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Compiling an Inventory of Possible Contaminating Activities for Source Areas and Protection Zones

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This booklet is part of a series of educational brochures and slide sets that focuses on various aspects of water source protection. The series has been prepared jointly by the University of California Agricultural Extension Service and the California Department of Health Services.

For further information about this and other documents in the series, contact the project team leader (see below) or visit the following website:

www.dhs.ca.gov/ps/ddwem/dwsap/DWSAPindex.htm

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Probably the most time-consuming, element of any drinking water source assessment program is the inventory of possible contaminating activities (PCAs) within source areas and protection zones. PCAs are activities, industries, or land uses considered to be potential origins of contamination to a drinking water supply.

An inventory of PCAs can serve at least three important functions:

- It can help to identify past, present, and future (proposed) activities that might pose a threat to the drinking water supply, by causing or fostering the release of contaminants. These activities may include transporting, storing, manufacturing, producing, using, or disposing of industrial chemicals, agricultural chemicals, or other potential contaminants. Historic activities are important to include, as are activities that may contribute to a cumulative impact by a potential contaminant that may otherwise be considered somewhat innocuous.
- It can provide information on the existence of PCAs and the proximity of each PCA to the drinking water source.
- It can provide an effective means of educating the public about potential problems.

Although there are various steps in developing the PCA inventory, the process should be viewed as an iterative one. If a type of possible contaminating activity occurs within a zone, then there is a potential origin of contamination, and this would be indicated in the initial phases of the source assessment. Additional review may provide site-specific information indicating that the activity is not a potential origin of significant contamination. For example, a septic system far from a well may be of less importance than one nearby, in terms of its microbiological significance. On the other hand, a PCA may be important even though it is a great distance away from the source, because of the particular contaminant(s) associated with it, or because of the characteristics of the PCA or the drinking water source.

The information obtained for the PCA inventory may be helpful in refining the delineation process described in other booklets in this series. In addition, iterations of the PCA inventory and delineations of the source area and protection zones are important in the vulnerability analysis and voluntary protection programs.

Gasoline filling stations are nearly always classified as Very High Risk PCAs, due to the potential for leaks from underground fuel storage tanks. Spills of fuel or oil are also a concern.

Two Approaches

For a *minimum* source water assessment, a PCA inventory focuses on identifying whether a *type* of activity (PCA) exists within a source area or protection zone. Neither the exact location nor the number of sites of that type of PCA need be determined.

The alternative is to do a more detailed assessment. For that, the water system can include in the inventory specific PCA locations and the density (number of facilities) for a PCA type. This latter approach is particularly useful if a source protection program is anticipated.

Sources of Information

DHS has included on its Internet site (refer to the box on this page) a list of agencies and organizations that may be useful sources of information when preparing a PCA inventory. DHS will update and maintain the list, but will not be responsible for the quality of, or for updating the data of, other agencies. Accessing this list and examining the data of other agencies could be a useful first step when conducting a PCA inventory.

Information from the statewide data sources must be supplemented with local information. Local agencies sometimes can provide information on the presence or location of: septic systems, livestock operations, storm

DHS Website

The address of the DHS website for the Drinking Water Source Assessment Program is as follows:

http://www.dhs.ca.gov/ps/ddwem/dwsap/DWSAPindex.htm

water runoff, recreational bathing beaches, and other PCAs. Hazardous substance databases may be available, too. Such databases often are maintained by local fire departments, county environmental health departments, and county agricultural commissioners.

Much of the information for PCA inventories can be obtained through research of written documents and by review of land use data. Conducting surveys and field reconnaissance are also useful activities. Each of these methods is described in more detail below.

Written documents include those maintained by federal, state, and local agencies, such as lists, inventories, records and other items, that would identify the following: underground or above ground storage tanks, federal Superfund sites, contamination sites, landfill locations, septic systems, and other state- and locally-regulated activities.

In California, Certified Unified Program Agencies (CUPAs) regulate underground storage tanks, above ground tanks, hazardous waste generators, and hazardous waste on-site treatment. These CUPAs maintain records on the facilities they regulate and may be a good source of information for a PCA inventory.

Other written documents include telephone directories, business records, property tax records, news articles, and historical or archival information. Commercial database compilation products, such as VistaCheck and EDR, may be useful in conducting a PCA inventory. Information about these products may be found on the Internet.

Land use data can help identify possible contaminating activities or sources of pollution. Such data can often be extracted from information made available by local planning or building departments, such as aerial photographs, topographic maps, zoning maps, and building permits. Some local land use planning agencies have built databases and GIS systems that identify the current land use for each parcel.

Surveys may prove useful to confirm or supplement information collected by other means. The surveys can be prioritized, by type of PCA or by zone. Types of surveys include mail questionnaires, telephone surveys, personal interviews, and automobile windshield ("drive by") surveys.

A field review may be helpful to identify additional PCAs. It also is one way to look for potential sources of contamination not clearly identified by other methods. Items to document could include: abandoned or improperly destroyed wells, closely spaced septic systems, point source and non-point source contaminants, unauthorized activities, and changes in business use.

Steps to Follow

The purpose of the PCA inventory is twofold: (1) to identify the existence of past, present, and proposed activities that might be a potential threat to the water supply, and (2) to estimate the proximity of the PCAs to the water supply.

The steps involved in a PCA inventory are as follows:

(1) Assemble Resources

The initial list of types of PCAs should include known sources of contamination. It should also include high-risk activities within or near the recharge area, watershed, or protection zones, and other activities that the inventory preparer feels should not be overlooked in the inventory process. DHS has prepared a list displaying the types of PCAs frequently of concern when protecting drinking water sources (see Table 2). This list should be reviewed to identify activities that exist near the source.

Before proceeding with the inventory, resources should be assembled that will assist in locating PCAs: DHS's Internet site data directory, land use maps, files, and for the names and phone numbers of people that may have current or historical knowledge of the study area.

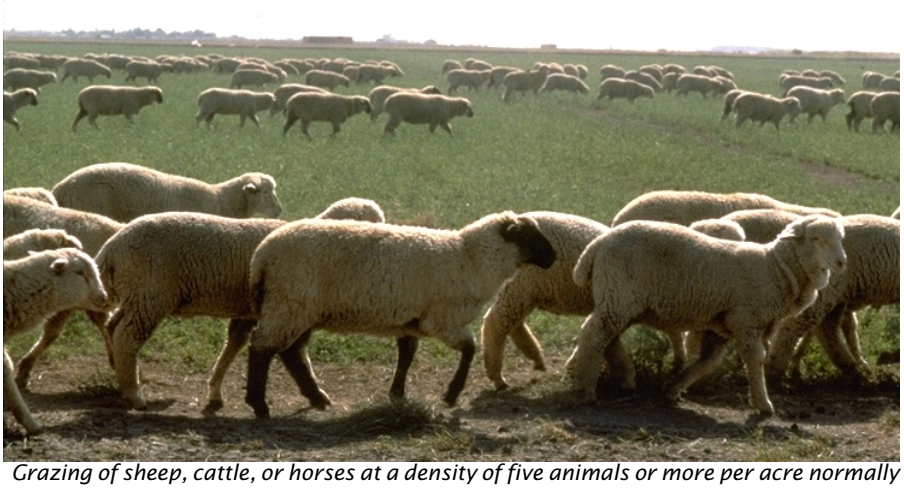
Contaminants of Concern

If any of the following contaminants of concern are associated with an activity, then that activity must be included in the PCA inventory:

- Microorganisms of importance in drinking water, including fecal coliform bacteria, *Escherichia coli*, viruses, *Giardia lambia*, and *Cryptosporidium*.
- Chemicals for which maximum contaminant levels (MCLs) or California drinking water action levels have been established, and unregulated chemicals in drinking water for which monitoring is required.
- Turbidity or high total organic carbon (TOC). Turbidity can adversely affect treatment and can interfere with the monitoring of microbiological contaminants. High TOC may increase the level of disinfection byproducts, which may be of concern because in some situations they can be carcinogenic.

(2) Prepare PCA Inventory Form

DHS has developed PCA Inventory Forms for surface water sources and for groundwater sources. The PCA inventory forms should not be considered complete lists of all potential origins of contamination. If a type of PCA of concern from the initial review step is not on an inventory form, it may be added to the appropriate inventory form. Note, however, that there are over 100 PCAs listed on the DHS forms. Most activities of significance generally fit into one or another of the PCAs on the DHS forms. Other forms may be acceptable for the PCA inventory. The format to use should be determined in consultation with DHS.



Grazing of sheep, cattle, or horses at a density of five animals or more per acre normally is considered to be a Moderate Risk PCA. If such activity occurs within Zone A, it is considered a High Risk PCA.

Tables 3, 4, 5 and 6 list various types of possible contaminating activities, differentiated by potential risk to a water supply (very high, high, moderate, and low). Those tables provide a means of ranking the types of PCAs for the vulnerability analysis. DHS's inventory forms for surface water sources and groundwater sources incorporate the information from the tables. The risk rankings are based on the general nature of activities and the contaminants associated with them (refer to Table 2), not on facility-specific management practices. Instead, such management practices may be considered in the vulnerability analysis, and should be considered in a protection program.

The list of PCAs and the associated risk rankings were developed after reviewing EPA's guidance documents, other state programs, input from advisory committees, and reviewers' comments regarding the DWSAP program. The risk ranking for each type of PCA is based on the relative risk of a drinking water supply to the contaminants associated with that PCA. The risk ranking may change based on the zone in which the PCA occurs. For example, PCAs associated with microbiological contamination (septic systems, animal facilities, sewer lines) are a very high risk if located within Zone A. Outside of this area they are considered less of a risk because the bacteria and viruses die off over time.

(3) Conduct PCA Inventory

The initial review of the PCA inventory may be best performed by an individual or group who has knowledge of the activities that presently occur, or have occurred in the past, around the drinking water source. The initial review could be done with an assessment map (showing drinking water source, source area, and zones) and other maps that may be available.

During the initial review, those persons conducting the assessment should attempt to narrow down the list of PCAs, eliminating types of PCAs that do not occur and noting the proximity (zone) of the types of PCAs whose existence is known.

After the initial review, the PCA inventory should be completed using other readily available resources. The tasks may include: consultation with various government agency or water system staff (especially for historical information), review of maps and files, access to electronic data sources, and field visits.

Again, it is not the intent of the basic DWSAP assessment program to identify the exact location of each and every PCA within the source area and protection zones. The assessments are intended as a first step in an on-going, iterative process. The initial PCA inventory should be considered an identification of the types of PCAs that exist within the delineated area(s). A water purveyor may desire to do a more detailed PCA inventory as part of a source water protection program. As more detailed information becomes available, it is useful to include these in the assessment.

(4) Complete PCA Inventory Checklists

The fourth step is to complete the PCA checklists, noting the area or zone(s) in which PCAs occur. DHS's minimum PCA inventory is a "Presence/Absence" review. For that level of assessment, the intent is merely to determine whether a type of PCA exists within a zone, not how many facilities of that type there are, or the exact locations of the facilities.

If a facility includes multiple activities that are PCAs, each one should be noted on the PCA inventory. For example, a gas station may have had a leaking tank sometime in the past and a known contaminant plume, yet now has an upgraded tank. All of these PCAs should

be noted in the inventory for the zone in which the gas station is located.

If any contaminants have been detected in the water supply, the PCA inventory should indicate the type of PCAs that are the most likely sources of the contaminants.

It should be noted that the initial PCA inventory might be based on general information and approximations. The inventory should not be used as an endpoint for targeting source protection efforts and resources, but as a starting point for further investigation. One should never assume that an assessment map and PCA inventory contain all possible contaminating activities or activity types, nor should one assume that all possible contaminating activities noted in the inventory are actual contamination sources.

(5) Prepare Map

As an option, if the information is available, the locations of some PCAs may be shown as points or symbols on the assessment map. If a water system has a map that more clearly indicates the location of PCAs (e.g., parcel, land use, or service area maps) this may be submitted in addition to the assessment map.

Identifying specifically a PCA, in terms of name and address, is not needed for DHS's minimum assessment. For example, if one or more gas stations are located within Zone A, B5, or B10 of a well, for purposes of the assessment, the presence of the facilities and the general proximity to the water source are the most significant information.

Information regarding ownership or other specifics of any site or business activity can be acquired from various public agencies, should such information prove necessary for local protection programs or other purposes.

Concern has been expressed about lumping together all facilities of a type of activity as one PCA without taking into account whether an individual facility is small or large, or whether it poses an actual risk (based on historical contamination), or a potential risk, based on its specific business operations. For DHS's minimum assessment, the source is considered just as vulnerable to a type of PCA whether there are multiple facilities or one.

Table 1: Maximum Contaminant Levels, Action Levels, & Unregulated Chemicals Requiring Monitoring

The following must be monitored in California drinking water:

- Maximum Contaminant Levels (MCLs) are primary and secondary drinking water standards. They are enforceable regulatory levels, under the Safe Drinking Water Act, and must be met by all public drinking water systems to which they apply.
- Primary MCLs are established for a number of chemical and radioactive contaminants. Primary MCLs can be found in *Title 22 California Code of Regulations* (*CCR*) for inorganic chemicals (§64431), trihalomethanes (§64439), radioactivity (§64441 and §64443) and organic chemicals (§64444).
- Secondary MCLS, which are set for taste, odor, or appearance of drinking water, are presented in 22 CCR §64449. Secondary MCLs exist for more than a dozen chemicals and characteristics.
- Lead and copper have specific regulations in 22 CCR, Chapter 17.5 §64670 et seq. The lead and copper regulations use the term "action level" for each substance, for purposes of regulatory compliance.
- Action Levels (ALs), except for lead and copper as described above, are advisory levels for unregulated chemicals, and are not enforceable standards. DHS recommends that drinking water utilities provide public notification, if ALs are exceeded.If sources exceeding ALs are taken out of service, notification is not needed.
- Some chemicals are "unregulated" but have certain monitoring requirements, as set forth in 22 CCR §64450. A number of unregulated chemicals may or may not require monitoring, depending on the vulnerability of drinking water systems.

Lists of the primary and secondary MCLs, action levels, and unregulated chemicals requiring monitoring are posted on the DHS website (http://www.dhs.ca.gov/ps/ddwem/chemicals/chemindex.htm). These lists are updated regularly.

Table 2: Potential Sources of Water Contaminants

COMMERCIAL/INDUSTRIAL

Potential Source	Water Contaminant[1,2,3]
Automobile body shops/repair shops	Waste oils; solvents; acids; paints; automotive wastes;[4] miscellaneous cutting oils
Automobile car washes	Soaps; detergents, waxes; miscellaneous chemicals, hydrocarbons
Automobile gas stations/ sumps	Oils; solvents; miscellaneous wastes
Automobile car washes	Soaps; detergents, waxes; miscellaneous chemicals, hydrocarbons
Boat Services/repair/refinishing	Diesel fuels; oil; septage from boat waste disposal area; wood preservative and treatment chemicals; paints; waxes; varnishes; automotive wastes[4]
Automobile car washes	Soaps; detergents, waxes; miscellaneous chemicals, hydrocarbons
Cement/concrete plants	Diesel fuels; solvents; oils; miscellaneous wastes; salts, high pH
Chemical/petroleum processing/storage	Hazardous chemicals; solvents; hydrocarbons; heavy metals; asphalt
Dry cleaners	Solvents (perchloroethylene, petroleum solvents, Freon); spotting chemicals (trichloroethane, methylchloroform, ammonia, peroxides, hydrochloric acid, rust removers, amyl acetate)
Electrical/electronic manufacturing	Cyanides; metal sludges; caustic (chromic acid); solvents; oils; alkalis; acids; paints and paint sludges; calcium fluoride sludges; methylene chloride; perchloroethylene; trichloroethane; acetone; methanol; toluene; PCBs
Fleet/trucking/bus terminals	Waste oil; solvents; gasoline and diesel fuel from vehicles and storage tanks; fuel oil; other automotive wastes[4]
Food processing	Nitrates; salts; phosphorus; miscellaneous food wastes; chlorine; ammonia; ethylene glycol
Funeral services/graveyards	Formaldehyde; wetting agents; fumigants; solvents; leachate; lawn and garden maintenance chemicals[5]
Furniture repair/manufacturing	Paints; solvents; degreasing and solvent recovery sludges; lacquers; sealants
Hardware/lumber/parts stores	Hazardous chemical products in inventories; heating oil and fork lift fuel from storage tanks; wood-staining and treating products such as creosote; paints; thinners; lacquers; varnishes
Home manufacturing	Solvents; paints; glues and other adhesives; waste insulation; lacquers; tars; sealants; epoxy wastes; miscellaneous chemical wastes
Junk/scrap/salvage yards	Automotive wastes [4]; PCB contaminated wastes; any wastes from businesses[6] and households[7]; oils; lead
Machine shops	Solvents; metals; miscellaneous organics; sludges; oily metal shavings; lubricant and cutting oils; degreasers (tetrachloroethylene); metal marking fluids; mold-release agents
Medical/vet offices	X-ray developers and fixers[8]; infectious wastes; radiological wastes; biological wastes; disinfectants; asbestos; beryllium; dental acids; miscellaneous chemicals
Metal plating/finishing/ fabricating	Sodium and hydrogen cyanide; metallic salts; hydrochloric acid; sulfuric acid; chromic acid; boric acid; paint wastes; heavy metals; plating wastes; oils; solvents
Mines/gravel pits	Mine spills or tailings that often contain metals; acids; highly corrosive mineralized waters; metal sulfides; metals; acids; minerals sulfides; other hazardous and nonhazardous chemicals[9]

Table 2: Potential Sources of Water Contaminants *(continued)*

COMMERCIAL/INDUSTRIAL, *continued*

Potential Source	Water Contaminant[1,2,3]
Office buildings/complexes	Building wastes[6]; lawn and garden maintenance chemicals[5]; gasoline; motor oil
Parking lots/malls (> 50 spaces)	Hydrocarbons; heavy metals; building wastes[6]
Photo processing/printing	Biosludges; silver sludges; cyanides; miscellaneous sludges; solvents; inks; dyes; oils; photographic chemicals
Plastics/synthetics producers	Solvents; oils; miscellaneous organic and inorganics (phenols, resins); paint wastes; cyanides; acids; alkalis; wastewater treatment sludges; cellulose esters; surfacant; glycols; phenols; formaldehyde; peroxides; etc.
Research laboratories	X-ray developers and fixers[8]; infectious wastes; radiological wastes; biological wastes, disinfectants; asbestos; beryllium; solvents; infectious materials; drugs; disinfectants; (quaternary ammonia, hexachlorophene, peroxides, chlornexade, bleach); miscellaneous chemicals
Recreational vehicle (RV)/mini storage	Automobile wastes[4]; gasoline and diesel fuel from vehicles and storage tanks
Sewer lines	Sewage
Wood preserving/treating	Wood preservatives; creosote, pentachlorophenol, arsenic
Wood/pulp/paper processing and mills	Metals; acids; minerals; sulfides; other hazardous and nonhazardous chemicals[9]; organic sludges; sodium hydroxide; chlorine; hypochlorite; chlorine dioxide; hydrogen peroxide; treated wood residue (copper quinolate, mercury, sodium bazide); tanner gas; paint sludges; solvents; creosote; coating and gluing wastes

AGRICULTURAL/RURAL

Potential Source	Water Contaminant[1,2,3]
Confined animal feeding operations	Livestock sewage wastes; nitrates; phosphates; chloride; chemical sprays and dips for controlling insect, bacterial, viral and fungal pests on livestocks; coliform[10] and noncoliform bacteria; viruses; protozoa; total dissolved solids
Grazing animals, other animal operations	Livestock sewage wastes; nitrates; phosphates; coliform and noncoliform bacteria; protozoa, viruses; total dissolved solids
Dairies	Livestock sewage wastes; nitrates; total dissolved solids; salts; phosphates; potassium
Farm chemical distributors/application services	Pesticides[11]; fertilizers[12]; hydrocarbons from motor vehicles and storage tanks
Farm machinery repair	Automotive wastes[4]; welding wastes
Irrigated crops	Pesticides[11]; fertilizers [12]; nitrates; phosphates; potassium (can be worsened by over-watering)
Lagoons	Nitrates; livestock sewage wastes; salts; pesticides[11]; fertilizers[17]; bacteria
Nonirrigated crops	Pesticides[11]; fertilizers[12]; nitrates; phosphates; potassium
Pesticide/fertilizer/petroleum storage & transfer areas	Pesticides[11]; fertilizers[12]; petroleum residues
Rural homesteads	*Machine shops:* Automotive wastes[4]; welding wastes; solvents; metals; lubricants; sludges *Septic systems:* Septage; coliform[10] and noncoliform bacteria; viruses; nitrates; heavy metals; synthetic detergents; cooking andmotor oils; bleach; pesticides;[5,13] paints; paint thinner; photographic chemicals; swimming pool chemicals;[14] septic tank/cesspool cleaner chemicals;[15] elevated levels of chloride, sulfate, calcium, magnesium, potassium, and phosphate

Table 2: Potential Sources of Water Contaminants *(continued)*

AGRICULTURAL/RURAL, *continued* Potential Source	Water Contaminant[1,2,3]
Sludge application to land	Organic and inorganic chemicals, coliform and noncoliform bacteria, viruses, protozoa[16]
Agricultural Drainage	Pesticides[11]; fertilizers[12]; total dissolved solids; total organic carbon; nitrates

RESIDENTIAL/MUNICIPAL Potential Source	Water Contaminant[1,2,3]
Airports (maintenance/fueling areas)	Jet fuels; deicers; diesel fuel; chlorinated solvents; automotive wastes;[4] heating oil; building wastes[6]
Apartments and condominiums	Swimming pool maintenance chemicals[14] ; pesticides for lawn and garden maintenance and cockroach, termite, ant, rodent, and other pest control[5,13], wastes from on-site sewage treatment plants; household hazardous wastes[7]
Camp grounds/RV parks	Septage; gasoline; diesel fuel from boats; pesticides for controlling mosquitoes, ants, ticks, gypsy moths, and other pests[11,13]; household hazardous wastes from RVs[7]
Drinking water treatment plants	Treatment chemicals; pesticides[11]
Fire stations	General building wastes[6]; hydrocarbons from test burn areas
Golf courses	Fertilizers[12]; herbicides[11]; pesticides for controlling mosquitoes, ticks, ants, gypsy moths, and other pests[5]
Housing	*Household hazardous wastes*[7] Household cleaners; oven cleaners; drain cleaners; toilet cleaners; disinfectants; metal polishes; jewelry cleaners; shoe polishes; synthetic detergents; bleach; laundry soil and stain removers; spot removers and dry cleaning fluid; solvents; lye or caustic soda; household pesticides;[13] photo chemical; printing ink, paints; varnishes; stains; dyes; wood preservatives (creosote); paint and lacquer thinners; paint and varnish removers and deglossers; paint brush cleaners; floor and furniture strippers *Mechanical Repair and Other Maintenance Products:* Automotive wastes;[4] waste oils; diesel fuel; kerosene; #2 heating oil; grease; degreasers for driveways and garages; metal degreasers; asphalt and roofing tar; tar removers; lubricants; rustproofers; car wash detergents; car waxes and polishes; rock salt; refrigerants *Lawn/garden care:* Fertilizers;[11] herbicides and other pesticides used for lawn and garden maintenance[5] (can be worsened by over-watering) *Swimming pools:* Swimming pool maintenance chemicals[14] *Urban runoff/stormwater*[3]: Gasoline; oil; other petroleum products; microbiological contaminants
Landfills/dumps	Leachate; organic and inorganic chemical contaminants; waste from households[7] and businesses[6]; nitrates; oils; metals; solvents; sludge
Motor pools	Automotive wastes[4]: solvents; waste oils; hydrocarbons from storage tanks
Parks	Fertilizers[12]; herbicides[5]; insecticides[11,13]; (can be worsened by over-watering)
Railroad yards/maintenance/fueling areas	Diesel fuel; herbicides for rights-of-way[11]; creosote for preserving wood ties; solvents; paints; waste oils
Recreational use of surface water sources (body contact)	Microbiological contamination from swimmers
Recreational use of surface water sources (motorized watercraft)	Gasoline fuel from watercraft; marinas
Schools	Machinery/vehicle serving wastes; gasoline and heating oil from storage tanks; general building wastes[6]; pesticides[11,13]

Table 2: Potential Sources of Water Contaminants *(continued)*

RESIDENTIAL/MUNICIPAL, *continued*

Potential Source	Water Contaminant[1,2,3]
Septic systems	Septage; coliform[10] and noncoliform bacteria; viruses; nitrates; heavy metals; synthetic detergents; cooking and motor oils; bleach; pesticides;[5,13] paints; paint thinner; photographic chemicals; swimming pool chemicals;[14] septic tank/cesspool cleaner chemicals[15]; elevated levels of chloride, sulfate, calcium, magnesium, potassium, and phosphate; other household hazardous wastes[7]
Sewer lines	Sewage
Utility stations/maintenance areas	PCBs from transformers and capacitors; oils; solvents; sludges; acid solution; metal plating solutions (chromium, nickel, cadmium); herbicides from utility rights-of-way
Waste transfer/recycling stations	Residential and commercial solid waste residues
Wastewater	Municipal wastewater; sludge[16]; treatment chemicals[17]; nitrates; heavy metals; coliform[10] and noncoliform bacteria; nonhazardous wastes[16]

OTHER

Potential Source	Water Contaminant[1,2,3]
Above ground storage tanks	Heating oil; diesel fuel; gasoline; other chemicals
Construction/demolition areas (plumbing, heating, and air conditioning, painting, paper hanging, decorating, drywall and plastering, acoustical insulation, carpentry, flooring, roofing, and sheet metal etc.)	Solvents; asbestos; paints; glues and other adhesives; waste insulation; lacquers; tars; sealants; epoxy waste; miscellaneous chemical wastes
Historic gas stations	Diesel fuel; gasoline; kerosene
Historic waste dumps/landfills	Leachate; organic and inorganic chemicals; waste from households [7]; and businesses [6]; nitrates; oils; heavy metals; solvents
	Automotive wastes[4]; welding wastes
Hospitals	Various chemical and radiological substances, and microorganisms
Injection wells/drywells/sumps	Storm water runoff [3]; spilled liquids; used oils; antifreeze; gasoline; solvents; other petroleum products; pesticides[11]; and a wide variety of other substances
Managed forests	Pesticides; fertilizers; total dissolved solids
Medical/dental offices and clinics	Various chemical substances
Military installations	Wide variety of hazardous and nonhazardous wastes depending on the nature of the facility and operation[3,9]; diesel fuels; jet fuels; solvents; paints; waste oils; heavy metals; radioactive wastes
Seawater intrusion	Salinity, disinfection byproducts
Silviculture	Pesticides, fertilizers, total dissolved solids
Surface water - stream/lakes/rivers	Directly related to surface water quality in the stream, lake, or river which is recharging groundwater
Transportation corridors	Herbicides in highway right-of-way[11,5]; road salt (sodium and calcium chloride); road salt, anticaking additives (ferric ferrocyanide, sodium ferrocyanide); road salt anticorrosives (phosphate and chromate); automotive wastes[4]
Underground storage tanks	Diesel fuel; gasoline; heating oil; other chemical and petroleum products
Veterinary offices/clinics	Various chemical and radiological substances and microorganisms

Table 2: Potential Sources of Water Contaminants *(continued)*

OTHER, *continued* Potential Source	Water Contaminant[1,2,3]
Wells, agricultural (such as irrigation wells, abandoned wells)	Storm water runoff, irrigation water runoff, nitrates, pesticides, and other substances
Wells: gas, oil, geothermal	Various petroleum-related substances, inorganics
Wells such as water supply wells, monitoring wells, unsealed or abandoned wells, and test holes	Storm water runoff [3]; solvents; nitrates; septic tanks; hydrocarbons; and other substances

SOURCE: Adapted from EPA 1993 and the Oregon Wellhead Protection Program

[1] In general, source water contamination stems from the *misuse and improper disposal* of liquid and solid wastes; the *illegal dumping or abandonment* of household, commercial, or industrial chemicals; the *accidental spilling* of chemicals from trucks, railways, aircraft, handling facilities, and storage tanks; or the *improper siting, design, construction, operation, or maintenance* of agricultural, residential, municipal, commercial, and industrial drinking water wells and liquid and solid waste disposal facilities. Contaminants also can stem from *atmospheric pollutants*, such as airborne sulfur and nitrogen compounds, which are created by smoke, flue dust, aerosols, and automobile emissions, and which are removed from the atmosphere by wet or dry deposition, and runoff from or percolate through the soil. *When the sources listed in this table are used and managed properly, contamination is not likely to occur, or is likely to occur at low levels.*

[2] Contaminants can reach groundwater from activities occurring on the land surface, such as industrial waste storage; from sources below the land surface, but above the water table, such as septic systems; from structures beneath the water table, such as wells; or from contaminated recharge water.

[3] This table lists the most common wastes, but not all potential wastes. For example, it is not possible to list all potential contaminants contained in storm water runoff or from military installations.

[4] Automobile wastes can include gasoline; antifreeze; automatic transmission fluid; battery acid; engine and radiator flushes; engine and metal degreasers; hydraulic (brake) fluid; and motor oils.

[5] Common pesticides used for lawn and garden maintenance (i.e., weed killers, and mite, grub, and aphid controls) include such chemicals as 2,4-D; chlorpyrifos; diazinon; benomyl; captan; dicofol; and methoxychlor.

[6] Common wastes from public and commercial buildings include automotive wastes; and residues from cleaning products that may contain chemicals such a xylenols, glycol esters, isopropanol, 1,1,1,-trichloroethane, sulfonates, chlorinated phenols, and cresols.

[7] Household hazardous wastes are common household products that contain a variety of toxic or hazardous components.

[8] X-ray developers and fixers may contain reclaimable silver, glutaldehyde, hydroquinone, potassium bromide, sodium sulfite, sodium carbonate, thiosulfates, and potassium alum.

[9] The Resource Conservation and Recovery Act (RCRA) defines a hazardous waste as a solid waste that may cause an increase in mortality or serious illness or pose a substantial threat to human health and the environment when improperly treated, stored, transported, disposed of, or otherwise managed. A waste is hazardous if it exhibits characteristics of ignitability, corrosivity, reactivity, and/or toxicity. Not covered by RCRA regulations are domestic sewage; irrigation waters or industrial discharges allowed by the Clean Water Act; certain nuclear and mining wastes; household wastes; agricultural wastes (excluding some pesticides); and small quantity hazardous wastes (i.e., less than 220 pounds per month) generated by businesses.

[10] Coliform bacteria can indicate the presence of pathogenic (disease-causing) microorganisms that may be transmitted in human feces. Diseases such as typhoid fever, hepatitis, diarrhea, and dysentery can result from sewage contamination of water supplies.

[11] Pesticides include herbicides, insecticides, rodenticides, fungicides and avicides. EPA has registered approximately 50,000 different pesticide products for use in the United States. Many are highly toxic and quite mobile in the subsurface. An EPA survey found that the most common pesticides found in drinking water wells were DCPA (dacthal) and atrazine, which EPA classifies as *moderately toxic* (class 3) and *slightly toxic* (class 4) materials, respectively.

[12] The EPA National Pesticides Survey found that the use of fertilizers correlates to nitrate contamination of groundwater supplies.

[13] Common household pesticides for controlling pests such as ants, termites, bees, wasps, flies, cockroaches, silverfish, mites, ticks, fleas, worm, rates, and mice can contain active ingredients include naphthalene, phosphorus, xylene, chloroform, heavy metals, chlorinated hydrocarbons, arsenic, strychnine, kerosene, nitrosamines, and dioxin.

[14] Swimming pool chemicals can contain free and combined chlorine; bromine; iodine; mercury-based, copper-based, and quaternary algaecides; cyanuric acid; calcium or sodium hypochlorite; muriatic acid; sodium carbonate.

[15] Septic tank/cesspool cleaners include synthetic organic chemicals such as 1,1,1 trichloroethane, tetrachloroethylene, carbon tetrachloride, and methylene chloride.

[16] Municipal wastewater treatment sludge can contain organic matter, nitrates; inorganic salts, heavy metals; coliform and noncoliform bacteria; protozoa (giardia and cryptosporidium) and viruses.

[17] Municipal wastewater treatment chemicals include calcium oxide; alum; activated alum, carbon, and silica; polymers; ion exchange resins; sodium hydroxide; chlorine; ozone; and corrosion inhibitors.

Table 3: PCAs Associated with Very High Potential Risks

The following Possible Contaminating Activities (PCAs) are designated *very high risk* . These PCAs are considered to have the highest potential for contaminating drinking water.

COMMERCIAL/INDUSTRIAL

- Automobile-related activities: gas stations
- Chemical/petroleum processing/storage
- Dry cleaners
- Metal plating/ finishing/fabricating
- Plastics/synthetics producers

RESIDENTIAL/MUNICIPAL

- Airports - maintenance/fueling areas
- Landfills/dumps
- Septic systems* - High density (>1/acre); Very High in Zone A; otherwise, Moderate
- Wastewater Treatment Plants*; Very High in Zone A; otherwise, High

AGRICULTURAL/RURAL

- Animal Feeding Operations*; Very High in Zone A; otherwise, High
- Concentrated Aquatic Animal Production Facilities*; Very High for surface water in Zone A; otherwise, High
- Managed Forests* for surface water in Zone A

OTHER

- Underground injection of commercial/ industrial discharges
- Historic gas stations
- Historic waste dumps/landfills
- Injection wells/dry wells/sumps
- Known contaminant plumes
- Military installations
- Mining operations: historic or active
- Underground storage tanks: confirmed leaking tanks

*This PCA may be associated with microbiological contamination.

Railroad yards usually are counted as a High Risk PCA.

Table 4: PCAs Associated with High Potential Risks

The following Possible Contaminating Activities (PCAs) are designated *high risk*.They are considered to have less potential for contaminating drinking water than those designated *very high risk* (Table 3), but greater potential for contaminating drinking water than those designated *moderate risk* (Table 5), or *low risk* (Table 6).

COMMERCIAL/INDUSTRIAL

- Automobile related Activities: Body shops and Repair shops
- Boat services/repair/refinishing
- Chemical/petroleum pipelines
- Electrical/electronic manufacturing
- Fleet/trucking/bus terminals
- Furniture repair/manufacturing
- Home manufacturing
- Junk/scrap/salvage yards
- Machine shops
- Photo processing/printing
- Research laboratories
- Wood preserving/treating
- Lumber processing and manufacturing
- Wood/pulp/paper processing and mills
- Sewer collection systems*; High in Zone A; otherwise, Low

RESIDENTIAL/MUNICIPAL

- Railroad yards/maintenance/fueling areas
- Sewer collection systems*; High in Zone A; otherwise, Low
- Utility stations - maintenance areas
- Wastewater Treatment Plants*; Very High in Zone A; otherwise, High

AGRICULTURAL/RURAL

- Grazing* (> 5 animals/acre); High in Zone A; otherwise, Moderate
- Animal Feeding Operations*; Very High in Zone A; otherwise, High
- Other animal operations*; High in Zone A; otherwise, Moderate
- Concentrated Aquatic Animal Production Facilities; Very High in zones for surface water; otherwise, High
- Other aquatic animal operations; High in zones for surface water; otherwise, Moderate
- Farm chemical distributor/ application service
- Farm machinery repair
- Septic systems-low density* (<1/acre); High in Zone A; otherwise, Low
- Lagoons/liquid wastes*
- Machine shops
- Pesticide/fertilizer/petroleum storage and transfer areas
- Managed Forests; Very High in zones for surface water; otherwise, High
- Agricultural Drainage; High in Zone A; otherwise, Moderate
- Wells- Agricultural, Irrigation

OTHER

- NPDES/WDR permitted discharges
- Illegal activities/unauthorized dumping
- Mining – Sand/Gravel
- Wells- Oil, Gas, Geothermal
- Salt water intrusion
- Recreational area - surface water source*
- Underground storage tanks: either non-regulated tanks (tanks smaller than regulatory limit) or not yet upgraded or registered tanks
- Snow Ski Areas; High in zones for surface water; otherwise, Moderate
- Recent (< 10 years) Burn Areas; High in zones for surface water; otherwise, Moderate
- Dredging; High in zones for surface water; otherwise, Moderate

*This PCA may be associated with microbiological contamination.

Table 5: PCAs Associated with Moderate Potential Risks

The following Possible Contaminating Activities (PCAs) are designated *moderate risk*.They are considered to have less potential for contaminating drinking water than those designated *very high risk* (Table 3) and *high risk* (Table 4), but more potential for contaminating drinking water than those designated *low risk* (Table 6).

COMMERCIAL/INDUSTRIAL

- Car washes
- Parking lots/malls (>50 spaces)
- Cement/concrete plants
- Food processing*
- Funeral services/graveyards
- Hardware/lumber/parts stores

RESIDENTIAL/MUNICIPAL

- Septic systems - High density* (>1/acre); Very High in Zone A; otherwise, Moderate
- Drinking water treatment plants
- Golf courses
- Housing - High density (>1 house/0.5 acres)
- Motor pools
- Parks
- Waste transfer/recycling stations

AGRICULTURAL/RURAL

- Grazing* (> 5 animals/acre); High in Zone A; otherwise, Moderate
- Other animal operations*; High in Zone A; otherwise, Moderate
- Other aquatic animal operations; High in zones for surface water; otherwise, Moderate
- Crops, irrigated (berries, hops, mint, orchards, sod, greenhouses, vineyards, nurseries, vegetables)**
- Sewage sludge* (biosolids) land application
- Fertilizer, pesticide/herbicide application
- Managed Forests; Moderate for groundwater
- Agricultural Drainage; High in Zone A; otherwise, Moderate

OTHER

- Above ground storage tanks
- Wells – water supply
- Construction/demolition staging areas
- Contractor or government agency equipment storage yards
- Managed forests
- Transportation corridors: Freeways/state highways, Railroads, Historic railroad right-of-ways, Road right-of-ways (herbicide use areas)
- Hospitals
- Storm drain discharge points
- Storm water detention facilities
- Artificial recharge projects – non-potable water (includes recycled, storm, and untreated imported water): Injection wells and Spreading basins
- Snow Ski Areas; High in zones for surface water; otherwise, Moderate
- Recent (< 10 years) Burn Areas; High in zones for surface water; otherwise, Moderate
- Dredging; High in zones for surface water; otherwise, Moderate

* This PCA may be associated with microbiological contamination.
** Drip-irrigated crops are considered Low risks.

Table 6: PCAs Associated with Low Potential Risks

The following Possible Contaminating Activities (PCAs) are designated *low risk*.These PCAs are considered to have the least potential for contaminating drinking water .

COMMERCIAL/INDUSTRIAL

- Sewer collection systems*; High in Zone A; otherwise, Low
- Appliance/Electronic repair
- Office buildings/complexes
- Rental yards
- RV/mini storage

RESIDENTIAL/MUNICIPAL

- Sewer collection systems*; High in Zone A; otherwise, Low
- Apartments and condominiums
- Campgrounds/Recreational areas
- Fire stations
- RV parks
- Schools
- Hotels, Motels

AGRICULTURAL/RURAL

- Crops, non-irrigated (e.g., Christmas trees, grains, grass seeds, hay) or drip-irrigated
- Septic systems – low density* (<1/acre); High in Zone A; otherwise, Low

OTHER

- Underground storage tanks: Decommissioned - inactive; and Upgraded and/or registered – active
- Roads/Streets
- Artificial recharge projects - potable water: Injection wells and Spreading basins
- Medical/dental offices/clinics
- Veterinary offices/clinics
- Surface water - streams/lakes/rivers*
- Wells – Monitoring, test holes, borings

*This PCA may be associated with microbiological contamination.

Application of fertilizer or pesticide is usually considered a Moderate Risk PCA. This worker is spraying alfalfa near Winters, Calif., to suppress weevils.