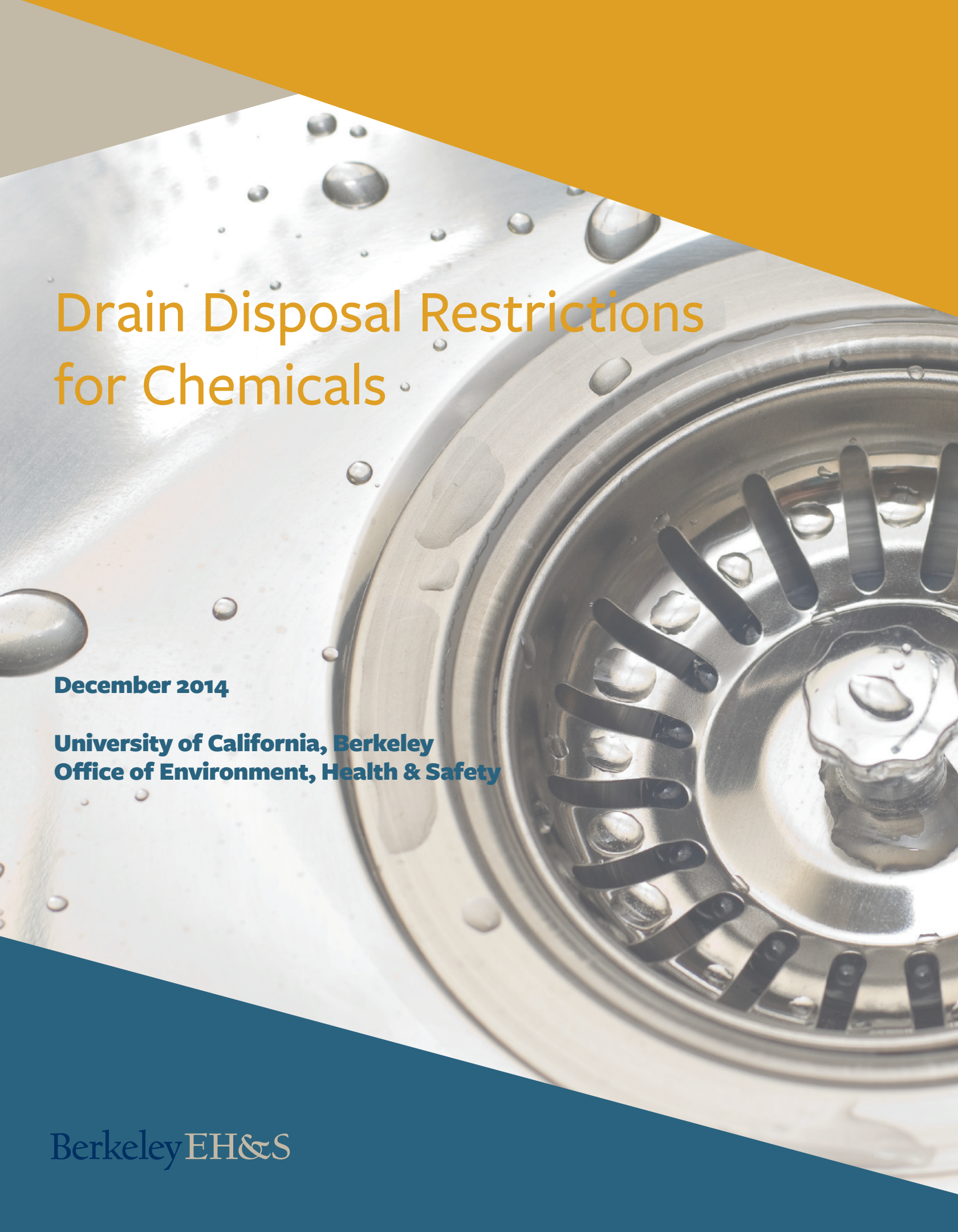
Drain Disposal Restrictions for Chemicals



December 2014

University of California, Berkeley
Office of Environment, Health & Safety

Berkeley EH&S

University of California, Berkeley

Drain Disposal Restrictions for Chemicals

December 2014

Prepared by the Office of Environment, Health & Safety

EMERGENCY SPILL REPORTING INSTRUCTIONS:

If a chemical spill enters a sink or floor drain, immediately notify the Office of Environment, Health & Safety (642-3073) during business hours 8:00 am – 5:00 pm. After business hours, immediately notify the UC Police Department (642-6760) and ask them to contact the EH&S off-hours emergency responder. EH&S will notify EBMUD of the discharge.

Table of Contents

1. Introduction

Disposal of chemicals into the sanitary sewer is regulated by federal and state laws and regulations, by the local East Bay Municipal Utility District (EBMUD) Wastewater Control Ordinance and by the EBMUD Wastewater Discharge Permit issued to the campus. These laws and regulations prohibit any drain disposal of hazardous wastes and limit the allowable wastewater concentration of a number of specific substances. The University of California, Berkeley (UC Berkeley) is committed to protection of the local community and the environment through strict compliance with these laws and regulations. Discharge of hazardous chemical wastes into the campus sanitary sewer system is prohibited by campus policy (Water Protection Policy, http://campuspol.chance.berkeley.edu/policies/waterprotection.pdf).

The range of substances that can be considered hazardous waste is enormous. Indeed, almost any substance is a hazardous waste if it is disposed of in large quantities or in high concentrations. Federal and California laws permit laboratories to drain dispose small amounts of some chemicals in quantities that do not pose a hazard to human health or the environment.

The following requirements for drain disposal of chemicals at the UC Berkeley were developed by the Laboratory Operations & Safety Committee (LO&SC) together with the Office of Environment Health & Safety (EH&S). These requirements are based on state law, EBMUD regulations and permits, and on procedures set forth in the National Research Council (NRC) publication "Prudent Practices for Disposal of Chemicals from Laboratories," National Academy Press, Washington D.C., 1983 (Reference 1) and "Prudent Practices for Handling of Hazardous Chemicals in Laboratories," National Academy Press, Washington D.C., 1981 (Reference 2). Drain disposal is permitted by campus policy only within the requirements set forth in this document.

Disposal of radioactive materials into the sanitary sewer is not authorized. All liquids generated as part of radioactive materials experiments must be collected and sampled for radioactivity. Any sample whose count rate is more than three standard deviations above background, (e.g. good approximation is: $bkg + (3\sqrt{bkg})$) is considered a statistically significant amount of radioactivity above background and must be collected for disposal through EH&S as radioactive waste. Any aqueous sample with a count rate below this threshold can be disposed of if they meet all other criteria laid out in this document.

Mixed radioactive waste (waste containing both radioactive and chemical components) must be collected by EH&S for proper disposal.

This version of the Drain Disposal Restrictions replaces any previous versions.

Notice: EBMUD regularly monitors campus wastewater. Failure to comply with wastewater discharge regulations could lead to fines of up to $25,000 per day and/or restrictions on University water use.

Notice: Laboratory and facility management operations at Richmond Field Station must follow City of Richmond Wastewater Discharge Requirements for chemical drain disposal. City of Richmond requirements have been incorporated into these Drain Disposal Requirements. All other Field Stations are advised to contact EH&S for drain disposal guidance, as these requirements may not apply due to local ordinances.

2. Overview of Drain Disposal of Chemicals

Campus interior drains (and several outside drains) are connected to sanitary sewer systems, and their effluent drains to the EBMUD water pollution control plant. Chemicals and some food wastes may be prohibited from drain disposal for a variety of reasons. Radioactive materials are prohibited from drain disposal.

Potential Problems at EBMUD Water Pollution Control Plant:

Chemicals and some food wastes may be prohibited from disposal to the water pollution control plant because they:

- interfere with the biological processes of sewage treatment,
- are not digested in the sewage treatment process, pass through treatment and are released as pollutants to the air,
- are released to San Francisco Bay where they are toxic to aquatic organisms or where they accumulate in Bay sediments,
- concentrate in the sewage treatment sludge, compromising EBMUD's ability to use the sludge for beneficial purposes,
- cause blockages in sewers that result in sewage backing up into buildings or discharges from manholes where raw sewage could come into contact with humans and the environment.

UC Berkeley policies governing drain disposal of chemicals and certain food wastes to campus sewers have specifically been formulated to comply with these prohibitions.

In addition, Bay Area Air Quality Management District (BAAQMD) air toxics regulations require EBMUD to reduce their release of reactive organic gases (ozone precursors) and other toxic air contaminants. One strategy EBMUD uses to reduce air emissions from the water pollution control plant is source control, limiting the release of chemicals through permit restrictions. For example, for the campus EBMUD has set very low limits for discharge of chlorinated hydrocarbons to the wastewater, which are eventually released as toxic air contaminants from the water pollution control plant.

Potential Problems in Drains and Campus Sewers:

Chemicals and some food wastes may be prohibited from disposal to laboratory drains because they can:

- create hazards of fire, explosion, or local air pollution or stench,
- react with other chemicals to form hazardous gases,
- corrode lab and building plumbing,
- leak out of old pipes as liquid to pollute campus grounds,
- escape from sewer pipes as air pollutants,
- expose plumbers to contact or inhalation hazards.

Campus drains are generally interconnected; substances that go down one sink drain may well come up as a vapor in another. Sinks are usually communal property, and there is a very real hazard of chemicals from two sources contacting one another; the sulfide poured into one drain may contact the acid poured into another with unpleasant consequences for all in the building.

Much of the campus plumbing infrastructure is old and may not be resistant to chemicals placed into the drains. The cost of replacing corroded plumbing can easily exceed the cost of disposal of corrosive chemicals as hazardous waste.

3. Characteristics of Hazardous Wastes

Hazardous wastes are prohibited from discharge. Chemical wastes are hazardous if they are:

- corrosive
- ignitable
- reactive
- moderately or highly toxic

Waste that contains both a radioactive constituent and a chemical which is prohibited from drain disposal is called a "mixed waste." Disposal of mixed waste into the campus sewer system is prohibited. Production of mixed waste is to be avoided or minimized. When mixed waste is generated, store it in a safe and protected location. Contact EH&S (642-3073) for disposal of mixed waste.

Drain Disposal of Biohazardous Wastes

Disposal of infectious or biohazardous waste, as defined by the California Department of Public Health (CDPH), into the campus sewer system is prohibited. Infectious or biohazardous waste must be handled, stored, treated, and disposed of in accordance with the California Medical Waste Management Act and requirements of Biological Use Authorizations (BUAs).

4. General Rules for Sanitary Drain Disposal

A. General Rules for Sanitary Drain Disposal of Chemicals

The following general rules apply to drain disposal of chemicals to sanitary sewers at UC Berkeley*****. Disposal of chemicals is limited to occasional disposal of small amounts of chemicals, as detailed in the requirements below. Large scale or continuous disposal of any chemical is permitted only with the written approval of the LO&SC (Lab Operations & Safety Committee). (EH&S should be contacted to obtain this approval.)

a. Only water-soluble substances** may be disposed of in sinks, toilets, and floor drains. Solutions should be flushed down the drain with an appropriate amount of water. [Residue animal or vegetable fats and oils generated as a result of normal cleaning activities are an exception to the solubility rule. However, significant amounts of these oils and fats (approximately more than a pint) can cause clogging in interior drains and so should be collected and disposed of appropriately (see Appendix V for additional guidance on solubility).]

   (**Note****: A compound is considered water-soluble if it dissolves to the extent of at least 3%. In general, a soluble substance that contains a substance that is not soluble should not be poured down the drain. However, if the water-insoluble material comprises less than about 2% of the mixture, drain disposal is usually acceptable because the small quantity of water-insoluble material will be well dispersed in the aqueous effluent.)

b. Only acid and base solutions in the range of pH 5-10 may be disposed of in the sink. At Richmond Field Station, only acid and basic solutions in the range of pH 6-10 may be disposed of in the sink.

c. Highly toxic, malodorous, or lachrymatory (that is, those that cause strong eye irritation) chemicals shall not be disposed of down the drain.

d. Unless EH&S has provided prior written approval, unwanted or waste chemicals and products must not be poured down the drain, treated or diluted as a means of disposal. These materials must be picked up by EH&S personnel.

***** Adapted from Reference 2, pp 231-232.
****** Adapted from Reference 1, pp 52-53.

5. Specific Requirements for Laboratory Drain Disposal

We divide chemicals into three groups with regard to drain disposal in laboratories:

(1) **Class A.**
Class A includes chemicals that pose little or no hazard in dilute aqueous solution. These aqueous solutions are suitable for disposal down the drain in quantities of up to about 100 g of solute per laboratory per day (e.g. 100 g of ethanol in one liter of water).

(2) **Class B.**
Class B includes chemicals of moderate hazard in dilute aqueous solution. These aqueous solutions are suitable for disposal down the drain with excess water in quantities no greater than 1 g of solute per laboratory per day.

(3) **Class C.**
Class C includes chemicals that may not be drain disposed in any amount ***except by written approval*** of the LOSC or their delegate. *Normally requests for exceptions are made to EH&S who obtains any necessary additional information and coordinates review by the Committee(s).*

Class A chemicals include many simple organic and inorganic compounds, as well as common inorganic chemicals. Included in Class A are most biological metabolites and nontoxic cellular constituents (proteins, nucleic acids, carbohydrates, soluble fats, and their precursors and catabolites). A partial list of Class A chemicals, derived from State regulations and Appendix K of Reference 2, is provided below in Appendix I.

Class B chemicals include all of the chemicals listed as toxic (T) in the California Code of Regulations Section 22-66261.30 et. seq. that are water soluble, except for those listed as Class A chemicals in Appendix I or Class C chemicals in Appendix III. Class B chemicals also include all inorganic salts listed in reference 2 as "high hazard" in tables 6.1 and 6.2. A partial list of Class B chemicals appears in Appendix II.

Class C chemicals include all chemicals that are not soluble as defined above, chemicals that cause unacceptable concentrations of offensive, toxic or explosive vapors, and chemicals that are toxic or reactive at concentrations below 1 ppm in aqueous solution. Class C chemicals include the chemicals identified in the Main Campus EBMUD Wastewater Discharge Permit "Priority Pollutant Management Plan" Compliance Requirement (Federal Clean Water Act priority pollutants listed in 40 CFR Part 122 Appendix D, Tables II and III). A partial list of Class C chemicals appears in Appendix III.

6. Specific Drain Disposal Requirements for Shops, Studios, Kitchens, Janitorial Areas, Grounds, Athletics Operations, Maintenance Operations, and Construction Sites

Drain Disposable Chemicals and Process Wastewater

Chemicals and wastewater of little or no hazard in dilute solutions are suitable for disposal down the drain in quantities that would be expected in normal operations (for example, latex paint brush wash-water or a bucket of mop water). Large quantity wastewater discharges from physical plant equipment can be drain disposed if approved by EBMUD (for example, cooling tower discharges and boiler blow-down).

Following are examples of drain disposable chemicals and process wastewater for shops, physical plant operations, kitchens, janitorial, grounds, and athletic operations.

- Latex paint wash-water from the rinsing of brushes, rollers, sprayers, and other water base painting equipment washing.
- Drywall compound wash-water.
- Commercially available custodial and cleaning products such as soaps and detergents if they are used in accordance with the manufacturer instructions.
- Super-chlorinated water used to disinfect new plumbing.
- Photographic developer solutions, neutralized (does not include used fixer solutions).
- Garbage truck and dumpster wash-out.
- Building wash-water that is managed in accordance with the Procedures for Wastewater Management from UC Berkeley Building Washing and Maintenance Operations.

Hazardous Chemicals That Are Prohibited From Drain Disposal

The following are prohibited from drain disposal.

ORGANIC CHEMICALS

- All alkanes and water-insoluble hydrocarbons, including:

  Mineral spirits
  Stoddard solvent
  Paint stripper (e.g., Jasco)
  Petroleum hydrocarbons
  Naptha
  Solvent based adhesives

- All chlorinated and brominated solvents, including:

  Methylene chloride (dichloromethane)
  Tetrachloroethylene (perchloroethylene)
  Trichloroethane
  Trichloroethylene

- Chlorofluorocarbons (freons)
- Concentrated acids and bases (pH <5 or >10) * At Richmond Field Station, concentrated acids with a pH<6 are prohibited.
- Latex paint (other than wash-water)
- Oil and grease (e.g., crankcase oil, lube oil, grease (all kinds), vegetable oil, shortening)

- Oil based paint
- Oil based paint solvents
- PCBs (polychlorinated biphenyls)
- EPA Priority Pollutants (See Appendix C)

7. Accidental Spill Prevention and Emergency Notification

UC Berkeley's EBMUD Wastewater Discharge Permit requires that the campus maintain a Slug* Control Plan. The purpose of this Slug Control Plan is to eliminate or minimize the potential for an accidental, or slug discharge of any pollutant including laboratory, construction, maintenance, and photoprocessing chemicals which could interfere with EBMUD's Wastewater Treatment Plant.

***Definition of a Slug Discharge**

For the purposes of this plan, a slug discharge means any discharge of a non-routine, episodic nature, including but not limited to:

- an accidental spill or a non-customary batch discharge,
- discharges that exceed EBMUD Wastewater Control Ordinance (No. 311) limitations,
- hazardous waste discharges, and
- discharges that are not allowed by these Drain Disposal Restrictions for Chemicals at UC Berkeley.

Due to the diverse nature of laboratory, shop, construction, and facility operations that use, store, and handle chemicals, the Slug Control Plan does not contain specific prevention practices for all campus operations. General best management practices (BMPs) for spill prevention applicable to all chemical use, handling, and storage operations are presented below. These spill prevention measures should be incorporated as standard operating procedures for chemical use operations.

Measures for containing toxic organic and inorganic pollutants, including solvents, from laboratories, shops, construction, and facilities operations:

General best management practices for slug discharge prevention:

- avoid open container use of chemicals near sinks and floor drains,
- where open container use of chemicals near sinks and floor drains is unavoidable, cap or plug sinks and drains during chemical use,
- store chemicals in tubs, cabinets, bermed or diked areas, or in other secondary containment,
- avoid storing excess quantities of chemicals - order only what you need and dispose of unwanted or expired chemicals through EH&S,
- secure storage cabinets and shelves to prevent tipping or falling,
- use proper container restraints,
- maintain spill containment and clean-up materials nearby, and
- follow good housekeeping practices - never use sinks to store chemicals.

Inspection and maintenance of storage areas:

All chemical use and storage areas (for example, storerooms) should be inspected for BMP implementation on a regular basis. Storerooms that contain floor drains routed to the sanitary sewer should have the floor drains plugged at all times, except when floor drains are needed (for example, when floors are mopped). Storerooms should use removable drain plugs in such cases.

Material handling and transfer:

When chemicals are transferred within buildings or between buildings, they should be placed in secondary containers which can contain over 100% of the chemical, should the primary container break.

Loading and unloading operations:

Most exterior loading and unloading locations (loading docks) drain to the storm drain system, and storm water pollution prevention BMPs should be followed. Where locations drain to the sanitary sewer, floor drains should be plugged at all times, except when floor drains are needed (for example, when floors are mopped). Temporary drain plugs should be used during time when floor drains are not in use.

Control of site runoff:

Most site runoff drains to the storm drain system, and storm water pollution prevention BMPs should be followed for any operation that has the potential for discharging a pollutant to the storm drain. Prior to initiating any operation, determine the location and drainage route of all drains. Storm water pollution prevention or slug discharge BMPs should be implemented as necessary. For more information regarding storm water pollution prevention BMPs, contact EH&S at 642-3073.

Worker training:

All laboratory, photoprocessing, shop, construction, and facility workers in operations that could cause a slug discharge must be trained in slug discharge prevention and spill reporting. This is accomplished through the Chemical Hygiene Plan and Worker Right-to-Know training and other training implemented by Department Safety Coordinators (DSCs). Drain disposal restrictions and spill discharge notification requirements are also posted through the use of sink stickers, which are required for laboratory, shop, and facility chemical use areas.

If prohibited chemicals or substances enter a sink or drain, immediately notify EH&S at 642-3073 during business hours or, after hours and weekends, call the University Police Department dispatch by dialing 642-6760 or 911 from a regular phone or 642-3333 from a cell phone.

Upon receiving notification of a chemical release, EH&S will make the appropriate agency and Campus contacts.

Appendix I – Class A

Class A chemicals are of little or no hazard in dilute aqueous solution. These are aqueous solutions suitable for disposal down the drain in quantities of up to approximately 100 g of solute per laboratory per day (e.g. 100 g of ethanol in one liter of water)
Class A chemicals include many simple organic and inorganic compounds, as well as common inorganic chemicals. This includes most normal biological metabolites and nontoxic cellular constituents (proteins, nucleic acids, carbohydrates, soluble fats, and their precursors and catabolites).

This list is illustrative, but cannot include all of the chemicals that do or could fall into Class A; therefore, if you have a question as to the classification of a material contact EH&S.

1. ORGANIC CHEMICALS

Normal biological metabolites and nontoxic cellular constituents (proteins, nucleic acids, carbohydrates, soluble fats, and their precursors and catabolites).

Alcohols
- alkanols with fewer than 5 atoms
- alkanediols with fewer than 8 atoms
- sugars and sugar alcohols
- alkoxyalkanols with fewer than 7 carbon atoms
- butanol, 1-(n-butyl alcohol)
- butanol, 2-(sec-butyl alcohol)
- ethanol
- ethanol,2-(2-butoxyethoxy)
- ethylene glycol
- glycerol
- methanol
- methyl 1-propanol, 2-(isobutyl alcohol)
- methyl 2- butanol, 2-(t-amyl alcohol)
- methyl 2-propanol, 2-(tert-butyl alcohol)
- propanol, 1-(n-propyl alcohol)
- propanol, 2-(isopropyl alcohol)

Aldehydes
- aliphatic aldehydes with fewer than 5 carbon atoms
- acetaldehyde
- butyraldehyde
- formaldehyde (only formaldehyde solutions that are $\leq$ 2.5% concentration may be drain disposed)
- gluteraldehyde
- propionaldehyde

Amides
- $RCONH_2$ and RCONHR with fewer than 5 carbon atoms
- $RCONR_2$ with fewer than 11 carbon atoms
- formamide
- propionamide
- methylpropionamide, N-
- butanamide

Amines**
- aliphatic amines with fewer than 7 carbon atoms
- aliphatic diamines with fewer than 7 carbon atoms
- benzylamine
- butylamine, n-
- dimethylamine
- dipropylamine
- propylamine
- pyridine

Appendix I - Class A continued

Carboxylic Acids**
- alkanoic acids with fewer than 6 carbon atoms
- alkanedioic acids with fewer than 6 carbon atoms
- hydroxyalkanoic acids with fewer than 6 carbon atoms
- aminoalkanoic acids with fewer than 7 carbon atoms
- ammonium, sodium, and potassium salts of the above acid classes with fewer than 21 carbon atoms
- acetic acid
- citric acid
- oxalic acid
- potassium binoxalate
- propanoic acid
- formic acid
- sodium acetate
- sodium citrate

** Those organic compounds with a disagreeable odor, such as dimethylamine, 1,4 butanediamine, butyric acids and valeric acids, should be neutralized, and the resulting salt solutions flushed down the drain, diluted with at least 1000 volumes of water.

Esters
- esters with fewer than 5 carbon atoms
- ethyl acetate
- isopropyl acetate
- methyl acetate
- methyl formate
- methyl propionate
- propyl formate, n-

Ethers
- dioxane, 1,4-
- dioxolane
- tetrahydrofuran

Ketones
- ketones with fewer than 6 carbon atoms
- acetone (2-propanone)
- cyclohexanone
- methyl ethyl ketone (2-butanone)
- methyl isobutyl ketone
- pentanone, 2-

Nitriles
- acetonitrile
- propionitrile

Sulfonic Acids
- sodium or potassium salts of most are acceptable

Appendix I - Class A continued

2. INORGANIC CHEMICALS

This list comprises water-soluble compounds of low toxicity hazard cations and anions. Compounds of any of these ions must be in the range of pH 5 – 10 unless at the Richmond Field Station where compounds must be in the pH range 6 – 10.

Cations :
aluminum Al^{3+}
ammonium NH^{4+}
calcium Ca^{2+}
cesium Cs^{+}
hydrogen H^{+}
lithium Li^{+}
magnesium Mg^{2+}
potassium K^{+}
sodium Na^{+}
strontium Sr^{2+}
tin Sn^{2+}
titanium Ti^{3+}, Ti^{4+}
zirconium Zr^{2+}

Anions:
borate (BO_3^{3-}, $B_4O_7^{2-}$)
bromide (Br^{-})
carbonate (CO_3^{2-})
chloride (Cl^{-})
bisulfite (HSO_3^{-})
hydroxide (OH^{-})
oxide (O^{2-})
iodide (I^{-})
nitrate (NO_3^{-})
phosphate (PO_4^{3-})
sulfate (SO_4^{2-})

3. PROPRIETARY PRODUCTS

Bleach (sodium hypochlorite solution)
Detergents (alkanesulfonates)
Photographic solutions - spent black and white developers and developer replenishers (No Fixers)
Household ammonia

Appendix I - Class A continued

Alphabetical Lists of Commonly Used Class A Chemicals

CLASS A Organic

acetaldehyde
acetic acid
acetone (2-propanone)
acetonitrile
benzylamine
butanamide
butanol, 1-(n-butyl alcohol)
butanol, 2-(sec-butyl alcohol)
butylamine, n-
butyraldehyde
citric acid
cyclohexanone
dimethylamine
dioxane, 1,4-
dioxolane
dipropylamine
ethanol
ethanol, 2-(2-butoxyethoxy)
ethyl acetate
ethylene glycol
formaldehyde
formamide
formic acid
gluteraldehyde
glycerol
isopropyl acetate
methanol
methyl 1-propanol, 2-(isobutyl alcohol)
methyl 2- butanol, 2-(t-amyl alcohol)
methyl 2-propanol, 2-(tert-butyl alcohol)
methyl acetate
methyl ethyl ketone (2-butanone)
methyl formate
methyl isobutyl ketone
methylpropionamide, N-
methyl propionate
oxalic acid
pentanone, 2-
potassium binoxalate
propanoic acid
propanol, 1-(n-propyl alcohol)
propanol, 2-(isopropyl alcohol)
propionaldehyde
propionamide
propionitrile
propyl formate, n-
propylamine
pyridine
sodium acetate
sodium citrate
tetrahydrofuran

CLASS A Inorganic

ammonium chloride
ammonium nitrate
ammonium sulfate
ammonium thiosulfate
boric acid
calcium carbonate
calcium chloride
calcium hydroxide
calcium nitrate
calcium sulfate
cesium chloride
hydrochloric acid (neutralized)
lithium bromide
lithium chloride
magnesium chloride
magnesium oxide
magnesium sulfate
nitric acid (neutralized)
perchloric acid (neutralized)
phosphoric acid (neutralized)
Plaster of Paris (calcium sulfate)
potassium bicarbonate
potassium bromide
potassium carbonate
potassium chloride
potassium iodide
potassium nitrate
potassium phosphate
potassium sulfate
sodium bicarbonate
sodium borate
sodium carbonate
sodium chloride
sodium hydroxide (neutralized)
sodium iodide
sodium molybdate
sodium nitrate
sodium phosphate
sodium sulfate
sodium sulfite
sodium thiosulfate
sulfuric acid (neutralized)

Appendix II – Class B

Class B chemicals are of moderate hazard in dilute aqueous solutions. These aqueous solutions are suitable for disposal down the drain with excess water in quantities no greater than 1 gram of solute per laboratory per day. The final concentration in wastewater must not exceed 1 ppm after flushing with an appropriate amount of water.

This list is illustrative, but cannot include all of the chemicals that do or could fall into Class B; therefore, if you have a question as to the classification of a material, contact EH&S.

1. ORGANIC CHEMICALS

Commonly used Class B organic chemicals:

acrylamide
trypan blue

2. INORGANIC CHEMICALS

Cations of the following metals :

barium
cobalt
gallium
germanium
hafnium
indium
iridium
iron
manganese
molybdate
osmium
platinum
rhenium
rhodium
ruthenium
tellurium
tungsten
vanadium

Anions and neutral compounds:

aluminum hydride (AlH_4)
amide (NH_2^-)
azide (N_3^-)
borohydride (BH^{4-})
bromate (BrO^{3-})
chlorate (ClO^{3-})
fluoride (F^-)
hydride (H^-)
hydroperoxide (O_2H^-)
hydrosulfide (SH^-)
hypochlorite (OCl^-)
iodate (IO_3^-)
nitrite (NO_2^-)
perchlorate (ClO_4^-)
permanganate (MnO_4^-)
peroxide (O_2^{2-})
persulfate ($S_2O_8^{2-}$)
sulfide (S^{2-})

Appendix III – Class C

Class C chemicals are ones that may not be drain disposed in any amount **except by written approval** of the LOSC (or in some cases the RSC). Contact EH&S for assistance in obtaining this approval.

This list is illustrative, but cannot include all of the chemicals that do or could fall into Class C; therefore, if you have a question as to the classification of a material contact EH&S.

1. RADIOACTIVE MATERIALS

Radioactive liquid wastes are not authorized for drain disposal. All liquids generated as part of radioactive materials experiments must be collected and sampled for radioactivity. Any sample whose count rate is more than three standard deviations above background, (e.g**.,** a good approximation is: $bkg + (3\sqrt{bkg})$) is considered a statistically significant amount of radioactivity above background and must be collected for disposal through EH&S as radioactive waste. Any aqueous sample with a count rate below this threshold can be disposed of if they meet all other criteria laid out in this document. Mixed radioactive waste (waste containing both radioactive and chemical components) must be collected by EH&S for proper disposal.

2. ORGANIC CHEMICALS

All alkanes and water-insoluble hydrocarbons.
All chlorinated and brominated hydrocarbons.
EPA Priority Pollutants (see list below).
Specific commonly used Class C organic chemicals:

- benzene
- cyclohexane
- ethyl ether
- ethidium bromide
- hexane
- phenol and phenolic compounds
- toluene
- xylene
- ortho-phthalaldehyde (Cidex-OPA)
- chlorinated hydrocarbons
  - chloroform
  - carbon tetrachloride
  - methylene chloride (dichloromethane)
  - PCBs
  - tetrachloroethylene
  - trichloroethane
  - trichloroethylene
- chlorofluorocarbons (freons, halons)

3. INORGANIC CHEMICALS

Chemicals containing the following metals and compounds:

- antimony
- arsenic (including arsenate [AsO_3^-, AsO_4^{3-}] and arsenite [AsO_2^-])
- beryllium
- cadmium
- chromium (including chromate and dichromate)
- copper
- cyanides, cyanates (OCN^-), thiocyanates (SCN^-)
- lead
- mercury
- nickel

selenium
silver, including photographic fixer
thallium
zinc

Specific commonly used Class C inorganic chemicals:

sodium azide
sodium cyanide
chromium glassware cleaners- chromerge, chromium trioxide/sulfuric acid solutions
“biodegradable” liquid scintillation cocktails

4. EPA PRIORITY POLLUTANTS (40 CFR Part 122 Appendix D, Tables II and III)

TABLE II – ORGANIC TOXIC POLLUTANTS IN EACH OF FOUR FRACTIONS IN ANALYSIS BY GAS CHROMATOGRAPHY/MASS SPECTROSCOPY (GS/MS)

Volatiles

1V	acrolein
2V	acrylonitrile
3V	benzene
5V	bromoform
6V	carbon tetrachloride
7V	chlorobenzene
8V	chlorodibromomethane
9V	chloroethane
10V	2-chloroethylvinyl ether
11V	chloroform
12V	dichlorobromomethane
14V	1,1-dichloroethane
15V	1,2-dichloroethane
16V	1,1-dichloroethylene
17V	1,2-dichloropropane
18V	1,3-dichloropropylene
19V	ethylbenzene
20V	methyl bromide
21V	methyl chloride
22V	methylene chloride
23V	1,1,2,2-tetrachloroethane
24V	tetrachloroethylene
25V	toluene
26V	1,2-trans-dichloroethylene
27V	1,1,1-trichloroethane
28V	1,1,2-trichloroethane
29V	trichloroethylene
31V	vinyl chloride

Acid Compounds

1A	2-chlorophenol
2A	2,4-dichlorophenol
3A	2,4-dimethylphenol
4A	4,6-dinitro-o-cresol
5A	2,4-dinitrophenol
6A	2-nitrophenol
7A	4-nitrophenol
8A	p-chloro-m-cresol
9A	pentachlorophenol
10A	phenol
11A	2,4,6-trichlorophenol

Base/Neutral

1B	acenaphthene
2B	acenaphthylene
3B	anthracene
4B	benzidine
5B	benzo(a)anthracene
6B	benzo(a)pyrene
7B	3,4-benzofluoranthene
8B	benzo(ghi)perylene
9B	benzo(k)fluoranthene
10B	bis(2-chloroethoxy)methane
11B	bis(2-chloroethyl)ether
12B	bis(2-chloroisopropyl)ether
13B	bis(2-ethylhexyl)phthalate
14B	4-bromophenyl phenyl ether
15B	butylbenzyl phthalate
16B	2-chloronaphthalene
17B	4-chlorophenyl phenyl ether
18B	chrysene
19B	dibenzo(a, h)anthracene
20B	1,2-dichlorobenzene
21B	1,3-dichlorobenzene
22B	1,4-dichlorobenzene
23B	3,3'-dichlorobenzidine
24B	diethyl phthalate
25B	dimethyl phthalate
26B	di-n-butyl phthalate
27B	2,4-dinitrotoluene
28B	2,6-dinitrotoluene
29B	di-n-octyl phthalate
30B	1,2-diphenylhydrazine (as azobenzene)
31B	fluroranthene
32B	fluorene
33B	hexachlorobenzene
34B	hexachlorobutadiene
35B	hexachlorocyclopentadiene
36B	hexachloroethane
37B	indeno(1,2,3-cd)pyrene
38B	isophorone
39B	naphthalene
40B	nitrobenzene
41B	N-nitrosodimethylamine
42B	N-nitrosodi-n-propylamine
43B	N-nitrosodiphenylamine
44B	phenanthrene
45B	pyrene
46B	1,2,4-trichlorobenzene

Pesticides

1P	aldrin
2P	alpha-BHC
3P	beta-BHC
4P	gamma-BHC
5P	delta-BHC
6P	chlordane
7P	4,4'-DDT
8P	4,4'-DDE
9P	4,4'-DDD
10P	dieldrin
11P	alpha-endosulfan
12P	beta-endosulfan
13P	endosulfan sulfate
14P	endrin
15P	endrin aldehyde
16P	heptachlor
17P	heptachlor epoxide
18P	PCB-1242
19P	PCB-1254
20P	PCB-1221
21P	PCB-1232
22P	PCB-1248
23P	PCB-1260
24P	PCB-1016
25P	toxaphene

Other

dioxins- 2,3,7,8 tetrachloro-dibenzo-p-dioxin (TCDD) and others
asbestos

TABLE III – OTHER TOXIC POLLUTANTS (METALS AND CYANIDE) AND TOTAL PHENOLS

antimony, total
arsenic, total
beryllium, total
cadmium, total
chromium, total
copper, total
lead, total
mercury, total
nickel, total
selenium, total
silver, total
thallium, total
zinc, total
cyanide, total
phenols, total

Appendix IV – Additional Guidance on the Determination of Solubility

There are many approaches that may be used to determine a chemical compound's solubility in water. The following discusses two of the more common approaches.

The solubility class of the compound to be released could be determined directly from common literature data (e.g., *Handbook of Chemistry and Physics* - CRC Press, and *Lange's Handbook of Chemistry* - McGraw-Hill Book Company). If a compound is classified as "**vs**' (very soluble) or "**s**" (soluble), this would indicate the compound is "**readily soluble**." On the other hand, if it is classified as "**i**" (insoluble), "**sls**" (slightly soluble), or "**vsls**" (very slightly soluble), this would indicate materials that are "**not readily soluble**." Certain compounds are designated as class "**d**" (decompose). Additionally, if the decomposed species of these compounds are classified as either '**vs**' or '**s**,' this would indicate that the parent compound is "**readily soluble**." If these decomposed species are simple ions, such compounds (class 'd') should be considered "**readily soluble**."

Compound solubilities (g/100 ml or mole fraction per 100 ml) are also listed in the chemical literature. From a review of general scientific literature, "**formal solubilities**" **greater than 0.003 mole/liter** would indicate the compound is **readily soluble**. Formal solubilities **less than 0.003 mole/liter** would indicate compounds that are "**not readily soluble**."

Solubility information is readily available from the supplier. Materials that are "**NRS**" or "**Unknown**" indicate these materials **MAY NOT** be disposed to the campus sanitary sewer system. **ONLY** materials that have a solubility of **RS** can be disposed to the sanitary sewer system.

Solubility Product (Ksp) Determination: The solubility product constant of the compound could also be used to determine if a compound is readily soluble in water. The solubility product constant, Ksp, for a strong electrolyte MmAa, is expressed as:

$$Ksp = [M]^{m} [A]^{a}$$

where "[M]" and "m" are the ionic concentration (mole/liter) and the number of moles, respectively, of the dissolved cation; and [A] and "a" are the ionic concentration and the number of moles, respectively, of the dissolved anion.

For a simple electrolytic compound, with one mole of a dissolved cation species and one mole of a dissolved anion species, a Ksp greater than 1.00 E-05 mole/liter would indicate that a compound is readily soluble. For other compounds with more complex dissolution reactions (i.e., more than one mole dissolved for each species and/or more anionic or cationic species present in the dissolved products), the Ksp constant would increase exponentially, based on the number of moles and/or the number of dissociated species. For example, if three moles are present (two for the anion and one for the cation), the unit of Ksp would be:

$Mole^3/liter^3$, and the corresponding Ksp would be $(1\ E\text{-}05)^{3/2}$ or
3.2 E-08 mole/liter; the same principle could be applied for more complex dissolution reactions.

Formal Solubility Determination: Compound solubility (g/100 ml or mole fraction per 100 ml) are also listed in the chemical literature. From a review of general scientific literature, "formal solubilities" greater than 0.003 mole/liter would indicate that a compound is readily soluble.

The general relation between the formal solubility, Sf, and the solubility product, Ksp, of a strong electrolyte MmAa in water is given by:

$$Sf = (Ksp/(m^{m}\ a^{a}))^{1/(m+a)}$$

where Ksp is the solubility product, [M] is the molar concentration of the metal ion (cation), [A] is the molar concentration of the anion, "m" is the number of moles of dissolved cation per mole of

dissolved substance, and "a" is the number of moles of the dissolved anion per mole of dissolved substance.

A formal solubility of less than 0.003 mole/liter indicates a compound that is not readily soluble.

It should be pointed out that all values mentioned above (e.g., solubility class, formal solubility, and solubility product) correspond to measurements taken under standard conditions (e.g., 25^{ø}C, 101.3 kPa, pH of 7, and Eh of 0).

If material to be released would not qualify as being readily soluble, it will require an exemption from the campus requirements. Exemptions are judged on a case-by-case basis. A permit for disposal of these materials may be granted, if it is demonstrated that release to sanitary sewerage is consistent with applicable regulations and in the public interest.

References

For further discussion on the determination of solubility products and formal solubility, refer to Chapter 6, "Precipitation and Dilution," from Water Chemistry, by Vernon L. Snoeyink and David Jenkins (John Wiley and Sons: 1983) or texts relating to physical and/or analytical chemistry.

Annual Book of ASTM Standards. Volume 11.01, "Water (I)." American Society for Testing and Materials, Easton, MD, 1989.

CRC Handbook of Chemistry and Physics. CRC Press, Inc., Boca Raton, FL, 65th ed, 1984.

Lange's Handbook of Chemistry. McGraw-Hill, Inc., New York, NY, 13th ed, 1985.

Snoeyink, Vernon L. and David Jenkins, Water Chemistry. John Wiley & Sons, Inc., New York, NY, 1980.

Standard Methods for the Examination of Water and Wastewater. American Public Health Association, Washington, DC, 17th ed, 1989.

Appendix V – Decision Making Tree

Implementation of the UC Berkeley Drain Disposal Requirements for Chemicals

Notice: EBMUD regularly monitors campus wastewater. Failure to comply with wastewater discharge regulations could lead to fines of up to $25,000 per day and/or restrictions on University water use.

Hazardous Wastes

Hazardous wastes are prohibited from discharge. Chemical wastes are hazardous if they are:

- corrosive
- reactive
- ignitable
- moderately or highly toxic

General Rules for Sanitary Drain Disposal

Only water-soluble substances may be disposed of in sinks, toilets, and floor drains. Solutions should be flushed down the drain with an appropriate amount of water. (Residue animal or vegetable fats and oils generated as a result of normal cleaning activities are an exception to the solubility rule. However, significant amounts of these oils and fats (more than a 500 ml, approximately) can cause clogging in interior drains and so should be collected and disposed of appropriately.

Only solutions in the range of pH 5-10 may disposed of in the sink, unless at the Richmond Field Station where compounds must be in the pH range 6 – 10,

Highly toxic, malodorous, or lachrymatory (that is, those that cause strong eye irritation) chemicals shall not be disposed of down the drain.

Old, unwanted, or waste chemicals and products must not be poured down the drain as a means of disposal. These materials must be picked up EH&S personnel.

Specific Process for Laboratory Drain Disposal

Step One

- Do you know the chemical identity of the material and the concentration?
- Are you sure that the material is not hazardous (corrosive, reactive, ignitable, moderately or highly toxic).
- Is the pH between 5 and 10? (Unless at the Richmond Field Station, where compounds must be in the pH range 6 – 10.)

If the answer to any of the above is **NO**, the material cannot be disposed of to the sewer.
If the answer to all of the above is **YES**, proceed.

Step Two

Is the material a Class A? (chemicals that pose little or no hazard in dilute aqueous solution). Class A chemicals include many simple organic and inorganic compounds, as well as common inorganic chemicals. Included in Class A are most normal biological metabolites and non-toxic cellular constituents (proteins, nucleic acids, carbohydrates, soluble fats, and their precursors and

catabolites). A partial list of Class A chemicals, derived from state regulations and Appendix K of Reference 2, is provided in Appendix I.

If **YES**, these aqueous solutions are suitable for disposal down the drain in quantities of up to approximately
100 g of solute per laboratory per day (e.g. 100 g of ethanol in one liter of water).
If **NO**, continue.

Step Three

Is the material a Class B? (chemicals of moderate hazard in dilute aqueous solution). Class B chemicals include all of the chemicals listed as toxic (T) in the California Code of Regulations Section 22-66261.30 et. seq. that are water soluble, except for those listed as Class A chemicals in Appendix I or Class C chemicals in Appendix III. Class B chemicals also include all inorganic salts listed in reference 2 as high hazard in tables 6.1 and 6.2. A partial list of Class B chemicals appears in Appendix II.

If **YES**, these aqueous solutions are suitable for disposal down the drain with excess water in quantities no greater than 1 g of solute per laboratory per day).
If **NO**, continue.

Step Four

Is the material a Class C? (chemicals that may not be drain disposed in any amount except by written approval of the LOSC or their delegate). Class C chemicals include all chemicals that are not soluble as defined above, chemicals that cause unacceptable concentrations of offensive, toxic, or explosive vapors, and chemicals that are toxic or reactive at concentrations below 1 ppm in aqueous solution. Class C chemicals include the chemicals identified in the Main Campus EBMUD Wastewater Discharge Permit "Priority Pollutant Management Plan" Compliance Requirement (Federal Clean Water Act priority pollutants listed in 40 CFR Part 122 Appendix D, Tables II and III). A partial list of Class C chemicals appears in Appendix III.

If **YES**, these aqueous solutions are not suitable for disposal down the drain. However, you may ask for a specific exception by making a request to the LOSC. Contact EH&S to determine how this request is made.
If **NO**, contact EH&S for assistance in classifying your material for disposal purposes or to arrange pick-up of this material for proper disposal.

Note: **Radioactive material** may NOT be disposed of down the sewer.

Drain Disposal Restrictions References

"Prudent Practices for Disposal of Chemicals from Laboratories," National Academy Press, Washington D.C., 1983.

"Prudent Practices for Handling of Hazardous Chemicals in Laboratories," National Academy Press, Washington D.C., 1981

For questions related to these Drain Disposal Restrictions, please contact:
Office of Environment, Health & Safety
Main Number: **642-3073** Email: ehs@berkeley.edu