieces of equipment also have auxiliary equipment that, if operated, could injure workers making repairs. Thus, to properly isolate a pump, isolate both its electrical system and all appurtenant valves. To ensure that all related equipment is properly tagged out and secured in large systems, designate a responsible person who is familiar with the equipment and system to be an isolation supervisor. District facilities do not qualify as a large system. The procedure is still desirable.

Each person should adhere to established lockout procedures for their own benefit and to respect hold or tag out cards regardless of the isolation method. Locks and tags may be removed only by the person(s) they were meant to protect. Ignoring lockout and tag out procedures could result in personal injury or equipment damage.

ELECTRICAL

Treat all electricity and electric power equipment cautiously. According to extensive studies, currents as low as 10 to 15 mA can cause loss of muscle control and, on complete contact, 12 V may cause injury (Bridges *et al.*, 1985). Ordinary 120 V electricity can be fatal. District water/wastewater facility electrical systems operate at voltages from 120 to 440 V. Consider all voltages dangerous.

Electricity kills by paralyzing the nervous system and stopping muscular action. It may hit the breathing center at the base of the brain, interrupting the transmission of nervous impulses to the muscles responsible for breathing; it may affect the heart, causing it to cease pumping blood; or it may cause severe and extensive burns.

If someone does come in contact with electricity, free the victim from the live conductor promptly using a dry stick or other nonconductor or by turning off the electricity. Never use bare hands to remove a live wire from a victim or a victim from an electrical source. Next, begin cardiopulmonary resuscitation (CPR) or artificial respiration immediately and continue until breathing is restored or until a doctor or emergency medical technician arrives (see "Rescue Practices" in this safety manual).

SAFE WORKING RULES AND PRACTICES. General Rules. Assume a circuit is live unless you are certain it is dead and cannot be inadvertently energized. Additional rules for electrical maintenance safety include the following:

- Avoid becoming grounded inadvertently to water piping or other metallic equipment when working on or in contact with electrical equipment or wiring, and do not touch or pass tools with a person who is grounded;
- Only qualified and authorized personnel are to work on electrical equipment or perform electrical maintenance;
- Be sure overhead electrical power lines are neutralized or do not come in close proximity to tools or equipment - do not rely on electrical isolation devices for protection from such sources of electricity;
- Consult local authorities before digging or tunneling to prevent contact with buried electrical sources;
- All electrical controls are accessible, well marked, and in safe working order;
- Prevent wires from becoming a tripping hazard;
- Do not use metal or conducting ladders, metal tape measures, or other metal tools around electrical equipment;
- Handle wires as if they were live;
- When working around electrical equipment, always keep the hazard in mind;
- Work from a firm base and cover energized buses or parts with a good electrical insulator such as a rubber blanket;
- Do not remove guards, use oversized fuses, or block or bypass protective devices unless it is absolutely essential to the repair or maintenance activity, and then only after alerting the operating personnel and maintenance supervisor; and
- When working on machinery remote from disconnect devices, especially at a long distance, lock and tag disconnecting device to prevent someone reconnecting while maintenance people are still at work, ground the conductors to dissipate any stored energy and to prevent inadvertent energizing.

Work Practices. Do not work alone on energized equipment with equipment and circuits completely shut off and preferably located in a clean, dry, well-lighted area with good accessibility. Two employees working together can double-check each other, and one of them can deenergize circuits, apply first aid, or summon assistance in the event of a mishap.

Notify supervisors and others of intent to perform work on electrical systems or components. If interim repairs are necessary, be sure affected personnel know this and take remedial measures to reduce the opportunity for injury or damage.

HOLDING AND LOCKING OUT ELECTRICAL CIRCUITS. Tagging and Locking. Create and adhere to a good system for holding and locking out electrical circuits when equipment is being repaired. Unexpected power in electrical equipment that can be started by automatic or manual remote control may injure persons who happen to be near enough to be struck.

When motors or other electrical equipment require repair, open the circuit at the switch box and padlock the switch in the "off" position, tagging it with a description of the repair and the name of the repairer.

There are serious risks to maintenance personnel. For safety, use the procedure with the necessary keys, locks, and arrangements.

When practical, locks will be issued to each individual performing maintenance where lockouts are required, each worker keeps one key and the supervisor keeps the other. The supervisor should have a master list of key numbers for each lock. Only the supervisor will use the extra key until the lock and keys are destroyed and replaced with new equipment.

Maintenance personnel are to follow lockout procedures:

- Alert the operator.
- Before starting work on any power transmission equipment or power-driven machine, be sure it cannot be set in motion without the maintenance worker's permission.
- Make sure each worker places individual padlocks on each control switch, lever, or valve so every worker must remove one padlock per block before the equipment can be operated again.
- If no padlock is available, place a sign at the control and block the mechanism, fastening both sign and blocking securely so they cannot be removed easily.
- At the end of each shift, make sure workers remove their individual padlocks, signs, and blocking themselves, but only if removing them will not expose another person to danger.
- If the padlock key is lost, immediately report it to the supervisor and get a new padlock.

Remember, energizing an electrical circuit at the wrong time could cause death.

Since the District normally has contract electricians for major electrical maintenance and installations, employees will not be faced with the practice in the following four sections (testing, feedback, transformers and grounding), but should be aware of each and safety related to them.

Testing. Electrical maintenance often involves performing equipment and diagnostic tests using electricity. These tasks may require exercising switches, relays, and equipment protective devices, bypassing other controls or lockout devices. Before conducting such tasks, evaluate the consequences of ordinary-and fault-condition reactions. Similarly, when measuring electrically live circuits, be sure to use the appropriate capacity testing device and cables. Probes used to access terminals can cause short circuits or alternate electrical pathways.

Avoid introducing stray signals or commands that may affect the operation of programmable controllers and other logic-based electronic devices. If these devices perform a safety function, test the safety feature to be sure it works.

Before working on a line or bus, ground it in addition to deenergizing it and locking it out. But before grounding the line or bus, test it with a pretested voltmeter to be sure it is off.

Feedback. Feedback is the return of a fraction of the electrical output signal to the input. It often occurs because of the impedance characteristics of a circuit and can cause component failure or, in control circuits, be misinterpreted as a control signal.

Take precautions to avoid feedback on a deenergized circuit. Feedback can occur from: a control circuit interlocked with another control circuit that is fed from a different source; the high-voltage side of the transformer energized by an extraneous source acting as a step-up transformer; or standby on an emergency electrical power source. Symptoms of feedback conditions include premature failure of

components, the presence of intermittent control/sensor signals, or surges within circuits. These conditions may be subtle and require extensive diagnostic routines to identify the problem's origin.

TRANSFORMERS. Transformers are passive devices whose only indication of energy is a hysteresis hum, which may not be present at low or partial loads. Be sure both primary and secondary leads are disconnected before working on them. While ordinarily used for electrical flow in one direction, transformers are reversible. If only the primary lead is disconnected, an inadvertent cross-connection on the secondary side could induce high voltage on the primary side.

GROUNDING. Electrical system grounding is the connection between an electrical circuit or equipment and the earth or some large conducting body that serves in place of the earth. Grounding is used to establish polarity or electrical potentials and protect against electrical short circuits. The impedance separating an energized circuit from a ground may determine the path of electrical current flow and is a critical element in the potential for electrocution.

Grounding Portable Electrical Tools. Each portable electrical tool that is not inherently double insulated should be equipped with a separate electrical conductor in or on the cord that will effectively ground the metallic case of the tool. Single-phase, 120 V tools should have a three-conductor cord, with the case-grounding conductor wired to a three-prong polarized plug. The plug should be designed to be inserted into the receptacle in only one way.

The mating contact in the grounding plug's receptacle is wired to a special grounding wire carried in the same conduit with the supply wires or else connected to a continuous metal conduit used as a ground path. This conductor is usually colored green and should be used only to ground equipment. Do not break the ground blade off a grounding plug so it will fit a two-wire receptacle. If using a three-wire to two-wire plug adapter, be sure the ground is continued by a separate wire or through the cover screw and ground wire or conduit supplying the receptacles. Poor or nonexistent connections to grounding for 15- or 20-A receptacles can be tested instantly by plugging in a tester with three lights and a quantity code for each light.

When used around water or wastewater, plug the portable tool into a ground fault interrupter to protect the user. Check the grounding circuit periodically to be sure it is intact between the plug-receptacle interface and the tool case. A broken ground wire in the tool's cord could cause an accident because of a false sense of security. At least once a quarter, check all tools with a megohmmeter (megger) to verify the grounding circuit is complete.

Double-insulated, portable electrical tools do not require a grounding conductor. Periodically check to be sure the double insulation has not been damaged, which could cause dangerous electrical leakage, and examine the cord for wear, cuts, or abrasions. Use extreme care when working in wet locations and do not use portable electrical tools near an explosive hazard.

Test tools with a portable ground fault interrupter on a regular schedule, regardless of whether the tool is double insulated or has three prongs.

Distribution System Neutral Grounding. Grounding the neutral wire of the plant electrical distribution and utilization supply systems limits the voltage between any of the phases and the ground to the neutral voltage phase (86.6% of line voltage). Any piece of electrical equipment or wiring that accidentally grounds will cause ground fault current to flow, trip a circuit breaker, and thereby separate the faulted circuit from the system. However, neutral grounding systems have nothing to limit the voltage that might appear between a phase conductor and ground, which could reach several times the value of the system voltage. Thus, an employee working on 480 V equipment could receive a shock several times greater.

In many older plants, the neutral wire of the power utilization voltage is left ungrounded so essential equipment may work temporarily, even during a single accidental ground. For safety, modify these ungrounded systems to grounded systems. At minimum, equip ungrounded systems with a ground detector and alarm to notify operating personnel immediately of an accidental ground, so maintenance personnel can locate the ground and disconnect the grounded equipment or circuit from the system immediately.

"Green" Wire Grounds. The District grounding system has "green" wire grounds in accordance with The National Electric Code (NEC) Article 250. The green grounding wire is the same size as conductors for lower power applications, while for higher current draw it may be one or two sizes smaller.

Computer and Electronic Equipment. Use special training and static discharge elimination equipment to protect both workers and equipment. Computer and digital sensors are extremely sensitive and can be damaged or destroyed by as small an electrical charge as the static charge generated by moving your hand to touch the electrical board. On the other hand, capacitors and solid-state voltage-increasing circuits can create high voltages in seemingly low-voltage electronic equipment. Computer and electronic equipment are very susceptible to stray electrical currents. The small independence in a grounding circuit, invisible to ordinary electrical power, can become significant voltage when subjected to the extremely high frequency waveforms found in modern electronics. Work in electronic equipment areas should be only by people knowledgeable in this field.

Deenergizing Lines and Buses. Insulation protects the current-carrying conductor from accidental grounding.

WORKING ON AN ELECTRICALLY LIVE CIRCUIT. Sometimes maintenance personnel need to work on equipment that is electrically energized, such as when they are taking electrical measurements, functionally exercising electrical components, observing polarity based on motor rotation, or performing diagnostics. Avoid such activities as much as possible, but when they are necessary, use additional precautions and protective measures. The following sections address some of these considerations.

Buddy System. When working on "hot" electrical systems, use a team of at least two workers. One team member is designated the safety observer, whose full attention is devoted to watching the work to make sure all safety rules are followed. The safety observer should be trained in CPR, has grounding equipment available, and will review the procedure with the workers before it is performed. This person's authority to stop the work is absolute. If a safety violation is observed, the safety observer will stop work until it is corrected. If an employee is injured, especially by contact with energized wires or equipment, the safety observer is the first line of rescue and first aid.

Use of Insulating Blankets and Nonconducting Materials. Before working inside switchboards, power cabinets, and other locations where there are exposed energized buses or parts, be sure all conductors are deenergized to the greatest degree practical. If some circuits remain energized, take the following precautions to minimize the possibility of shock or short circuit:

- Cover all live buses with insulating blankets.
- Be careful to avoid accidental contact with live buses or parts within reach, and take extra care to prevent dropping tools on live buses or falling against live buses or parts.
- To prevent eye damage from possible high-intensity arcing, wear protective goggles for all work inside energized switchgear.
- Remove rings, watches, metal-framed glasses, and all other jewelry before performing such work.

- Avoid touching live parts, but if absolutely necessary, touch them standing only on a dry insulating surface, clear of all other conductors or grounding surfaces. Wear rubber safety gloves in good tested condition and approved for use on the voltage, and touch the circuit with only one hand.

Small metallic objects, such as tools, flashlights, and jewelry, can make an electrical contact with or cause a short across live electrical parts. Do not wear any jewelry when working with or near electrical circuitry. Key chains can be a major hazard in electrical work; remove them and store them in the toolbox for safety.

Pliers, screwdrivers, wrenches, and other tools used in electrical work should have insulated handles, and the uninsulated working surfaces of these tools should be as small as practicable to minimize the possibility of metal contacting live parts. Electrical tape or other insulating materials may be used to cover metal surfaces, but use insulated tools whenever possible. Avoid using metal flashlights.

Miscellaneous Considerations. *EXPLOSION PROOF EQUIPMENT.* When working on electrically live or charged equipment, electrical energy may discharge, arcing or shooting sparks. This can present an explosion hazard in areas containing flammable or combustible mixtures.

Before breaking the seal on an explosion proof enclosure, make sure the work area is well ventilated. Check for gas and shut down nearby equipment and facilities if practical. Continually monitor the area for gas, and use only nonsparking, nonferrous tools. When finished, make certain that the explosion proof fittings are resealed.

FIRE EXTINGUISHER . Class "C" fire extinguishers—for electrical fires—are mounted on all motor control centers, transformer banks, and switchgear installations. Do not use water or other conductive liquids and materials on electrical fires. Class "C" fire extinguishers are red with a wide yellow stripe.

MECHANICAL

Much of the water/wastewater works equipment requiring maintenance is mechanical but electrically driven, so a combination of safety practices is required. For example, pumps are electrically driven, but the pumps themselves are mechanical devices, with associated valves, piping, and level controls and potential movement caused by the flow they handle. Because of size, the pump may need to be lifted with special electric equipment for repairs and/or replacement. Other heavy devices, such as valves, are entirely mechanical but may require electric lifting equipment for repairs.

Operating personnel coordinate closely to maintain, repair, or remove mechanical equipment with minimal shutdown time. Unfortunately, the need to restore service quickly may cause workers to disregard all appropriate safety measures, so as much as is possible, plan, schedule, and perform maintenance with all the necessary tools, materials, and manpower available at the site of the operation. Employees should know their jobs and understand the potential hazards to themselves, other employees, and the mechanical systems.

Take care to follow lockout procedures for equipment that can be remotely or automatically operated. Tag equipment and use chocks or blocks to prevent movement if all other measures fail.

LIFTING EQUIPMENT. Because of the size or location, equipment may need to be lifted to perform maintenance. Beware of injury whether the equipment is lifted manually or with the aid of various lifting devices. When manually lifting an object, keep it close to the body and use leg strength to lift rather than the back. Do not lift heavy objects without mechanical assistance.

The following sections discuss some of the safety considerations associated with using cranes, hoists, and forklift trucks as lifting devices.

Use of Installed Cranes and Hoists. The District plant is equipped with overhead traveling cranes in the water plant to move materials and heavy equipment, such as chlorine cylinder pumps and valves. These cranes have rated capacities that are posted and not to be exceeded. The crane-hoist hooks have safety latches, and have tag lines for loads that may swing or must go through limited openings. Check each load's balance by lifting it only slightly off the ground at first before attempting to move it. Do not stand or work under a suspended load or near a cable, chain, or rope under tension.

To avoid confusion, designate only one person to signal crane operators. Use standard hand signals for safety and efficiency. The signaler and the operator should be able to see each other at all times and fully understand and comply with the signals given.

Only trained and certified operators (where required) are to operate lifting equipment. Operators should continuously watch for evidence of overload. They should only leave the lifting device after the load is lowered to the ground and all power is turned off—never while the load is suspended.

Use of Portable Cranes and Hoists. The difference between portable lifting equipment and permanently installed equipment is that portable equipment is less stable, communication is poorer, and portable equipment can tip, touch power lines, two-block, overload, and overextend its reach. Use additional surveillance and care.

Only trained operators should drive mobile cranes or other mobile units such as backhoes, when functioning in a crane mode or operation. Individuals familiar with the facility should coordinate mobile crane use, taking into consideration the work surface, lift route, load weight, and lifting schedule to avoid overloading the crane, making it unstable, or tipping it over. The load moment can change substantially during a lift and could become irrecoverable, especially when a load is being lowered. Although some cranes are equipped with load moment indicators, do not rely solely on these devices to prevent tipping. Because moment is a function of distance between the load and the crane base, as well as the angle of the boom and weight, operators should be especially alert when near the limits of the crane's rating to avoid overreaching and, consequently, tipping.

Besides electrocution and load-shifting problems, movements of the boom, jib, and load can cause two-blocking, a condition in which the lower load block or hook assembly comes in contact with the upper block or boom point sheave assembly. Elevating a load too high and telescoping where the load block touches the upper block can cause the rope to fail and the load to drop. The operator is responsible for watching the load to avoid two-blocking; do not rely solely on anti-two-blocking devices.

To avoid electrocution through contact with the lifting rope, load, boom, or crane, deenergize electrical sources. Although some cranes can be equipped with devices that alert operators to nearby electric fields, do not depend solely on these devices to alert the operator.

The District does not have a mobile crane, but these precautions are important if a contractor or outside servicer does use such equipment on District facilities and District people are working in the same area.

Section III
Safety Related to Design and Construction

District facilities have been designed and built to minimize hazardous or potentially hazardous work areas to minimize human exposure to structural or chemical containments. Each employee should be cognizant of these safety aids and circumstances and continuously be on the lookout for items where improvement can be made from a safety point of view. Of course to be of value, the employee observation and suggested improvements must be conveyed to District management.

SIGNS AND VISUAL INDICATORS

It is most important that each District employee know where all safety equipment is stored or located; such as eyewash facilities, shower facilities, fire extinguishers, life jackets, gas masks, atmosphere tester, special tools, etc. and is hands on familiar with each item's function and performance.

FIRE DETECTION SYSTEMS AND EQUIPMENT

The District has no automatic fire detection system or systems. Fire extinguishers painted red are dry chemical units and should be used on all fires other than electrical. Fire extinguishers painted red with "Halotron" printed on it are halotron filled extinguishers and are to be used on all electrical fires including computer fires. The District is totally dependent for fire fighting and emergency services on Lake Travis Fire Rescue.

CONSTRUCTION ACTIVITIES

According to the National Safety Council, the most frequent and severe accidents occur in construction activities (NSC, 1993). They are typically associated with:

- Strain or exertion;
- Slips or falls from work surfaces, elevated work areas, or ladders; or
- Machine or tool use or being struck by or striking against a machine or tool.

Wastewater treatment or water plant facility construction activities may involve ongoing repairs, minor construction projects using either in-house or contractor personnel, and major construction projects performed by contractors while facility employees may be on site.

The wastewater treatment or water plant facility's safety and health standards and safety plan should be included in the design of all construction projects: bid specifications, prebid meetings, preconstruction meetings, and project monitoring.

INJURY PREVENTION PROGRAMS. Construction health and safety standards should focus on items typically overlooked by labor or the employer. The following examples are not intended to be all-inclusive in implementing an injury and illness prevention program and will normally be stipulated in the construction contract or work order:

- Anticipate, recognize, evaluate, and abate hazards.
- Clear delineation and separation of construction activities from operational areas for both in-house and contractor activities. As much as possible, physical separation of the areas, and limited plant personnel access to the construction activity and contractors access to the operational plant. The delineation will be in writing, designating a restricted number of access points to control traffic, with an update of delineations frequently as construction progresses.
- Safety monitoring and periodic evaluation and correction in accordance with written policies and procedures.
- Actively train and educate employees.

- Designate responsibility for the program to a qualified and competent person.
- Actively collect data from accident investigations, causes, and corrective actions to establish workplace and employee statistics. Monitor and assess occupational hazards using the compiled statistics.
- Use meetings, tailgate safety sessions, and postings to communicate hazard information and specific work practices.
- Establish a mechanism for employees to inform management/employers of potential safety problems.
- Write an employer-and-labor commitment to actively enforce compliance with safety and health standards.

The foregoing elements of a construction project injury and illness prevention program can be easily applied to suit any workplace.

Section IV
Safety in Motor Vehicles

Most utility districts have a tremendous amount of capital tied up in the specialty vehicles that are required for system maintenance, so safe operation and maintenance of motor vehicles should be part of any utility district's safety program. A well-conceived and -implemented vehicle safety program is an efficient use of resources because every time one of these vehicles is in an accident, not only are human resources lost, but also the time and money used to repair the vehicle.

VEHICLE OPERATION

DRIVER QUALIFICATIONS. To operate a vehicle, an operator should not only be qualified and licensed to drive it as required by law, but also have the specific skills needed to operate the vehicle's additional machinery.

Legal Requirements. On October 26, 1986, the U.S. Congress passed the Commercial Motor Vehicle Safety Act, which requires all states to use minimum federal standards in licensing commercial vehicle operators. This law describes a commercial vehicle as which is the same for the State of Texas:

- Any vehicle with a gross vehicle weight rating of more than 26,000 lb.;
- Any vehicle that is required to have hazardous materials placards;
- Any vehicle designed to carry more than 15 people; or
- Any trailer with a gross vehicle weight rating of more than 10,000 lb. if the gross combination weight rating is more than 26,000 lb.

Because ~~some~~ none of the vehicles used by the District meet these descriptions, no employees ~~operators of these vehicles~~ will be required to obtain a commercial vehicle operator's license. Specific requirements for a commercial vehicle operator's license will vary from state to state, but typically, and in Texas, will include the following:

- A written examination of general knowledge of traffic laws and regulations, and possibly a special knowledge test, such as the one required for hazardous materials transporters;
- A driver's skill test in which the driver's actual skills are tested on the road; and
- A test of the driver's physical characteristics, such as vision and response time.

All the requirements are set forth in "Texas Drivers Handbook" and "CDO Handbook" available at the Texas Drivers License Office. This law also requires the commercial vehicle operator to keep specific records.

In-house Qualifications. A comprehensive vehicle safety program ensures that the driver is legally qualified to operate the vehicle, familiar with how to operate the specific vehicle assigned, and physically capable of operating it. The supervisor should ensure that the operator not only has a license but also knows the assigned vehicle's controls and gauges~~, as well as the vehicle weight, length, width, and height~~. Many vehicle accidents occur because the operator is not familiar with the vehicle. The supervisor should also be sure the operator is not impaired because of drug or alcohol abuse, prescriptions or over-the-counter medications, injuries, or even something as simple as forgetting to wear corrective lenses. ~~Finally, the operator should have demonstrated to the District his driving skills in the assigned vehicle, to include skills in parking, backing, and knowledge of controls and gauges under typical traffic conditions.~~

Each January, ~~all vehicle operators must be requalified, beginning with~~ a review of the driver's safety record will be obtained from the Department of Safety. If the operator has been involved in accidents or received traffic citations, determine the underlying cause of these safety violations and correct it before

permitting ~~requalification~~the employee to operate a District vehicle. ~~This mandatory requalification program can correct unsafe problems before they become accidents.~~

DRIVING ATTITUDES AND HABITS. One of the biggest contributors to motor vehicle accidents is the driver's attitude. Angry and impatient drivers tend to be more aggressive and to take more risks. Their actions convey the impression that the road belongs to them and everyone else is trespassing on their space. Not only is this attitude dangerous, but also public relations are damaged when ratepayers encounter careless and/or dangerous District vehicle drivers.

Safe driving requires all drivers on the street to be cooperative. Drivers should be aware of and practice some simple courtesies that will not only help avoid accidents but will also help build goodwill with the community:

- When being passed, do not speed up or attempt to avoid being passed. Maintain speed and look for an escape route if the person passing makes an error.
- Do not assume that the other driver will do the right thing. Keep alert and look for escape routes.
- Be aware of each vehicle's blind spots and make sure they are clear before turning, passing, or changing lanes.
- Clearly indicate intentions to pass, park, or turn.
- Do not tailgate. It only makes the other drivers nervous and could cause them to have an accident involving the tailgater.
- Only use the horn when necessary to warn other drivers of your presence.
- Obey all traffic laws.
- Drive according to conditions.
- Drive defensively—as if other drivers are inexperienced and unpredictable.
- Drive courteously.

PARKING AND BACKING VEHICLES. Minor fender benders or serious injuries can happen when parking and backing vehicles. To reduce the dangers associated with these operations, use a skilled, alert driver and a "spotter".

A spotter is an individual outside the vehicle, with a clear view of the area, who assists the driver. Spotters are typically used for backing; entering narrow locations, such as a garage; or assisting in precise parking situations, such as at job sites. The driver should always have an unobstructed view of the spotter. If the spotter moves out of the driver's range of vision, the driver should stop the vehicle immediately and wait for the spotter to come back into view. This may prevent hitting an inattentive spotter.

When parking at the side of the road, be sure that oncoming vehicles have a safe clearance and set out appropriate warning signs.

ENTERING AND EXITING VEHICLES

More accidents occur from getting in and out of a vehicle than most people realize. District vehicles are usually parked either at the Field Office or at the job site, and both locations are hazardous.

Typically at the maintenance yard, several vehicles are parked in groups in designated areas. Leaking oil can create slick areas and the extended mirrors on larger vehicles can be a bumping hazard, so keep the parking area clean (absorb the oil) and park the vehicles far enough apart so that an employee can walk between them. Slick or damaged steps or running boards, loose or damaged handrails, and unsecured items in the interior can also cause falls and injuries.

Job site hazards may include traffic, unfamiliar parking areas, and unsettled vehicle loads. Traffic hazards can be minimized through proper traffic control (see "Traffic Control" section below).

Parking in an unfamiliar area can cause someone to inadvertently step in a pothole or ditch or trip on rocks and fall or injure an ankle. Drivers should take time to become familiar with the area and watch where they step, or plan ahead by designating parking areas in the traffic control plan.

Finally, improperly loaded tools and materials could fall on the driver or other workers, so be sure all loads are properly secured before the vehicle moves.

VEHICLE INSPECTIONS

A motor vehicle is nothing more than a tool used to accomplish a task. Any tool in disrepair can be dangerous, whether it is an ungrounded electric drill or a motor vehicle with bad tires, so keep the vehicle in top operating condition. This safety program expects the driver to be responsible for ensuring that the vehicle is safe to operate. Inspect the vehicle to be sure the vehicle is road worthy, checking the following items:

- Brakes and clutch
- Fluids, oils, and coolants
  - Check windshield washer fluid and motor oil daily and
  - Check brake fluid, power steering fluid, transmission oil, battery water, and engine coolant weekly
- Gauges
- Safety equipment
  - Load and properly secure fire extinguishers, emergency flares, safety vests, first aid kits, and other required safety equipment
- Tire condition
  - Look for unusual tread wear or inflation and
  - If used, be sure chains are properly installed and secured
- Tools and materials
  - Securely load them on the vehicle
- Trailer hitches
  - Be sure hitch is secure, safety chains are attached, and signal wiring harness is connected and all signal lights function
- Vehicle carriage
  - Walk around the vehicle checking for obstructions or safety hazards
  - Be sure nothing crawled under the vehicle while it was parked, and
  - Be sure there are no overhead obstructions that the vehicle could drive or back into
- Vehicle interior
  - Be sure interior is clean and free of unsecured items that can become projectiles during an accident and
  - Be sure seat belts are operable
- Warning signals, lights, and horn
  - Include flashers, backing signal alarm, signal lights, parking lights, headlights, and taillights
- Windshield, wipers, and mirrors
  - Be sure windshield and mirrors are clean and free of cracks or other obstructions.

The District has all of the vehicles basically assigned to an individual. That individual is responsible for the vehicle's safe operation, and the regular maintenance to ensure compliance. A written checklist will

be turned in ~~each month~~every six months for each vehicle. If a trailer is connected to the vehicle, check its hitch and wiring harness, tire condition, fluid leakage, load condition, and lights. In the event a vehicle is not assigned to a particular individual, then a formal inspection form signed by the driver will help ensure all items are checked before the vehicle is used.

TRAFFIC CONTROL AT THE JOB SITE

Proper traffic control at the job site helps keep workers safe. All vehicles and workers involved in a job in a traffic area should comply with state and local requirements for traffic control. For information about specific state traffic control requirements, contact the local police or the state highway department.

OTHER DANGERS

Besides the usual hazards associated with motor vehicles, be sure to consider some of the other dangers associated with District vehicles when developing a vehicle safety program. Use ear protection and observe the threshold limits of vacuum trucks and jet trucks, which can produce noise levels in excess of 100 db while operating. Moving mechanical parts, such as pumps, are just as hazardous on vehicles as they are on standing equipment.

Section V
Toxic and Hazardous Materials and Confined Spaces

TYPES OF HAZARDS

CHEMICAL. Under normal operations the District utilizes several chemicals each of which should be handled in a safe manner and in accordance with applicable state and federal laws and regulations.

All chemical suppliers are required to provide the District with a Material Safety Data Sheet (MSDS) for each specific chemical. Every District employee accepting receipt of a chemical from a supplier or transporter must receive a MSDS form for each chemical from that supplier or transporter.

The employee receiving delivery of the chemical and the accompanying MSDS shall post the MSDS in the MSDS station in the vicinity of its use. All employees handling and using said chemical shall become familiar with the applicable MSDS and become aware of all the hazards set forth therein.

These chemicals include solvents, chlorine forms, sulfur dioxide, ferric chloride, alum, lime, polymers, pure oxygen, insecticides, weed killer, paints, and petroleum products. Some of these chemicals or substances may be present or created in the operation of water/wastewater handling.

These materials may have corrosive, flammable, explosive, or toxic characteristics that can weaken concrete and metal structures and equipment as well as endangering personnel. Safety practices relative to chlorine is set forth in a later section.

FLUORIDE. This section to be developed.

ALUM. This section to be developed.

LIQUID AMMONIUM SULFATE. This section to be developed.

BIOLOGICAL. Because of its source, wastewater contains countless microorganisms, some of which are harmful to humans. These microorganisms are in a liquid medium well-suited for their survival and continued growth. Until this wastewater passes through the entire treatment process, it poses a hazard to wastewater treatment personnel.

Blood-carried pathogens such as the human immunodeficiency virus (HIV) that causes acquired immune deficiency syndrome (AIDS) and the hepatitis B virus may be particularly hazardous to wastewater treatment plant personnel, but not enough information is available to determine the specific level of danger. Present research seems to indicate a low survival rate for the viruses outside of the body, although some level of infectivity is observed for approximately 12 hours under idealized temperature and pH conditions (Casson *et al.*, 1992). This would indicate a small risk of infection from incidental contact; however, the fate and transport mechanisms are ill defined at this time. As a precaution, direct contact with raw wastewater should be avoided (WEF, 1992).

These hazards can be further minimized if each employee adheres to a minimum personal hygiene level. Simply washing hands before eating or smoking and laundering work clothes on the job can effectively prevent disease transmission.

GASES AND VAPORS. Bacterial action, wastewater gathering and the treatment system generate gases and vapors. Significant gas and vapor levels can be explosive, flammable, and toxic to anyone who breathes the concentrated atmosphere. This is a particular concern in confined spaces, where airborne toxic substances tend to concentrate because of lower ventilation rates and less air dilution.

Besides toxic chemicals, some chemicals are dangerous because they supplant oxygen or reduce the level of oxygen to life-threatening levels. Test a work area not only for the presence of hazardous chemicals but also for sufficient oxygen levels.

A noxious gas or vapor directly or indirectly injures or destroys the safety of human or animal life. Even in an atmosphere with an oxygen content of 19.5 to 21%, which normally can support life, a noxious gas can burn, irritate, poison, or asphyxiate.

Many substances from wastewater enter the air at wastewater treatment plants through such processes as mixing or aeration. The following Table lists the characteristics of gases normally encountered in wastewater treatment works. A gas or vapor may have any one or all of these properties.

ODORS. Odors emanating from a wastewater treatment facility may be nontoxic; however, nontoxic odors can affect employee alertness and indirectly cause accidents.

Investigate ammonia, chlorine, hydrogen sulfide, and other toxic gas odors as they could indicate possible equipment or process malfunctions.

AEROSOLS. Aerosols and mists generated at wastewater treatment facilities can be responsible for the spread of infectious bacteria and viruses. Humans can be infected directly by inhalation or indirectly by droplets settling on clothing.

Eliminating all sources of aerosols is impossible. Knowing the facts that may affect bacteria and viral survival in aerosols can minimize exposure. High relative humidity delays droplet evaporation and retards organism die-off. Sunlight, high temperature and open air are all toxic to microorganisms and viruses. The most important means of providing bacterial and viral infection in aerosol areas avoid the aerosol when possible and practice good personal hygiene.

DUST CONTROL. Employees constantly exposed to dust from wind, composting practices, construction activities, moving vehicles, or other unit processes and drying activities can endanger their health through inhalation or eye damage. Wear proper eye and respiratory protection.

OXYGEN DEFICIENCY. Although typically found in confined spaces, oxygen-deficient atmospheres can occur elsewhere through unusual circumstances. A heavy vapor in a still atmosphere may also create an oxygen deficiency.

The most common circumstance that can create an oxygen-deficient atmosphere in a nonconfined space is fire. The smoke can consume oxygen to create a hazardous atmosphere, and the fire can heat the atmosphere to a temperature that sears lung tissue, preventing a person from receiving sufficient oxygen into the blood even if the atmosphere has enough oxygen.

It is not possible to prepare each space in a plant for potential oxygen deficiency, but workers can be prepared to recognize the hazards of oxygen depletion, its early indicators, and how to extract themselves from oxygen deficient atmospheres.

See Table.

Characteristics of gases common to the wastewater industry.

Gas and chemical formula	Specific gravity	Explosive limits LEL	Explosive limits UEL	Maximum Safe 60-minute exposure, % by volume in Air	Maximum safe 8-hour exposure, % By volume in air	Common properties	Physiological effects	Location of highest concentration	Most common sources	Simplest and safest method of testing
Ammonia (NH_3)	0.59	16	25	0.03	0.01	Colorless, sharp, pungent	Irritates eyes and respiratory tract; toxic at 0.01%	Up high	Wastewater gas	Oxygen deficiency indicator; odor
Carbon dioxide (CO_2)	1.53	Nonflammable		4.0-6.0	0.5	Colorless, odorless, nonflammable; may cause acid taste in large quantities	Acts on respiratory nerves; 10% can not be endured for more than a few minutes	Down low, but may rise if heated	Sludge, wastewater gas, combustion carbon and its compounds	Oxygen deficiency indicator
Carbon monoxide (CO)	0.97	12.5	74.2	4.0	0.005	Colorless, odorless, tasteless, nonirritating, flammable, explosive, poisonous	Combines with hemoglobin of blood, causing oxygen starvation; fatal in 1 hour at 0.1%	Up high, specifically if in presence of illuminating gas	Engine exhaust and fires	CO indicator
Chlorine (Cl_2)	2.49	Nonflammable		0.0004	0.0001	Yellow, green color; irritating, pungent odor; nonflammable and supports combustion	Irritates respiratory tract; causes irritation and burning of the skin, coughing, and pulmonary edema in small concentrations	Down low	Chlorine cylinder and feed line leaks	Chlorine detector
Ethane (C_2H_6)	1.05	3.1	15	No limit, provided oxygen percentage (at least 12%) is sufficient for life		Colorless, odorless, tasteless, flammable, explosive, nonpoisonous	Acts mechanically to deprive tissues of oxygen; does not support life	Down low	Natural gas	Combustible gas indicator; oxygen deficiency indicator
Gasoline (C_5H_{12}-C_9H_{20})	3.0-4.0	1.3	7	0.4-0.7	Varies	Color, flammable, explosive, odor noticeable at 0.03% concentration	Symptoms of intoxication when inhaled, difficult breathing and convulsions; fatal at 2.43%	Down low	Service stations, storage tanks, automobiles and trucks	Combustible gas indicator; oxygen deficiency indicator

Characteristics of gases common to the wastewater industry (continued).

Gas and chemical formula	Specific gravity	Explosive limits LEL	Explosive limits UEL	Maximum Safe 60-minute exposure, % by volume in Air	Maximum safe 8-hour exposure, % by volume in air	Common properties	Physiological effects	Location of highest concentration	Most common sources	Simplest and safest method of testing
Hydrogen sulfide (H_2S)	1.19	4.3	46	0.02-0.03	0.001	Rotten egg odor in small concentrations; colorless, flammable, explosive	Paralyzes the respiratory system; lessens the sense of smell as concentration increases; rapidly fatal at 0.2%	Down low; can be higher if air is hot and humid	Wastewater gas, sludge gas	Lead acetate paper, lead acetate ampoules, H_2S detector
Methane (CH_4)	0.55	5	15	No limit, providing sufficient oxygen (at least 12%) is present		Colorless, odorless, tasteless, explosive, flammable, nonpoisonous	Deprives tissues of oxygen; does not support life	At top, increasing to certain depth	Digestion of sludge	Combustible gas indicator; oxygen deficiency indicator
Nitrogen (N_2)	0.97	Nonflammable		-	-	Colorless, odorless, tasteless, nonflammable	In high concentrations, reduces oxygen intake; does not support life	Up high and sometimes in low areas	Wastewater and sludge gas	Oxygen deficiency indicator
Oxygen (in air) (O_2)	1.11	Nonflammable		-	-	Colorless, odorless, tasteless; support combustion	Normal air contains 20.93% O_2. Below 19% considered deficient; 13% dangerous; below 5-7% fatal	Variable at different levels	Oxygen deficiency from poor ventilation and chemical combustion of O_2	Oxygen deficiency indicator
Sludge gas	Varies	5.3	19.3	Varies with composition		Flammable, practically odorless, colorless	Will not support life	Up high	Digestion of sludge	Combustible gas indicator; oxygen deficiency indicator

CONFINED SPACES

GENERAL. The District may not require an employee to enter or work in a confined space, unless it is in accordance with the provisions of this section. No one shall enter unless wearing harness with connected lifeline and two people handling said lifeline.

PERMIT. No one may enter with out completing entry checklist and securing a permit properly signed by a supervisor. After completion of job, complete and return the "District Confined Space Entry Procedure and Results" form to the Field Office. (See forms in back of section.)

SAMPLING. No person may enter a confined space until the atmosphere of the confined space is sampled and the air quality is determined for all levels and all area within the space.

- The atmosphere of a confined space shall be sampled:
  - oxygen
  - combustible gas and
  - any toxic substance which an employee is expected to work with or likely to be exposed to and which, the employer has reason to believe, may be present.
- The sampling device can simultaneously test for oxygen, toxic gas and combustible gas without manual switching shall be used to sample the atmosphere of a confined space. This instrument is available in the main service building M-1.
  - the sampling device is equipped with audible and visible warning devices, or both, which indicate when an atmosphere of a confined space has:
    - an oxygen content less than 19.5%
    - a toxic gas content of 35 parts per million or more, or
    - a combustible gas content 20% or more of the lower explosive list, L.E.L.
  - the sampling device is calibrated relative to the oxygen content of the ambient air at the time of sampling. Calibration of the sampling device relative to the oxygen content shall be performed where the 20.9% natural content of oxygen in the air is most likely to occur.
- Calibration of a sampling device for combustible gases shall be conducted as often as necessary to assure accuracy, but at least once every 6 months, with a standardized combustible gas supply.
- Calibration of a sampling device for toxic gases shall be conducted as often as necessary to assure accuracy, but at least once every 6 months.
- The sampling of the atmosphere of a confined space for toxic substances shall be by the use of a multi-gas detector or other testing device capable of detecting and measuring the concentrations of toxic substances likely to be present.

A confined space may not be entered, unless the atmosphere of the confined space has:

- an oxygen content of 19.5% or more;
- a combustible gas content less than 20% of the lower explosive limit, L.E.L. and
- an exposure level, for any toxic substance determined to be present, which is at or below the threshold limit values - short-term exposure limit for any substance specified by the American "Chemical Substances in the Work Environment".

A confined space with an atmosphere which is not within any or all of the limits specified may be ventilated and may be entered when sampling indicates an atmosphere within the limits specified.

A confined space with an atmosphere, which cannot be brought within all of the limits, specified for oxygen, or a toxic substance, may be entered if a self-contained positive pressure breathing apparatus or

an air line respirator is used. Continual testing of the atmosphere at the air line source to insure acceptable safe air is pumped or compressed for delivery to the operator working in the space that could not be adequately ventilated.

A confined space with an atmosphere which is not within the limit specified for combustible gas must not be entered even if a breathing apparatus or respirator is used.

For the purpose of determining the specific entry procedures to be followed, a confined space, which may be entered, shall be classified as either a level 1 space or a level 2 space based upon the air quality and the sources of possible contamination.

- A level 1 space shall be a confined space with an atmosphere within the limits specified and the only source of contamination expected or likely to affect the atmosphere is the employee's presence or the employee's activities.
- A level 2 space shall be confined space with an atmosphere which falls within one of the following conditions:
  - the air quality is within the limits specified and the confined space contains sources of contamination, other than the employee or the employee's activities, which may affect the atmosphere, or
  - the air quality is, or was at some time previously, not within any or all of the limits specified.

ENTRY PROCEDURES

Level 1 Spaces. Entry into or work in a level 1 space shall be in accordance with this section.

The atmosphere within the employee's immediate area shall be continuously monitored for oxygen, toxic gas and combustible gas while in the confined space using the sampling device.

Signals from the monitoring device shall immediately indicate when the atmosphere falls outside any of the air quality limits specified for oxygen, toxic gas and combustible gas.

While in a confined space, if the air quality falls outside any or all of limits specified for oxygen, toxic gas or combustible gas, the employee shall exit the confined space and the confined space shall be classified as a level 2 space.

Forced ventilation may not be used in lieu of monitoring devices.

Level 2 Spaces. Entry into or work in a level 2 space shall be in accordance with this section.

The atmosphere within the employee's immediate area shall be continuously monitored for oxygen, toxic gas and combustible gas while in the confined space.

Signals from the monitoring device shall immediately indicate when the atmosphere falls outside any of the air quality limits specified for oxygen, toxic gas and combustible gas.

While in a confined space, if the air quality falls outside any or all of limits specified for oxygen or toxic gas, the employee shall exit the confined space, except if equipped with a self-contained positive pressure breathing apparatus or air line respirator.

While in a confined space, if the air quality falls outside any or all of limits specified for combustible gas, the employee shall exit the confined space.

Forced ventilation may not be used in lieu of monitoring devices.

RESCUE

An employee entering any confined space for a rescue attempt shall be provided with and wear a full body harness and a self-contained positive pressure breathing apparatus or air line respirator.

Communication shall be made for additional help before a rescue attempt is made into any confined space.

GENERAL SAFETY REQUIREMENTS

- Employees who are required to enter confined spaces are first trained and equipped to recognize, understand and control air quality hazards that may be encountered in confined spaces.
  - Employees who are required to enter confined spaces must follow the written confined space entry procedure.
  - Safety equipment such as, but not limited to, gloves, hard hats and protective clothing is provided by the District and worn by employees entering a confined space.
  - No employee may smoke within 30 feet of a confined space.
  - Openings to confined spaces must be kept clear of hand tools and debris.
  - Sampling devices and radios used in confined spaces shall be intrinsically safe for use in combustible atmospheres.
  - Self contained positive pressure-breathing apparatus to be used in confined spaces must have at least a 30-minute air supply capacity.
- Entrances to confined spaces, which are located in streets, must be guarded in accordance with this section.
  - A vehicle's 4-way flashers must be activated and positioned near an entrance to a confined space.
  - A vehicle must be parked in such a way that traffic flows in an unobstructed manner and where possible, the vehicle provides protection for the employee.
  - A vehicle must be parked in such a manner that exhaust fumes cannot accumulate in the confined space. If this is not possible, the vehicle's exhaust pipe shall be extended away from the confined space.
  - Before uncovering a manhole, traffic safety cones must be placed around the manhole and any vehicle and should be visible to traffic in all directions. Cones are placed to protect the employee and to channel traffic flow. Cones are placed at distances and intervals in accordance with local traffic ordinances to adequately warn on-coming traffic.
  - In areas of high traffic volume or other sites warranting additional warning devices, illuminated traffic arrows, barricades and warning signs shall be used around the entrance and any vehicle.
  - When placement of the vehicle creates a situation or having only one open lane of traffic in high traffic volume areas, a flagman must be used to direct traffic flow.

EMERGENCY PROCEDURES

- Local emergency numbers should be posted in the truck - Ambulance, Police, Fire, and Hospital.
- If an emergency arises such as someone passing out in a manhole, RULE NO. 1 - DO NOT ENTER WITHOUT A BREATHING APPARATUS AND AT LEAST ONE TOP MAN TO HOLD THE SAFETY LINE. If no breathing apparatus or top man is available, call for assistance. Do not enter until assistance arrives.
- Remember that 60% of all deaths in confined spaces are a result of rescue attempts.

GAS DETECTOR OPERATING INSTRUCTIONS

- Units must be checked with test gas to check sensors every 6 months. Check with the Field Office on last time your unit was checked. In addition, the gas sensor shall be tagged with date of last check. If such date is past more than six months, reschedule (if possible) entry to a time after check of gas sensor.
- Directions on use are on each unit to verify the correct operating procedures.
- Oxygen setting is adjustable between 20.5 - 21.5 (20.9 set point). Before changing setting, check in open air. Press oxygen test button to verify setting is within the correct tolerance before each use.
- Other sensors are preset and not adjustable and these must be sent to the factory for replacement.
- If unit does not work, return to the Field Office as soon as possible.
- Cold weather sometimes affects the unit, try to avoid extreme cold. When truck is parked outside overnight, bring unit in to avoid leaving unit exposed to cold.
- Purge unit daily to verify operation.
- Keep batteries changed.
- If not completely sure of use of gas detectors, contact the Field Office for further instructions.

CONFINED SPACE ENTRY PROCEDURE AND RESULTS

LOCATION _____

DATE _____ TIME STARTED _____ COMPLETED _____

SCHEDULED WORK TO BE DONE: _____

_____

PERSONS AUTHORIZED TO ENTER: _____

_____

Sampling Equipment Used:	Type	Serial #	Date Calibrated	By Whom
	_____	_____	_____	_____
	_____	_____	_____	_____
	_____	_____	_____	_____
	_____	_____	_____	_____

Signed: _____
Supervisor Phone/Beeper

ENVIRONMENTAL MONITORING:

Test Conducted:	Time	Results	Initial	Time	Results	Initial
O_2 Level	_____	_____	_____	_____	_____	_____
Combustibility	_____	_____	_____	_____	_____	_____
Toxicity	_____	_____	_____	_____	_____	_____

MONITORING DONE BY: _____

EMERGENCY PROCEDURES

If an emergency should occur - first summon help. Do not enter a confined space until qualified help arrives and entry can be made safely. If a person is down for no apparent cause, you must assume that toxic gases or oxygen deficiency could exist - do not enter without full protective gear and self-contained breathing device.

EMERGENCY CALL _____

CONFINED SPACE ENTRY PERMIT

PRE-PLAN EACH JOB

The work shall not be started until the indicated signatures have been obtained, all requirements met, and any discrepancies corrected. This completed form is to be returned to your supervisor at the end of the job.

ENTRY CHECKLIST

All applicable items shall by "Yes" for the work and entrance to begin.	YES	NO	NOT APP
1. Procedure provided, reviewed, and enforced?	____	____	____
a. All job procedures reviewed and understood? Training completed?	____	____	____
b. Person on site at all times to enforce all procedures?	____	____	____
c. Material safety data sheet (MSDA) reviewed?	____	____	____
2. Welding, cutting, open flames present? Welding procedures approved and enforced?	____	____	____
3. Confined space isolated?	____	____	____
a. Lock and tag procedure followed?	____	____	____
b. Power sources "OFF"? Locked out?	____	____	____
c. Electrical hazards isolated, removed, tagged?	____	____	____
d. Rotating equipment locked out, removed, or disconnected?	____	____	____
e. Lines carrying materials to and from confined space blanked off? Section removed or locked by two valves and drained? Drain valve locked open and tagged?	____	____	____
f. Contents removed and space flushed?	____	____	____
4. Confined space atmosphere prepared and monitored?	____	____	____
a. Purged?	____	____	____
b. Flanges/access doors removed? Manholes opened?	____	____	____
c. Continuous ventilation provided?	____	____	____
d. Oxygen level maintained over 19.5% but less than 23%?	____	____	____
e. Continuous air monitoring equipment provided? Specific instructions given for its use?	____	____	____
5. a. Personal protective equipment provided? Specific instructions given for its use?	____	____	____
b. Air lines, self-contained breathing apparatus, or other approved respirators provided?	____	____	____
c. Safety harness with "D" ring and life line provided?	____	____	____
d. Head, hearing, hand, foot and body protection provided?	____	____	____
e. Lighting equipment of approved type provided and grounded?	____	____	____
f. Fire extinguishers readily available?	____	____	____
g. Walking/working surfaces protected from slippage?	____	____	____
6. a. Attendant standing outside of space, trained and prepared to respond to emergencies as instructed?	____	____	____
b. Rescue equipment provided at the confined space?	____	____	____
c. Emergency alarms or communications available?	____	____	____

Note: This list of items is not intended to be all-inclusive; certain jobs may require additional specifications.

_____ _____

Supervisor Signature Date

Section VI
Safety Equipment

OXYGEN SUFFICIENCY DETERMINATION

Because oxygen deficiencies are so prevalent in wastewater facilities, atmospheric testing is important. District facilities do not present many areas where oxygen will be in short or long supply, possible in any building or enclosure where machinery or operating or chemicals used plus other confined areas described in the section on confined spaces. No continuous monitoring of oxygen content is provided anywhere in the District facilities except as required under the confined space section provision herein. The District does have an instrument that will determine oxygen content. This equipment is located in the maintenance building at M-1. This same instrument will also detect combustible and toxic vapors.

RESPIRATORY PROTECTION EQUIPMENT

Because of fumes, vapors, oxygen deficiency, and similar dangers inherent in wastewater collection and treatment, respiratory protection equipment is frequently required. Properly selecting and using this equipment is essential to personal health and safety.

SCBA COMPETENCE. Each field employee will test on the SCBA at least twice per year. Because lung conditions change, workers will be tested before qualification and at periodic intervals of no more than six months. Records of this testing/training will be kept on file. Emphysema, other lung diseases, and accidents can damage lungs and may reduce a worker's ability to receive and process oxygen, putting the worker at severe risk when required to use respiratory equipment.

SAFE BREATHING APPARATUS. Do not consider safe breathing apparatus foolproof and absolute protection; they are mechanically operated, and any mechanical equipment can fail. Proper care and maintenance will improve reliability, but always be aware that the apparatus can fail and look for warnings of possible malfunction. The need to rescue an overcome worker is already proof of the potentially lethal atmosphere, so use safety equipment and be extra cautious in such cases.

Mask Fitting. Respiratory equipment will only work properly if it fits the worker's face and is comfortable. A properly fitting mask covers the nose and mouth and is sealed against outside air while it supplies needed oxygen. Beards are a problem: some soft masks will fit close enough for a good partial seal, but the necessary positive seal is virtually impossible. The personal right to wear a beard must be overridden by the need to safely use respiratory equipment, if it is a worker that will be expected to wear such equipment frequently.

To test for proper mask fit, subject self-contained breathing apparatus (SCBA)-equipped workers to a tear- or pepper-gas atmosphere for at least 15 minutes while they perform heavy manual labor. The drill will test both the fit of the mask and the functioning of the SCBA while teaching the workers how to pace themselves and avoid hyperventilating.

PARTICULATE PROTECTION. Particulate filter respirators cover the mouth and nose and protect against most kinds of airborne particles. Only use these devices in an oxygen-sufficient atmosphere. The device operates as long as the filtering material or filter removes particles from the air. Replace the particle-clogged filter with a fresh one when breathing becomes difficult. Be careful to choose the correct filter medium for the particulate expected. (For example, a coarse media filter for paint chips and paint droplets will provide little protection against asbestos fibers.) Typically, a coarse filter restricts breathing less but is also less protective. A finer filter protects more, but clogs quickly if used against a coarse particulate.

SUPPLIED AIR HOSE MASKS. The safest and most dependable device for an atmosphere with a high gas concentration or a low oxygen concentration is the supplied air hose mask. It uses an air line to

transport clean compressed air to the wearer either continuously or by pressure demand. It operates simply, with no dependence on chemicals or compressed oxygen and may, therefore, be used for extended periods of time. Some blowers can supply enough air for people to work for extended periods of time.

The air hose can be connected to a blower or a source of compressed air or simply opened to an uncontaminated clean atmosphere. Limit hoses connected to blowers to 300 ft. and those without blowers to 82 ft., and only use oil-cooled blowers or compressors if they are equipped with a positive oil filter system on the discharge line. When using compressors or blowers, station an attendant at the device to prevent anyone from accidentally stopping it.

SELF-CONTAINED BREATHING APPARATUS. When an employee enters an atmosphere that is or is suspected to be dangerous to life, use an SCBA. It provides complete respiratory protection in all toxic, oxygen deficient atmospheres. The two basic types of self-contained respirators are recirculating, which convert the exhaled breath into respirable air, and demand, which rely on a source of air such as a liquid or compressed oxygen. The District has six (6) units with compressed air (20 minute supply) that are located at: S-4 Belt Press (1); Storeroom at FO (2); S-5 lab (1); S-5 MCC door (1); and W-3 (1).

COMPRESSED OXYGEN RECIRCULATING RESPIRATOR. This respirator has a mouthpiece and nose clip and may have a full face piece. The seal around the face piece should be kept absolutely tight. A high-pressure oxygen cylinder with reducing and regulating valves supplies oxygen to the worker for inhalation through a long-regulating admission valve. Most units have a carbon dioxide scrubber and a reservoir breathing bag connected to the face piece or mouthpiece by tubes. The scrubber purifies the exhaled oxygen and allows the air to be recycled through the unit. The District does not have any of this type respirator.

COMPRESSED OXYGEN RESPIRATOR. This respirator includes a high-pressure cylinder of oxygen, a cylinder valve, a demand regulator, a face piece, and tube assembly. To use, the worker adjusts the face piece, turns on the cylinder valve, and breathes in to draw the oxygen through the demand regulator to the face piece. The worker exhales to the surrounding atmosphere through the exhalation valve. This type of unit can only be used for approximately 30 minutes at a time and is less efficient than the recirculating type. The District does not have any of this type respirator.

FIVE-MINUTE ESCAPE PACK. This respirator supplies the wearer with a 5-minute breathing supply of a mixture of 21% oxygen and 74% nitrogen. The air pack is attached to a hood with an exhalation valve and, when properly worn, the hood fits over the user's head with the air canister at the back of the neck. An elastic band and a drawstring can be adjusted to tightly seal the hood around the user's neck. The District does not currently have this type of unit, but consideration is being given to the purchase of one.

SAFETY HARNESS

Safety belts, life lines, harnesses, and lifting mechanisms protect the worker in a confined space. Use a body harness and/or a safety belt with a life line designed to keep a worker vertical when the employee is in an area where rescue entry would be difficult. If the exit opening is less than 18 in. in diameter, use a wrist or shoulder lifting harness. If a qualified person determines that none of the confined space hazards pose an immediate threat to life, then have life lines ready but not necessarily used during entry and work procedures unless the employees feel more comfortable with them.

A harness is particularly valuable when rescuing an unconscious or helpless victim because a harnessed worker may be safely and quickly raised to the surface for emergency treatment. The nearly vertical

position makes it easier to lift the victim through a manhole. Use a harness with 49 ft. of at least 0.79 in. manila rope or 0.51 in. polypropylene rope spliced on. The equipment is located at M-1.

PERSONAL PROTECTION CLOTHING

Use laboratory coats, aprons, smocks, pants, jackets, hoods, and similar garments to protect the body from corrosive chemicals.

GLOVES. Choose the type of gloves based on the work to be done. Cotton gloves protect the hands when handling typical abrasives, sharp objects, and glassware, but when finger dexterity is essential, use surgical-type gloves. Fleece-lined asbestos gloves protect against hot objects, while heavy rubber gloves are better for handling concentrated acids or other corrosives, especially for washing glassware with chromic acid. For manual tasks, such as shoveling and raking, wear leather work gloves.

Do not wear rings while working in the plant, because a ring can catch on machinery or equipment and injure the fingers and hands. A ring can also wear through a glove, breaking the glove's protective envelope. The District provides a wide variety of gloves.

PORTABLE LIGHTING EQUIPMENT

Normal operations of District facilities are handled in the daytime, but occasionally emergency failure of equipment, water lines, wastewater lines, etc. require that work be done at night. Flash lights and powered lights on stands are usually sufficient to get the job done. Special arrangements will have to be made if extended night time work is necessary. These are not for use in confined spaces. Extreme care should be exercised to assure that lighting is explosion proof when it is used in explosive areas.

NONSPARKING TOOLS

When repairs need to be made in confined enclosures where flammable or explosive gases exist, such as a partially dewatered digestion tank, use nonsparking tools made of beryllium-copper alloy. They are almost as durable as steel, but conduct heat so rapidly that sparks are nearly impossible. These repairs are still hazardous, however, because sparks may occur from other sources, so make repairs in a nonflammable atmosphere whenever possible.

PORTABLE BLOWERS

Used to ventilate tanks, pits, and manholes, portable blowers are furnished with vapor proof, totally enclosed motors; nonsparking gas engines; or other special precautions so they do not become an ignition source for flammable gas. Place the blower upwind or at right angles to the wind and at least 7 ft. from the manhole. When ventilating equipment is needed, operate it while the work progresses and periodically test for a hazardous atmosphere during work. Use common sense when operating this equipment. Consider the manhole's depth, the size of the enclosure, and the number of openings to an uncontaminated atmosphere. Sometimes, using a pressure tank or mechanical compressor to supply a jet of compressed air will induce ventilation.

SIGNS AND TRAFFIC CONTROL DEVICES

Because gas leaking from an open manhole or pressure-relief trap or concentrating in a partially empty digester is a fire and explosion hazard, post signs banning smoking and open flames in the vicinity of such tanks and in sludge digestion tank galleries where gas piping and safety devices are located.

However, posting these signs near the plant boilers is irrelevant, because an ignition source is already present.

Use barriers, cones, brightly colored tape, or hazard rope to clearly mark work sites inside the plant. Also, mark and lock out any deenergized electrical circuits. Notify all operations personnel of the work site both verbally and in the appropriate logbook.

When preparing to enter any underground structure, protect both the public and employees by putting warning devices, barricades, and/or guard rails around the area in accordance with local traffic laws. Do not remove the traffic control devices until the work is completed and the covers are replaced. Put trucks, tools, carts, and other equipment where they least impede or cause a hazard to traffic and provide a safe working area for personnel. If possible, place trucks with rotating warning lights between the working area and oncoming traffic.

To protect a work site on a roadway, notify the police, use proper safety equipment, and plan effectively. Local traffic conditions and road alignment will dictate the use of personnel directing traffic, and some local jurisdictions may require police officers instead. Personnel directing traffic should be physically and mentally qualified, trained, and responsible and know the proper procedures and signals. They should not leave their posts or become distracted by workers or passersby. While on duty, these personnel should wear traffic safety vests, hard hats, and reflective material.

For the minimum amount of congestion in directing traffic away from the work site, use traffic cones placed diagonally across the lane in a "wedge" to channel traffic into another lane. Use personnel to direct traffic if it will be channeled into an oncoming traffic lane. For flat, straight roads, multiply the speed limit in inches by 2 (10 for mph) for the approximate length of the wedge—for example, 260 ft. for 25 mph and 590 ft. for 56 mph. Space cones approximately 16 ft. apart for vehicle speeds of 0 to 35 mph and approximately 30 ft. apart for vehicle speeds more than 35 mph. The length of the wedge may need to be adjusted for interchange ramps, crossroads, hills, and curves near the work site.

For extended operations, use a stable, well-lit, and identifiable manhole cage over the shaft, both for protection and as a handhold when entering and exiting the manhole. At night, adequately illuminate the open manhole and its vicinity. All signs used during hours of darkness must have a reflector or be illuminated. Use an illuminated sign in areas where extraneous light sources interfere with reflector signs, making them ineffective.

At the end of the workday, secure the work site properly and remove all tools and equipment or place them out of the way. Close any open manholes or access hatches. If the site cannot be returned to its normal state, barricade and properly illuminate it to prevent someone from unknowingly entering the area.

SAFETY EQUIPMENT MAINTENANCE

Frequently used safety equipment will require inspection and periodic repair.

Section VII
Rescue Practices

This section is not a substitute for first aid training, nor a last-minute resort during an emergency, but rather a review of the immediate rescue steps to take from the time of an injury until medical care is obtained. Operation areas with specific potential hazards are also highlighted.

Typically, water/wastewater plant personnel are not trained in emergency services and should defer to trained emergency personnel. But when waiting for emergency services may be the difference between life or death, the people at the scene who can begin first aid and/or cardiopulmonary resuscitation (CPR) before emergency personnel arrive can increase the victim's chances for survival.

However, before rescuing someone else, all personnel should consider their own safety first. Most fatal confined space incidents involve not only the victim but also at least one would-be rescuer. The excitement of the incident can cloud a would-be rescuer's judgment; so, before attempting any rescue, ask if this can be done without risking oneself. Then ask if the incident can be left "as is" until trained rescue personnel arrive. Only if the second answer is "no" should the level of risk be evaluated.

FIRST AID AND MEDICAL PROCEDURES

The following rules are useful in all emergencies:

- First, be calm and evaluate the situation.
- Perform the simplest first aid tasks well.
- Take care of the most important conditions first—remove toxic fumes immediately, restore breathing, and stop bleeding.
- Do not move the person unless necessary.
- Make sure hands, materials, instruments, and the general area are clean when treating wounds.

First aid emergencies can be divided into rescues, severe injuries, and minor injuries. The following table lists the typical first aid steps for each category, followed by a list of related injuries.

Examples of emergency first aid procedures.

Kind of emergency and examples	General first aid steps
Rescue	
CPR (cardiopulmonary resuscitation)	Call for medical assistance immediately A—Open airways by tipping head, clearing mouth, supporting neck B—Restore breathing by CPR or artificial resuscitation C—Restore circulation with direct pressure on wounds D—Decide on therapy for other injuries
Heart attack	Treat for shock (see below) Keep person quiet, raise head, and prop him up if necessary to restore breathing Administer oxygen, if available
Choking	Use Heimlich maneuver—stand behind victim—hold your arms around his waist near diaphragm—hold your own wrists firmly and squeeze hard. If he is collapsed, place your hands on top of each other on back near diaphragm and push toward the head
Gas rescue	See section on fire and rescue practices in this section

Kind of emergency and examples	General first aid steps
Severe injuries	Call for medical assistance immediately
Hemorrhage	Stop bleeding by using direct pressure
Electrical shock	Treat for shock if necessary[a]
	Keep patient lying down and calm
Chemical burns	Clean and dress wounds if possible
Eye injuries	Flush chemical away from eye or skin with water
Thermal burns	
Fracture[b]	
Respiratory problems Irritation from bites, stings, chemicals	
Treatment for shock	
	Give artificial resuscitation if necessary
	Keep person lying down, head level with body and turned
	Elevate feet if not painful
	Raise head and chest if there is difficulty breathing
	Keep person warm with light blanket
	Give sips of water, only if conscious and there is no abdominal pain
Minor injuries	
Abrasions, cuts, scratches	Wash and rinse wounds
	Remove foreign material, if possible
Minor burns	Apply antiseptic and dressing
Head injuries	Treat for shock, if necessary
Chest injuries	
Mouth injuries	If teeth are dislodged, wrap in moist gauze and take to dentist
Nosebleeds	Apply cold compresses for nosebleeds, sprains, mild injuries
Puncture wounds	Refer to physician if puncture wound is deep or injury seems complicated
Sprains	
Strains	
Fainting	
Minor falls	

[a]Do not apply direct pressure to eyeball; use cold compress and seek medical assistance immediately.
[b]Keep joint straight and apply splint to extend above and below break.

GAS RESCUE OVERVIEW—CONFINED SPACE. An adequate crew is necessary. As a rescuer, do not breathe the gas, even temporarily, because no one is immune to noxious gases or oxygen deficiency. The would-be rescuer who walks unprotected or poorly protected into a hazardous atmosphere not only cannot assist the original victim but becomes an additional one for subsequent rescuers.

Steps for Gas Rescue. Working in groups protects individuals. Standby personnel's primary responsibility is to discover individuals needing rescue and then to do the following:

- Alert personnel near the emergency who can assist and request additional help;
- Request the assistance of the local fire department, paramedics, police and/or other emergency services by telephone, CB radio, or municipal radio; and
- Use a safety harness or rope to get the rescuer and an SCBA to the victim; or, in water emergencies, throw a line or life preserver to the victim.

Administer first aid as needed; for example, CPR may be necessary or stopping severe bleeding, until medical help arrives. As soon as possible, notify the District General Manager and/or a District

supervisor of the accident. Call for emergency help from the fire department (including emergency reserve people) and local police.

FIRE DEPARTMENT - 266-1775 EMERGENCY – 911 LAKEWAY POLICE - 261-6560

An accident report should be prepared by the party who suffered in the accident or his supervisor, if the injured party is unable to prepare the report. The report should be filed with the District Office Manager within 24 hours of the accident. A First Report of Injury form is located in the Office Manager's office.

Since the District is a small facility, with a very limited number of employees, this program that assigns specific duties to each employee to perform in an emergency is not practical. Each and every employee needs to be prepared in their thinking to face and handle whatever emergency occurs until the trained emergency people arrive. Facilities are spread over several isolated locations in the District; therefore an emergency alarm system is not practical. Such systems are effectively used in larger systems.

CHLORINE POISONING. Chlorine, other halogens, and chlorine compounds—such as bromine, chlorine dioxide, liquid sodium hypochlorite, and dry calcium hypochlorite—are all highly reactive and poisonous to plants, animals, and humans. Chlorine burns humans on contact because it rapidly combines with skin moisture to produce forms of hydrochloric acid. When inhaled, chlorine reacts quickly with nose and throat membranes, causing internal burns. An atmospheric concentration of 0.1% chlorine, when inhaled, damages tissue permanently and kills almost instantly.

Although nonflammable, chlorine's highly oxidative characteristics support combustion. Chlorine gas is yellow-green and, because of its high vapor density, quickly concentrates at the bottom of an area. Equip rescuers with SCBAs before they attempt the following rescue:

(1) Move the victim to an area away from all gas fumes.

(2) Place the victim flat on the back.

(3) Call paramedics or an emergency team.

(4) If the victim is conscious and breathing, keep victim quiet and calm and, if possible, supplement natural breathing with a pure oxygen inhalator (see section titled 'Inhalators").

(5) If the victim is unconscious and not breathing, begin artificial respiration, using the back pressure or arm-lift methods. If feasible, use a pure oxygen inhalator to supplement artificial respiration. Mouth-to-mouth resuscitation is not recommended because of the highly reactive chlorine gases in the victim's body.

(6) Have an associate remove any clothing contaminated with liquid chlorine and begin rinsing off the victim's exposed contaminated skin with water.

CARDIOPULMONARY RESUSCITATION. Cardiopulmonary resuscitation is primarily used to attempt to revive unconscious victims of electric shock, heart attack, drowning, or asphyxiation from oxygen deficiency or noxious fumes. Rescuers try to stimulate and restore breathing and blood circulation by doing the following:

(1) First, find out if the victim is conscious. If conscious, keep the victim still if possible and reassure the victim that help is coming and all is going to be fine.

(2) If unconscious, check to see if the victim is breathing. If yes, keep the victim still if possible and be reassuring.

(3) If not breathing, sweep a finger through the victim's mouth to check for obstructions. If the obstruction cannot be removed with a finger, turn the victim on the stomach, place hands between the shoulder blades at the middle of the back, and quickly thrust upward a few times to force the object out.

(4) If the victim begins breathing when the object is removed, keep the victim still if possible and be reassuring.

(5) If the victim is still not breathing, check for a pulse by placing two fingers on the side of the throat. If there is a pulse, begin artificial respiration only.

(6) If the victim has no pulse in addition to not breathing, begin CPR. Continue this procedure until relieved by paramedics or other trained emergency personnel.

This description is not a substitute for CPR training by a qualified person; it only summarizes the procedure. To be qualified to give CPR, enroll in an approved course and be certified. Recertification is necessary every 1 to 2 years, depending on local requirements.

Section VIII
Chlorine

District uses and stores chlorine at four locations:

W-3	Water plant (large supply)
S-4	Water Recycling plant (limited supply)
I-4	Treated water pond (limited supply)
S-5	Water Recycling plant (limited supply)

All locations are equipped with a chlorine detector.

CHLORINE CHARACTERISTICS FOR WATER AND WASTEWATER APPLICATIONS

CHLORINE USES AT TREATMENT FACILITIES. Chlorine is almost always used in potable (safe for drinking) water treatment as a disinfectant to destroy harmful organisms. It can also serve to remove color, eliminate hydrogen sulfide, oxidize iron and manganese to insoluble forms and reduce undesirable tastes and odors.

Chlorine is used in wastewater treatment primarily to disinfect the effluent in order to protect receiving users, such as golf courses, irrigation, median irrigation, cedar irrigation (and evaporation). There are other uses of chlorine such as hydrogen sulfide destruction, ammonia and ammonia compound removal, control of filamentous sludge, oxidation of organics, and the control of filter flies, none of which are programmed uses by the District.

Its use as a disinfectant far outweighs all other uses of chlorine in both potable water and wastewater treatment.

PHYSICAL PROPERTIES. The chemical symbol for chlorine is Cl but as a gas it normally is referred to as Cl_2. Since the gas molecule contains two atoms, the District utilizes chlorine only in the gaseous phase.

Chlorine is only slightly soluble in water. The gas has a characteristic, disagreeable and pungent odor (similar to chlorine-based laundry bleaches) and a greenish yellow color. It is detectable by smell at concentrations as low as 0.2 ppm. It is about two and one-half times as heavy as air. Thus, if it escapes from a container or system, it will tend to seek the lowest level in the building or area.

When added to potable water or wastewater, it reacts well with the water to form hypochlorous acid and hydrochloric acid. Hypochlorous acid is the predominant disinfecting form of chlorine. The quantity of chlorine needed and levels in ppm (parts per million) to be maintained vary with circumstances and points where tested, all a part of the District operating instructions.

PROPERTIES OF CONCERN TO OPERATORS AND EMERGENCY RESPONDERS.
Reactions and Metals. At temperatures below 250°F copper, steel, lead, and nickel are resistant to dry chlorine gas while aluminum is corrosive in dry chlorine gas. Wet chlorine is corrosive to most common metals at an ambient temperature.

Exposure Level. The Permissible Exposure limit (PEL) established by the Occupational Safety and Health Administration (OSHA) for chlorine is 1.0 ppm ceiling level. This means that personnel exposure cannot exceed 1.0 ppm at any time. The American Conference of Governmental Industrial Hygienists has established a threshold limit value for chlorine as follows:

Weighted Average (8 hour day/40 hour week) = 0.5 ppm
Short term Exposure Limit (15 minutes) = 1.0 ppm

The National Institute for Occupational Safety and Health (NIOSH) lists an IDLH (Immediately Dangerous to Life and Health) level of 30 ppm. Several breaths at 1000 ppm can be fatal. The U.S. Department of Transportation (DOT) lists chlorine as a poisonous gas, Zone B.

GENERAL HEALTH EFFECTS. In concentrations around the odor threshold (0.2 ppm), chlorine causes mild eye and respiratory tract irritation after several hours. As concentrations and duration increase, so do the symptoms. The affected individual may become apprehensive and restless with coughing accompanied by throat irritation, sneezing and excess salivation. The very young, the elderly and people with other health problems are most susceptible to chlorine's effects.

Effects of various levels of short term (less than 3 to 5 minutes) chlorine inhalation (depending on the physiological makeup of the person involved) are as follows:

- Less than one part per million (ppm): Threshold of odor perception for the average person.
- Three to five ppm: Slight irritation of the nose and upper respiratory tract.
- Five to eight ppm: Irritation of the respiratory tract and eyes.
- Fifteen to 20 ppm: Immediate severe irritation of the respiratory tract, intense cough and choking.
- Thirty ppm: Shortness of breath, chest pain, possibly nausea and vomiting.
- Forty to 60 ppm: Development of chemical bronchitis and fluid in the lungs, which may occur after several hours; chemical pneumonia may occur several days later.
- Prolonged exposure above 50 ppm: Unconsciousness and death.

CHLORINE CONTAINERS

Common chlorine containers delivered to the District are 150 lb. cylinders and ton containers. Though cylinders and ton containers have many handling similarities, emergency equipment is different and confusion can be avoided if "tons" are referred to as ton containers and not ton cylinders.

Chlorine containers must always be handled with care. When not connected or in use, the container valve protective housing should be in place. Containers should not be dropped or struck. A loading dock that is at the same height as the truck bed should be used when possible. If such dock is not available a hydraulic tail gate can be used. Containers should always be secured to prevent them from rolling.

CHLORINE CYLINDERS. The most common chlorine cylinders are 100 lb. and 150 lb. Cylinders can be of several types, footring, bumped-bottom or double-bottom. Chlorine cylinders are not permitted to have more than one opening. When delivered or stored, each cylinder should have a steel valve hood covering the valve. Chlorine cylinders should always be stored in an upright position and not on their side.

Cylinders must be stamped with the tare weight (weight of empty container with valves and fusible plugs but not valve protection devices) and the date for the last hydrostatic test near the neck ring area. It is against U.S. DOT regulations to mar or deface these markings. Cylinders must also be stenciled with the words "Inhalation Hazard".

Trucks transporting cylinders must be placed with a "Poison Gas" placard with the United Nations Number 1017 displayed on the placard.

When a cylinder is being moved, the cylinder should be chained or clamped to a hand truck or other moving device. Cylinders should be secured with the valve protective housing in place during movement and storage.

In the U.S. and Canada there is a standard cylinder valve. The valve outlet threads are designated as 1.030-14NGO-RH-EXT (not standard pipe threads). Cylinder valves are equipped with a fusible metal pressure relief device. Cylinder valves have a fusible metal plug in the valve body, below the valve seat. The fusible metal is designed to melt between 158°F and 165°F (70°C a and 74°C) to relieve pressure and prevent rupture of the cylinder in case of fire or other exposure to high temperature.

According to Federal regulation, cylinders must be hydrostatically tested every five years to 500 or 800 PSI depending on the cylinder's DOT specifications. More information can be found in Chlorine Institute pamphlet, "Cylinder and Ton Container Procedure for Chlorine Packaging".

Container Dimensions and Weights

Capacity	(lb.)	100	150	2000
Tare Weight	(lb.)	63-115	85-140	1300-1650
Outside Diameter	(in)	8 3/4-10 3/4	10 1/4-10 3/4	30
Overall Height [1]	(in)	39 1/2-59	53-56	79 3/4-82 1/2

Note: [1] Heights to top of valve protective housing; height to centerline of valve outlet is about 3-1/2" less.

TON CONTAINERS. Ton containers are welded steel tanks having a capacity of 2,000 lb. and a loaded weight of as much as 3,700 lb. Ton containers are stamped with the serial number, tare weight and the date of the most recent hydrostatic test. They must be stenciled lengthwise in 12" letters with the words "Inhalation Hazard, UN 1017". Dimensions and weights can be seen in the above Table. The heads are convex inward and forge-welded to the barrel. The sides are crimped inward at each end to form chimes, which provide a substantial grip for lifting valve protective housing. Each head contains three fusible plugs (six total) at approximately 120° angles. They are designed to melt between 158°F and 165°F to relieve internal pressure.

Federal regulations require ton containers to be hydrostatically tested to 500 PSI every five years.

TRANSPORTATION, STORAGE AND HANDLING OF CONTAINERS

TRANSPORTATION OF CHLORINE. The U.S. Department of Transportation (DOT) regulates the transportation of hazardous materials. The DOT classifies chlorine as a Poison Gas, Zone B. When transporting quantities over one pound placards are required on the vehicle for poison gas with U.N. number of 1017. Cylinders and ton containers must be stenciled with the words "Chlorine, Inhalation Hazard".

When a vehicle is transporting an empty chlorine vessel the vehicle placard should read "Residual". If the empty vessel has been purged, no placard is required.

Shipping papers must be prepared when chlorine is transported. This is the responsibility of the manufacturer or supplier, for their deliveries. If a facility is transporting chemicals between sites, the facility is responsible for preparing and keeping the shipping papers. These manifests must contain information on the origin, destination and route of the shipment and DOT descriptions of the material. DOT or the supplier should be contacted periodically to confirm that the wording used meets the current requirements. Manifests must be kept on file and the vehicle must carry a copy of the current manifest at all times. The driver must be thoroughly conversant with the applicable safety precautions, as they likely

will be the first person to deal with the situation in case of an accident. A commercial drivers license with hazardous materials endorsement is also required by DOT.

The following precautions should be observed during transport and delivery of chlorine:

- Vehicles must display the diamond-shaped Poison Gas DOT placard on all four sides, whether they are commercial carriers or agency vehicles.
- Chlorine cylinders must be secured by means of chains or straps.
- Cylinders should always be in an upright position.
- Hoists must be rated for the full weight of the container, the chlorine and the lifting devices. Cables or chains must not be frayed of damaged.
- Trucks should not be left running during the delivery unless the engine is needed to operate lift equipment during the unloading. Wheels must be chocked during unloading, and other DOT unloading requirements may also apply.
- Ton containers and cylinders must not be moved without the valve protective housing in place.
- Containers should never be dropped or struck.
- Cylinders must never be lifted or supported by the valve hood.

RECEIVING AND UNLOADING CHLORINE CONTAINERS. Ton Containers. Lifting may be accomplished by using a properly designed and rated hoist. Ton containers on the ground or floor must always be secured to prevent rolling. This can be done, for example, by use of a wedge. (WARNING: even an empty ton container may weigh 1,600 lb. and can cause severe injury when moving.)

Ton containers may be checked for leaks by inspecting the valve area and the six fusible plugs with ammonia vapors.

Cylinders. Cylinders should be unloaded by using a hand truck. They should always be secured to prevent falling. A chlorine odor will indicate the presence of a leak but may not be suitable for locating the source. Cylinder valves can be checked for leaks by using ammonia vapor around the valve protective housing. A leaking cylinder cannot be reloaded onto a truck for shipment. The leak must be stopped before transporting it.

MINOR LEAK DETECTION AND CORRECTION. When a minor leak is suspected, the Chlorine Institute recommends that ammonia vapors be used to find the source. If ammonia vapor is directed at a leak, a white cloud will form indicating the source of the leak. A plastic squeeze bottle containing aqua ammonia should be used. If a wash bottle is used, the dip tube should be cut off so that squeezing the bottle directs vapor, not liquid, out of the nozzle. Avoid contact of aqua ammonia with brass or copper. Commercial 26° Baume aqua ammonia should be used.

If a leak occurs in equipment or piping, the chlorine supply should be shut off, the pressure relieved and necessary repairs made. If welding is needed, the system should be purged with dry air or nonreactive gas before processing. Welding should comply with all applicable codes.

Leaks around shipping container valve stems usually can be stopped by tightening the packing gland. If this does not stop the leak, the container valve should be closed. If simple corrective measures are not sufficient, the appropriate Chlorine Institute Emergency Kit should be applied and the chlorine supplier notified. The District has emergency kits A & B for 150 lb. cylinders and 2,000 lb. containers.

GENERAL STORAGE CONSIDERATIONS. Chlorine may be stored safely indoors or outdoors depending on the facility. Containers should not be stored where they can drop, where heavy objects can fall on them or where vehicles can strike them. Access by unauthorized persons should not be allowed.

The chlorine storage and use area must be posted with signs.

Containers should not be stored near heating, ventilating or air conditioning (HAVOC) systems because dangerous concentrations of gas my spread rapidly if a leak occurs.

Storage facilities need to be arranged to permit routine inspection of all containers. In the event of a leak, easy access to all containers is important. Ton containers should not be stored against a wall; enough room should be left available to allow emergency responders to access containers with a self-contained breathing apparatus.

Exposure of containers to flame, intense radiant heat, steam lines or even direct sunlight must be avoided. If the metal in the vicinity of the fusible plug reaches about 158°F the plug will melt and chlorine will escape. This temperature can be reached if cylinders are in direct sunlight.

Intense local heat will increase corrosion of the steel walls; if the steel approaches 483°F it will ignite. Such temperatures are not foreseeable at the District facilities, absent a fire in the immediate area.

Empty containers should be stored separately from full containers. Even though a container is empty, the valve outlet cap(s) and the valve protective housing should be in place. Cylinders should be stored in an upright position.

Chlorine containers should be segregated from other compressed gas containers (e.g., anhydrous ammonia) and hydrocarbon chemicals.

Indoor Storage. Fire-resistive construction is recommended. Any building to house chlorine equipment or containers should be designed and constructed to protect all elements of the chlorine system from fire hazards. Do not store flammable materials nearby.

GAS DETECTION EQUIPMENT. Installations using or storing chlorine should have gas detection equipment to detect chlorine releases in storage and use areas. Chlorine detectors must be designed and adequately maintained to warn on-site personnel of a release or to signal a remote manned location about a release. Adequate maintenance includes a written plan for a regular calibration of the monitoring equipment, including documentation.

Outdoor Storage. The storage area should be clean so that accumulated trash does not present a fire hazard.

PIPING/FEED SYSTEM

BASIC SYSTEMS. Chlorine is shipped and stored in pressure vessels as a liquefied gas under pressure. Since each container contains both a liquid and a gas phase they are designed to supply one or the other. District cylinders are used to feed chlorine gas. Chlorine ton containers have two valves. When they are properly aligned in a vertical position the upper valve can feed chlorine gas while the lower valve is connected to the liquid phase. The District uses only the gas valve.

District storage facilities are all outdoors. When cylinders are in use, they are inside a building.

PIPING SYSTEMS FOR DRY CHLORINE. Dry chlorine is defined as gaseous or liquefied elemental chlorine containing 150 parts per million or less of moisture (water). All chlorine delivered to the District in cylinder and ton containers should be dry chlorine. Each chlorine feed system will be tested at least twice a year in accordance with instructions from General Manager.

VACUUM SYSTEMS. Chlorinators are operated under a vacuum that is created by pumping water through a venturi and past an injector. These are known as vacuum chlorinator systems. Many of the chlorinators that mount directly to cylinder or ton container valves are designed to close and stop the release of chlorine if this vacuum is lost. This can be a significant safety feature since any loss of vacuum including a piping leak will shut off the gas flow.

PERSONAL PROTECTION EQUIPMENT AND EMPLOYEE SAFETY

This section addresses only routine operations by facility employees at water/wastewater facilities. Emergency response operations are not covered here. Routine operations include opening and closing container valves, handling containers, inspecting systems or working in areas adjacent to chlorine storage and use areas.

STANDARD SAFETY EQUIPMENT. Protective Clothing. Specialized clothing is not required for performing routine plant operations. However, long pants, shirts, safety glasses (with side shields) or goggles, hard hats and safety shoes should be worn.

Respiratory Equipment. Respiratory equipment should be selected based on careful evaluation of hazards and degree of potential exposure.

Personnel working in an area where chlorine is stored or used should have escape respirators readily available. Documented, regularly scheduled training is required to insure competency with self-contained breathing devices.

Most chlorine releases are at low concentrations where the oxygen content in the air is greater than 19.5% and chemical cartridge respirators (up to 5 ppm) or canister gas masks (25 ppm, maximum) would offer adequate temporary protection during evacuation of the leak area. Pressure-demand self-contained breathing apparatus (SCBA), with full face piece, is required for performance tasks when chlorine may be present unless air sampling verifies low chlorine concentration.

OSHA requires use of positive pressure SCBA, used by trained personnel when responding to any chlorine leak unless monitoring indicates a lesser level of respiratory protection is acceptable.

Fit testing (insuring proper fit to the individual) and regular maintenance programs, a formal respiratory program and regular training for respirator equipment are required by OSHA standards.

Other Safety Equipment. Eye wash stations and deluge showers are available where needed.

EMERGENCY RESPONSE

In the event of a chlorine leak the detector will initiate an audible alarm, flashing light and notify the operator on duty electronically of said leak. The alarm is activated when the chlorine concentration reaches 1 to 3 ppm (parts per million). The actual chlorine content in the atmosphere may exceed the alarm level. Response by operator so notified should be immediate but pursued with caution when investigating. If the operator is in an area where the SCBA is immediately available, he should take it with him when he goes to investigate the leak.

The operator should approach the area of the leak with caution and only close enough to determine if the leak is large enough to form a vapor cloud. The operator should stay up wind of the leak and if possible on ground higher than the location of the leak.

If a vapor cloud is visible, the operator should immediately report the leak to his supervisor and General Manager and then contact the Fire Department (266-1775) and Lakeway Police (261-6560) to advise them of the potential need for immediate evacuation of those areas in the probable path of the chlorine vapors. The operator should stay on the scene upwind from the vapor cloud and if possible, on ground higher than the leak area. The operator should stay out of any area that has a chlorine odor and of course out of the vapor cloud.

If there is no visible vapor escaping, do not call the Fire or Police Department. Operator's immediate supervisor should be notified and advised of the nature of the apparent leak. The operator should stay in the area upwind of the chlorine cylinder(s) and well out of the area with a chlorine odor. The District does not have an instrument that can measure the actual chlorine concentration.

If the operator has one or two SCBA masks with him, he should advise his supervisor of that fact when the supervisor is notified of the problem. When the supervisor arrives, and assuming that both the operator and the supervisor are knowledgeable of the proper use of the compressed air masks, and the supervisor or the operator are knowledgeable of probable repair procedures to stop the leak, the two will operate as a team. The knowledgeable one wearing the compressed air mask will proceed to make such repairs that are needed to eliminate the leak. The other member of the team will stay in the chlorine free area and be prepared to put on the compressed air mask and go to the aid of the other member of the team for assistance if necessary. If neither the operator or his supervisor is knowledgeable of the chlorine equipment and repair of such equipment, they should proceed to locate the District employee that does have the knowledge.

EMERGENCY PLANNING. The District has developed and adopted a Risk Management Plan. A copy of this Plan is available at the Field Office.

Section IX
Material Safety Data Sheet (MSDS)

TRAINING

The MSDS provides hazard specifications such as the permissible exposure limit (PELs), the threshold limit value (TLV), safe use data, and emergency response data. The characteristics of chlorine gas such as the physical hazards (potential for fire, reactivity, etc.), health hazards, physical and chemical properties are included on the MSDS. Other valuable information such as spill and leak procedures and conditions to avoid are also included on the MSDS.

All employees must have access to, and be familiar with, the MSDS for chlorine. The facility should request an updated MSDS for chlorine gas from their supplier annually. Suppliers are obligated to provide new MSDS when changes are made.

SUPPLIER SUPPORT

Suppliers are responsible for providing Material Safety Data Sheets (MSDSs) that contain a detailed assessment of chemical characteristics, hazards and other information relative to health, safety and the environment. MSDSs provide the following information:

- Identification of chemical composition, Chemical Abstract Service (CAS) number, formula, molecular weight, and synonyms;
- Physical data on boiling, freezing and melting points, specific gravity, solubility and vapor pressure;
- Reactivity such as incompatibility, decomposition products, polymerization potential;
- Health hazard data on effects of exposure (acute and chronic), permissible exposure limits and warning signals;
- Environmental impact such as toxic effects upon the environment, shipping and other pertinent federal regulations;
- Exposure control methods such as personal protective measures and engineering and administrative controls;
- Work practices such as handling and storage procedures, normal cleanup and waste disposal methods;
- Emergency procedures for handling spills, fire, and explosions; and
- First aid procedures.

MSDS provides basic vital information for employees. They must be readily accessible to all employees as a reference source.

The individual MSDS sheets are posted at the MSDS stations around the District's facilities.

EMPLOYEE ACKNOWLEDGMENT:

DISTRICT SAFETY MANUAL POLICY

This will acknowledge that I have received a copy of the Lakeway Municipal Utility District Safety Manual policy, and have read and understood these policies.

These policies control over any statements made by a supervisor or other individual, and I understand that any agreements concerning my employment are not binding unless they are in writing and signed by the General Manager.

I will continue to be familiar with all rules and regulations in these safety policies, and any policy changes or additional rules and regulations affecting my job.

Date:_____

_____
Signature of Employee

_____
Print Name

_____
Employee Social Security #

*Note: This form to remain in employee notebook. Signed copy filed in employee master file.