B A C K G R O U N D D O C U M E N T NO. 4

HAZARDOUS WASTE MANAGEMENT SYSTEM: GENERAL; STANDARDS APPLICABLE TO OWNERS AND OPERATORS OF HAZARDOUS WASTE TREATMENT, STORAGE, AND DISPOSAL FACILITIES; AND HAZARDOUS WASTE PERMIT PROGRAM (40 CFR 260, 264, and 122)

Permitting of Land Disposal Facilities: Landfills

This document (ms. 1941.37) provides background information on EPA's proposed regulations for land disposal of hazardous waste

U.S. ENVIRONMENTAL PROTECTION AGENCY
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INTRODUCTION

Requirements for landfills were proposed on 18 December 1978 (43 FR 58946-59028). Numerous comments were received on that proposal at public hearings and as written comments. A summary of the comments and Agency responses, pertinent to the Part 264 regulations, is presented in Part II of this document. The reader is also referred to two other background documents:

(1) Background Document, Section 250.45-2, Standards for Landfills, U.S. EPA, Office of Solid Waste, December 15, 1978.

(2) Background Document, 40 CFR Part 265, Subpart N, Interim Status Standards for Landfills, U.S. EPA, Office of Solid Waste, May 2, 1980.

Numerous damage cases have been documented demonstrating the need to establish standards for landfills. Many are cited in the above referenced documents. The citations in those documents have been significantly amended, and are cited in full in this document. Additional information on the cited cases and additional examples af damage resulting from landfilled waste may be found in the Land Disposal Division Damage Case File, U.S. EPA, Office of Solid Waste.

A minor change has been made in the definition of a landfill in Part 260 to exclude seepage facilities from the definition.

I. NEED FOR REGULATION

A. Potential for Environmental Damage

EPA files contain many examples of environmental damage from improper land disposal of hazardous waste. Although damage to ground water is the most common occurrence, improper land disposal

has resulted in surface water and air pollution as well. The following discussion describes reported incidents involving the contamination of all these media as well as public health damage that has occurred.

An EPA ground water report, entitled "The Prevalence of Subsurface Migration of Hazardous Chemical Substances at Selected Industrial Waste Disposal Sites,"[1] investigated the likelihood of ground water contamination at hazardous waste land disposal sites. In this study, ground waters at 50 land disposal sites which received large quantities of industrial waste were sampled and analyzed. The sites selected were all located East of the Mississippi River, were representative of typical industrial land disposal facilities, and were situated in a wide variety of geologic environments. No previous contamination of ground water with hazardous substances had been reported at these facilities before sampling, and waste disposal had been in progress for a minimum of 3 years. At 43 of the 50 sites migration of one or more hazardous constituents was detected in the ground water. Twelve potentially hazardous inorganic constituents were detected in ground waters above background concentrations. The five most frequently detected were selenium, barium, cyanide, copper, and nickel in that order. Organic substances that were identified in ground waters included PCBs, chlorinated phenols, benzene and derivitives, and organic solvents.

At 26 sites, potentially hazardous inorganic constituents in the ground water from one or more of the monitoring wells exceeded the EPA drinking water limits. Of the potentially hazardous substances, selenium most frequently exceeded drinking water limits,

followed by arsenic, chromium, and lead.

Conclusions drawn from the study are:

- Ground-water contamination at industrial land disposal sites is a commom occurrence.
- Hazardous substances from industrial waste land disposal sites are capable of migrating into and with ground water.
- Few hydrogeologic environments are suitable for land disposal of hazardous waste without some risk of ground-water contamination.
- Continued development of programs for monitoring industrial waste land diposal sites is necessary to determine impact on ground-water quality.
- Many old industrial waste disposal sites, both active and abandoned, are located in geologic environments where ground water is particularly susceptible to contamination.
- Many waste disposal sites are located where the underlying aquifer system can discharge hazardous substances to a surface-water body.

B. Actual Damage Incidents

Numerous incidents of damage which resulted from improper land disposal are contained within EPA files. Some of those documented damage cases which support the need for these regulations are summarized below.

(1) Ground Water Contamination

- A landfill in Jackson Township, New Jersey was closed after it had contaminated approximately 100 drinking water wells. Analysis of water samples showed the presence of chloroform,

methylene chloride, benzene, toluene, trichloroethylene, ethylbenzene and acetone. Residents claim that premature deaths, kidney malfunctions, kidney removals, recurrent rashes, infections and other health related problems are due to the contaminated water supplies.[2]

- An industrial landfill in South Brunswick, New Jersey has been identified as the source of contamination of a number of residential wells adjacent to the facility. Significant levels of chloroform, toluene, xylene, trichloroethane and trichloroethylene have been found in well water.[3]
- A New Hanover County, North Carolina landfill which has accepted municipal and industrial wastes since 1972 has contaminated an underlying aquifer and several domestic wells to the extent that the water is hazardous for human consumption and other uses. Chemicals found in the residential wells at levels sufficient to adversely affect human health and the environment include tetrachloroethylene, benzene, vinyl chloride, trichloroethylene and 1,2-dichloroethane, all carcinogens, as well as methylene chloride and lead. In addition the presence of chlorides, dichlorophenol, chlorobenzene, iron, manganese, phenol and zinc, have rendered the water unfit for human consumption due to extreme bad taste or odor.[4]
- A company which engages in the distillation, recovery and disposal of industrial solvents in Southington, Connecticut has, through its improper handling, storage and disposal of hazardous wastes, contaminated the groundwater causing the

closure of three of the city's six wells. Chemicals found in the wells at levels which may adversely affect human health include: tetrachloroethylene, chloroform, trichloroethylene, 1,1,1,-trichloroethane, dichloroethane and carbon tetrachloride. In addition, soils and crops in the vicinity show very high levels of lead, reportedly from open burning of wastes at the site.[5]

- Chemical wastes in barrels were buried in two Plainfield, Connecticut gravel pits which resulted in groundwater contamination. The owner of the site was fined $25,000 and is paying for site cleanup, estimated at $750,000.[6]
- Wastes from a chemical company in Canton, Connecticut were disposed of in a dump between 1969 and 1972. Solvent type chemicals including carbon tetrachloride, methyl ethyl ketone, trichloroethylene and chloroform have contaminated eleven Canton wells. The estimated costs of extending water lines from nearby communities range from $145,000 to $379,000. The present owner of the dump has been ordered to clean up the site.[7]
- Tannery waste disposed of in the Saco, Maine town dump resulted in the contamination of private drinking water wells with chromium, iron and manganese.[8]
- Illegal dumping of chemical wastes in Rehobeth, Massachusetts resulted in the contamination of private wells and has threatened a reservior. Among the chemicals identified were toluene, trichloroethylene and ethyl acetate. The site was cleaned up by the State at a cost of $125,000.[9]

- Disposal of benzene, toluene, dichloroethylene, and other organics by an organic chemcial manufacturer in Acton, Massachusetts led to the loss of 45 percent of the municipal water supply. The company has agreed to pay for cleanup.[10]
- Seventeen private wells adjacent to a landfill at Exeter, New Hampshire were found to be contaminated with phenols, one of which was 750 times drinking water standards. The town has approved a $200,000 bond issue to supply public water to the area.[11]
- The Bristol, Rhode Island landfill has three illegal dump sites of chemical wastes. Toluene and trichloroethylene have been found at the site. The adjacent marshland and at least eleven wells have been contaminated by the site.[12]
- A Cumberland, Rhode Island landfill has been implicated in the closing of four municipal wells which became contaminated by tetrachloroethylene and 1,1,1,-trichloroethane.[13]
- A Deptford Township, New Jersey landfill which accepted chemical wastes resulted in the contamination of well water with cyanides and phenols at levels twice the recommended drinking water standards. In addition, fires have been reported at the site and workers have complained of skin and eye irritation as well as nausea.[14]
- Local residents began complaining in 1975 about water contamination in the area of a South Brunswick, New Jersey landfill. The site had accepted all types of chemical wastes, and significant amounts of organic chemicals were detected in six nearby wells. The State ordered the site

closed; however, damage to the aquifer is estimated at $300,000.[15]

- The 102nd Street landfill in Niagara Falls, New York was utilized for the disposal of hazardous wastes from the 1940's to 1972. Lindane, tetrachlorobenzene and phenol have migrated from the disposal site. The estimated cost to clean the site is $16,500,000.[16]
- The "S" area landfill in Niagara Falls, New York was utilized for the disposal of hazardous wastes between 1947 and 1975. Tetrachloroethylene and benzene hexachloride are migrating from the site and are entering the public drinking water supply. Remedial measures to clean this site are estimated at $50,000,000.[17]
- A landfill in Lehigh County, Pennsylvania which received industrial wastes contaminated a well which supplied water to about 50 homes. Excessive levels of phenols, ethyl acetate and trichloroethylene were present in the well water.[18]
- Rainwater and groundwater percolating through a landfill in Wilmington, Delaware produced a leachate containing high concentrations of iron, chlorides, ammonia, heavy metals and dissolved organics. The leachate migrated from the site and into the deeper Potomac aquifer used extensively in New Castle County for a water supply. At a cost of over $1,000,000 the County has installed wells to intercept contaminated groundwater in order to prevent the contamination of the public water supply wells.[19]
- Investigation of a landfill in Hillsborough County, Florida showed volatile organic groundwater contamination of six wells, three of which were for private residences and two wells

which served as community water supplies. Pending a long term solution, the County Health Department has instituted a bottled-water distribution program.[20]

- A landfill in New Hanover County, North Carolina which received industrial wastes has been shown to have contaminated 17 private wells in the vicinity. Approximately twenty additional private wells are in danger of becoming contaminated. The County is providing drinking water to residents with affected wells and plans are proceeding to provide a permanent outside water supply to the area. Court action is also proceeding against the State, County and operators of the landfill.[21]
- Leachate from a landfill accepting industrial waste near Aurora, Illinois has contaminated nine wells. Owners of the wells were forced to hook-up to the city of North Aurora's water lines.[22]
- An industrial landfill near Elkart, Indiana is the suspected source of contamination of six private wells with chromium at levels over 100 times the EPA drinking water standards. The problem was "remedied" by digging deeper wells. A recent USGS study is evaluating the extent of groundwater contamination.[23]
- In 1973, high levels of trichloroethylene (TCE) were found in the well of a private residence near Oscoda, Michigan. Over the following five years, seven other private residential wells and an industrial well became contaminated. The suspected source is the open dumping of TCE on the site of a nearby auto parts plant. Public water has been supplied to

the residents at a cost of $140,000.[24]

- Two illegal dumpsites in Oakland County, Michigan have been named as the source of PCB's, toxic solvents and other chemicals found in local wells in August 1979. Approximately 2000 drums were dumped at the sites 12 to 14 years ago. The cost to remove the drums from the site is estimated at $500,000.[25]
- Extremely high levels of PCB's in fish have resulted in an advisory against consuming fish from 129 miles of the Sheboygan, Mullet, and Onion Rivers in the State of Wisconsin. One suspected source of the chemical is a company which used wastes containing 10,000 parts per million PCB's as fill in the Sheboygan River floodplain. Remedial measures have been initiated by the Wisconsin Department of Natural Resources.[26]
- Instead of properly disposing of some drums containing unidentified residues, a disposal company dropped them at a dump located in Cabazon, California. A heavy rain unearthed the drums, which gave off poisonous gases and contaminated the water.[27]
- An old gravel quarry near Spokane, Washington was used to dispose of aluminum processing wastes until it was closed by a county order. The shallow perched water table has been contaminated by chlorides. The county has issued an order directing remedial actions at the site. The owner has agreed to do additional groundwater monitoring and to evaluate alternative remedial measures.[28]
- Water that had been used to wash RDX (a high explosive) out of shells leached from a dump in Kitsap County, Washington

and contaminated groundwater. The U.S. Navy spent $150,000 on a monitoring program, final costs might reach $1,000,000.[29]

- Grasshopper bait, a pesticide containing arsenic trioxide, was being buried on a farm near Perham, Minnesota between 1934 and 1936. In 1972, 36 years later, a well was drilled near the burial site to supply water for employees in a newly built office facility. Eleven of the thirteen employees of the facility became ill from arsenic poisoning. Two required hospitalization and treatment. One lost the use of his legs for about six months due to severe neuropathy. Analysis of the well water revealed arsenic levels of 21,000 ppb. (The USPHS drinking water standard is 50 ppb). The area of disposal was located twenty feet from the well. Estimated costs for solving the problem range form $2500 to $25,000.[30]
- A landfill near Montague, Michigan began operations in the 1950s and continued until 1970. A variety of materials were buried at the site including brine softening sludge, hexachlorocyclopentadiene, asbestos, and flyash. Approximately 400,000 cubic yards of wastes were disposed and the ground water has been contaminated as a result of improper operations.[31]
- A disposal site in Salt Lake City received waste tars and acidic bitumens from the 1920s until 1957. The volume of waste received is at least 37,000 cubic yards. Ground water contamination by oil and grease has been detected both up gradient and downgradient from the site due to ground water mounding at the site.[32]
- A landfill in Egg Harbor Township, New Jersey, has been the

depository of large quantities of organic and inorganic industrial wastes. In 1973, this landfill was ordered by the State not to accept any more industrial wastes since laboratory analysis of samples from nearby observation wells established the existence of a ground water pollution problem involving several chemical contaminants. Lead concentrations in the observation wells have been analyzed up to 18 ppm. (The U.S. Public Health Service mandatory drinking water standard for lead is 0.05 ppm.) A municipal water supply well field, situated within 0.6 miles (1 kilometer) of the area of contamination, has not been affected; however, it is being regularly monitored because of the obvious threat.[33]

- A disposal site in Hardeman County, Tennessee received pesticide wastes from 1964 to 1972. Compounds disposed include endrin, dieldrin, aldrin, heptachlor, and isodrin. Evidence of water contamination was discovered as early as 1967. Several private wells have been abandoned. Total costs to clean up the area are estimated at nearly $6,000,000.[34]
- In 1974 in Dover Township, New Jersey a total of 148 private wells were condemned because they contained hazardous organic chemicals. Sources of the contaminants include the Township landfill and an illegal chemical waste dump on which hundreds of thousands of gallons of petrochemical wastes had been stored and dumped.[35]
- A creosoting company near Minneapolis operated a disposal site between 1917 and 1972. In the 1930's a tar-like taste was detected in municipal and private wells which were

abandoned for deeper ground water. In 1973, phenolic compounds were detected in the deeper municipal wells. At least $20,000,000 will be required to clean up the ground water.[36]

- A variety of drummed chemical wastes were buried in the Hyde Park (N.Y.) Dump between 1953 and 1975. This site replaced the Love Canal Dump when that site closed. Toxic materials have been found in monitoring wells near the site.[37]
- A chemical manufacturing company has been dumping arsenic-containing wastes since 1953 at the LaBounty Dump Site along the Cedar River in South Charles City, Iowa. This chemical fill covers approximately 8.5 acres and contains an estimated 27,000,000 cubic feet of chemical sludge. In addition to various forms of arsenic, the site also contains phenols, orthonitroalinine, and nitrobenzene. The situation poses a serious threat because the underlying fractured limestone aquifer supplies 70 percent of all drinking and irrigation water used by Iowa residents. At one point toxic chemicals from LaBounty were found in the drinking water at Waterloo, 50 miles downstream on the Cedar River. In December 1977, the company was ordered by the Iowa Department of Environmental Quality to close its shop and cease dumping at LaBounty. The estimated cost of removal of these toxic wastes is about $20,000,000.[38]

(2) Surface Water Contamination

- Approximately 1,000 gallons of petroleum based cleaning fluids were dumped at a landfill in Haywood County, North Carolina in 1974 and leaked into a tributary of Homing Creek. Cattle died after drinking from the polluted water.[39]

- Powdered pesticides, including DDT, toxaphene, lindane and Alpha and Beta Benzene Hexachloride, killed several hundred fish in a Southeast Austin pond. The pesticides had been dumped in paper bags into an Austin, Texas landfill. Bulldozers constructing a baseball field unearthed the chemicals, and rain washed them into the pond. In August, 1979 construction in the park ceased while officials removed the contaminated soil.[40]
- Until approximately June 1970, Beech Creek, Waynesboro, Tennessee, was considered pure enough to be a source of drinking water. At that time, waste polychlorinated biphenyls (PCBs) from a nearby plant began to be deposited in the Waynesboro city dump site. Dumping continued until April 1972. Apparently the waste, upon being off-loaded at the dump, was pushed into a spring branch that rose under the dump and then emptied into Beech Creek. Shortly after depositing of such wastes began, an oil substance appeared in the Beech Creek waters. Dead fish, crawfish, and waterdogs were found, other wildlife which used the creek were also affected (e.g., two raccoons were found dead). Beech Creek had been used for watering stock, fishing, drinking water, and recreation for decades. Presently, the creek seems to be affected for at least 10 miles (16 kilometers) from its source and the pollution is moving steadily downstream to the Tennessee River. Health officials have advised that the creek should be fenced off to prevent cattle from drinking the water.[41]
- A number of disposal sites near Pickens, S.C. have received

PCB-contaminated equipment, capacitors, and transformers. PCBs have been found in the waters near these sites. Approximately $2,000,000 will be needed to clean up the area.[42]

(3) Ground and Surface Water Contamination

- Leachate from a Morristown, Tennessee dump containing municipal refuse, DDT, DDE, DDD and dieldrin polluted nearby wells and odors emanated from a leachate-polluted stream. TVA produced a final closing plan which included a two foot final cover and plastic covering of the pesticide disposal area.[43]
- Between 1971 and 1973 a chemical company near St. Louis, Michigan disposed of wastes containing at least 161,400 pounds of PBB's into a Gratiot County landfill. Significant traces of PBB's and various levels of other contaminants are presently being found in ground and surface water in and around the landfill site. A slurry wall trench system to contain the wastes is being developed.[44]
- A chemical company buried tons of brine, asbestos, fly ash and deadly pesticides on its factory site near Montague, Michigan. Included in this were as many as 20,000 drums that were leaking wastes resulting from the manufacture of the pesticide precurser C-56. In 1979, State offices discovered the highest levels of dioxin ever measured in Michigan. Chemicals from the landfill have leached into the groundwater, contaminating private wells and into White Lake which flows into Lake Michigan less than a mile away. The chemical company has agreed to install a purge well system to intercept contaminated water before it reaches White

Lake. Cleanup estimates range from $15,000,000 to $300,000,000.[45]

- Since 1948, a company at Jacksonville, Arkansas manufactured chlorophenoxy herbicides including 2,4-D and 2,4,5-T. Chemical wastes, such as dioxin and chlorinated hydrocarbon insecticides, are buried at eight locations. Traces of dioxin were discovered in the sediment of a nearby creek and a downstream bayou; both of which have been quarantined by the state health department. Soil contamination has been documented. The cost to cleanup the site may exceed $4,000,000.[46]
- A petroleum processor in Baton Rouge, Louisiana has dumped hazardous wastes into a waste disposal site. Heavy rains transported the chemicals to an adjacent 550 acres of farmland which damaged vegetation and killed 160 cattle. Cleanup costs are expected to be substantial.[47]
- The Stringfellow Class I Disposal Site operated near Glen Avon, California from 1957 to 1972. During that time 32,000,000 gallons of waste were received containing sulfuric, nitric, and hydrochloric acids, zinc, lead, mercury, and chromium. Toxic contaminants have been transmitted to the ground and surface waters and air pollution from the evaporation sprayers has been suspected.[48]
- In May 1974, three dead cattle were discovered on a power company's recently acquired farm property near Byron, Illinois, and pathological examination established that the cattle had died of cyanide poisoning. Further investigation revealed that the approximately 5-acre area, which is a part of a large property set aside for a nuclear power plant, had

been for several years a repository of large quantities of toxic industrial wastes. The former owner of the property used it to dispose of industrial waste his hauling company collected. The power company hired a consultant to study the environmental damage on the property and to recommend clean-up procedures. The subsequent study documented extensive harm to wildlife and vegetation. Nearby soils and surface and ground waters were heavily contaminated with cyanide and chromium. It is not yet known when farm crops can safely be harvested on the affected property again.[49]

(4) Major Public Health Damages Caused By Chemicals Migrating from Disposal Sites

- An old landfill on Neville Island, Pennsylvania which had received municipal refuse and miscellaneous industrial wastes was being made into a public park when site development was indefinitely stopped in the spring of 1979 after complaints of a high rate of health problems among workers. A field investigation of chemicals uncovered at the park included benzene, phenols, cyanide, mercury, coal tar residues and parathion.[50]
- The most highly publicized contamination incident by toxic chemicals occurred at the Love Canal industrial waste site in Niagara Falls, New York. Chemical wastes were disposed of at the site for approximately 25 years, until about 1953. Only of late have problems at the site become known to the public. Eighty-two chemicals, 11 of which are suspected or known carcinogens, were found on the surface and leaking

into the basements of homes that were constructed in the area. Two hundred thirty-nine families in the immediate area were evacuated, and their homes were purchased by the State government; in February 1979, about 100 more families -- those with pregnant women or children under two years of age living within a 20 square block area around the canal -- were urged to relocate. The report of the New York State Health Commissioner, which appeared in August of 1978, cited "growing evidence of ...subacute and chronic health hazards as well as spontaneous abortions and congenital malformations." A subsequent State Health Department study, released in February 1979, showed a higher than expected frequency of miscarriages, birth defects, and low birth weights.

Between $3 and 4 billion in lawsuits have been filed by victims seeking compensation for health and property damage. An additional $8,000,000 from the State and EPA is being used to contain the wastes on-site in an effort to minimize or eliminate additional damage. The site was declared a Federal disaster area, making this the first time that Federal disaster relief funds were made available for a man-made disaster.[51]

(5) Explosions and Fires

As these cases show, fires at landfills are frequently very difficult to extinguish, some burning or smoldering for months even years. Often, soaking the site with water is not sufficient; the waste must be excavated and physically mixed with water. The use of water increases the chances for ground and surface water contamination and where excavation is needed,

increases the chances for exposure of workers to hazardous wastes, including explosions and toxic fumes. If future excavation is needed at a site for remedial actions (e.g., for fires), drums containing ignitable wastes pose a serious safety problem. Fires themselves emit toxic fumes and/or other air pollutants, and may cause explosions resulting from reactive or explosive wastes, or ignitable wastes in containers. In summary, fires at landfills are generally extremely damaging to the environment, and often injurious to human health, as shown by the following cases:

- In February 1968, a seven year old boy died in a fire at the Kenilworth Dump, Washington, D.C.[52]
- Some 10,000 demolished houses had been dumped to 70 feet deep over a 40 acre area in Milwaukee, WI. On November 16, 1968, the dump caught fire. By mid January 1969, some 12,000 man-hours had been expended trying to put the fire out. Over 210 million gallons of water had been pumped onto the fire, most of which ran off and polluted the nearby river. Smoke from the fire traveled over 20 miles and obscured ground level visibility in the surrounding area to a few feet much of the time. On April 30, 1969, the fire was declared to be out for all practical purposes, after the expenditure of hundreds of thousands of dollars in manpower and equipment over nearly a six month period.[1]
- A number of automobile wrecks were caused on the Oakland Nimitz Freeway because smoke from a burning dump reduced visibility on the highway.[52]

- A coal mine gob pile ignited through spontaneous combustion. The resulting fumes injured vegetation, animals, and the health of a nearby resident. Feder V. Perry Coal Co., 279 Il. App. 314(1935).[52]
- A bulldozer operator at a sanitary landfill site near Cleveland, Ohio, ran his vehicle over a large quantity of magnesium grindings. The bulldozer became enveloped in a cloud of the grindings which exploded killing the operator.[1]
- Smoke from a dump fire on the nights of October 23-24, 1973, reduced visibility on the New Jersey Turnpike and caused nine separate multiple-vehicle accidents involving 66 vehicles and resulting in nine fatalities and 34 persons being injured.[53]
- Air traffic at the San Francisco, CA and Presque Isle, ME airports has been interrupted by smoke from fires at dumps in Burlingame, CA and Presque Isle, ME, respectively.[2]
- While closing the City of Dalton, GA dump in March 1969 with a bulldozer, a blade struck and ruptured a 5-pound camping-type LP gas container. Gas in the container ignited and flashed toward the dozer operator who apparently was leaning out of the window of his cab. He was burned on the face and left arm and died in the hospital about three weeks later.[54]
- A 10 month old Harleysville, PA boy was killed and his parents and brother rendered unconscious by carbon monoxide gas migrating underground into their home from a nearby underground fire at a landfill.[55]

- A landfill workman died of carbon monoxide poisoning while working in a building at the landfill. The gas was produced by a smoldering underground fire in the landfill which migrated through fissures to the building. The fire, which apparently was started by spontaneous combustion, was finally extinguished by excavating the smoldering material with a dragline.[56]
- Used chemical drums were dumped in a Carrollton, Kentucky landfill and later retrieved by a man for use as garbage cans. When using a torch to cut the tops off the drums, the chemicals inside exploded. The flying debris severed the foot of a 5 year old boy.[57]
- In Chester, Pennsylvania, a chemical fire at an industrial disposal site resulted in the hospitalization of firemen overcome by toxic fumes. Volatile organics including methacrylic acid and a variety of aromatic hydrocarbons were identified at the site. In addition, a water sampling program revealed concentrations of chromium, copper, nickel and lead substantially in excess of drinking water standards. The minimum cost to clean up the site is estimated at $1,250,000.[58]
- A combination of aluminum dust, magnesium chips and concentrated phosphorus ignited while being compacted at a landfill near Everett, Washington in 1974. Firemen applied water, which worsened the situation; two firemen were subsequently thrown from a front end loader, but escaped injury. Firefighters extinguished the surface fire but the

fire burned underground until it expended its fuel.[59]

- Two sites in Gary, Indiana operated by the same firm in the mid-1970s accepted general industrial hazardous waste including plating wastes, solvents, acids and cyanide. Both sites were scenes of explosions and fires. The cause of one of the fires has been established as the result of mixing acid solvents. The owner has abandoned both sites and the extent of contamination of the soil and ground and surface water has not yet been determined. At least $6,000,000 will be required to clean up the two sites.[60]
- In October 1975 an equipment operator at a disposal site in Cook County, Illinois, struck a drum filled with ethyl acetate. The man died three days later as a result of second and third degree burns.[61]
- A load of empty pesticide containers was delivered to a disposal site in Fresno, California. Unknown to the site operator, several full drums of an acetone/methanol mixture were included in the load. When the load was compacted by a bulldozer, the barreled waste ignited, engulfing the bulldozer in flames. The operator escaped unharmed, but the machine was seriously damaged. In the ensuing fire pesticide wastes were dispersed.[61]
- At a dump in Contra Costa County, California, a large number of drums containing solvents were deposited in a landfill. In the immediate area were leaky containers of concentrated mineral acids and several bags containing beryllium wastes in dust form. The operator failed to cover the waste at

the end of the day. The acids reacted with the solvents during the night, ignited them and started a large chemical fire. There was possible dispersion of beryllium dust into the environment. Inhalation, ingestion or contact with the beryllium dust by personnel could have led to serious health consequences.[61]

- A disposal site in central California accepted a load of solid dichromate salts and dumped it in a pit along with pesticide formulations and empty pesticide containers. For several days thereafter, small fires erupted in the pit due to the oxidation of the pesticide formulations by the dichromate. Fortunately, the site personnel were able to extinguish these fires before they burned out of control. There were no injuries, or property or equipment damage.[61]
- In 1971 a drum exploded during compacting operations and caused a fire that burned for several days. The air around and the landfill was polluted during the fire. The compacting bulldozer was destroyed. There is no indication that any remedial action was taken by the landfill operators, or by the state, local, or federal government as a result of this incident.[..]
- Two serious fires at the Merl-Milam Landfill, St. Clare County, Illinois (August 1973 and April 1974) were attributed to the presence of solvent wastes from plastics manufacturing.[2]
- A landfill in East Windsor, Connecticut started on fire in August 1979 and fifteen months later the fire was still smoldering. Attempts were made to extinguish the fire by

pumping in over one million gallons of water and then covering the area, with no positive results.[62]

- The Hamdon/New Haven, Connecticut landfill is a very deep fill located in a clay pit. A fire has persisted underground at this site for the past 7 or 8 years. Without creating water pollution problems, the fire is considered to be very difficult to extinguish.[63]
- Underground fires are presently burning at the Milford and City of Bridgeport, Connecticut landfills.[63]
- A landfill in Waukesha, WI caught fire. After many attempts to put the fire out by spraying large amounts of water on it, the owner had to excavate the waste with a bulldozer and spray the waste to put out the fire. This was a messy operation.[64]
- In October 1974, a bulldozer operator was killed in an explosion at an industrial landfill in New Jersey as he was burying and compacting several 55-gallon drums of unidentified chemical wastes. The victim died as a result of burns, which covered about 85% of his body.[65]

(6) Toxic Fumes Resulting from Mixing of Incompatable Wastes

- In Los Angeles County, a tank truck emptied several thousand gallons of cyanide waste onto refuse at a sanitary landfill. Another truck subsequently deposited several thousand gallons of acid waste at the same location. Reaction between the acid and the cyanide evolved large amounts of toxic hydrogen cyanide gas. A potential disaster was averted when a local chlorine dealer was called to oxidize the cyanide with

chlorine solution.[68]

- At a sanitary landfill near Dundalk, Maryland, a 2,000-gallon liquid industrial waste load containing iron sulfide, sodium sulfide, sodium carbonate and sodium thiosulfate, along with smaller quantities of organic compounds, was discharged into a depression atop a earthcovered area of the fill. When it reached eight to ten feet below the point of discharge, the liquid started to bubble and fume blue smoke. The smoke cloud quickly engulfed the truck driver and disabled him. Several nearby workers rushed to his aid and were also disabled. During the clean-up operation, one of the county firefighters also collapsed. All six of the injured were hospitalized and treated for hydrogen sulfide poisoning. The generation of hydrogen sulfide was probably due to the incompatibility of the waste with some of the landfill materials since the pH of the waste was measured to be 13 before it left the plant. It may also have been caused by the instability of the waste.[68]
- In July 1978 a truck driver died as a result of unloading chemicals at a Louisiana disposal site. At least 16,000,000 gallons of material contaminated with sulfur compounds, alkyl chloride, and sulfuric acid have been accepted at the site. A minimum of $17,000,000 will be required to clean up the site.[69]

(7) Explosive or Hazardous Gases Migrate from Landfill

- Volatilization of hexachlorobenzene (HCB) from landfilled wastes as well as from direct emissions into the air from

industrial plants in Darrow, Louisiana resulted in the settlement of HCB on pastures. This led to the bioaccumulation of HCB in the tissues of grazing cattle. Evidence of widespread contamination resulted in a quarantine of livestock produced over a 100 square mile area.[70]

- In the spring of 1975, residents near the Lees Lane landfill in Louisville, Kentucky experienced flash fires around water heaters and unusual gas odors in their homes. The landfill has received municipal and industrial wastes, including vinyl chloride wastes, for a number of years. Methane gas was being generated in explosive levels in the landfill and migrating into nearby homes resulting in seven families being evacuated. Studies are now underway to determine the most appropriate way to control the gas migration. A gas recovery system is being considered.[71]

(8) Formation of Water Soluble Toxic Substances from Ruptured Drums

- In Riverside County, California, several drums of phosphorus oxychloride, phosphorus thiochloride and thionyl chloride were improperly dropped off at a dump. Later during a flood, the drums were unearthed, ruptured, and washed downstream. They released hydrogen chloride gas and contaminated the water.[72]

(9) Wind Dispersal of Hazardous Waste

- Since 1867, asbestos product manufacturers have accumulated nearly 2 million cubic yards of assorted industrial wastes in open piles in a small Pennsylvania town. The original generator of the wastes went out of business in 1962. Since

then, two other companies have been responsible for enlarging the spoils piles. The atmosphere around the piles contains asbestos fibers, as a result of wind erosion. An air monitoring program, conducted by the U.S. Environmental Protection Agency in October 1973, indicated ambient background levels of asbestos to be 6 ng/m^3. An asbestos level of 9.6 ng/m^3 was found at a playground near the largest waste pile. Values obtained near active disposal piles range from 114 to 1,745 ng/m^3. A high pH level in a nearby stream has resulted from the piles. The State has ordered and gotten compliance for closing the site. The ongoing (as of October 1979) closure plan includes halting additions to the piles, stablizing the piles, reducing erosion and runoff by planting vegetation on the piles, and fencing them off. The State is confident that the piles now present no human health hazard.[73]

- A similar asbestos waste pile exists at Hyde Park, Vermont. The pile was approximately 400 feet high, approximately 2600 feet long, and approximately 1000 feet wide as of September 1973. At that time the site contained 20 million metric tons of tailings. The site had been in use for 15 years at that time. Percentages of chrysotile asbestos in samples of debris from the tailings pile ranged from 12.7 to 21.1. Ambient concentrations (away from the site) ranged from 3 to 13,600 ng/m^3; average concentration was about 1300 ng/m^3. Windblown emissions from the tailings pile averaged 500 ng/m^3. In this case emissions from mining, milling, and

roadways probably contributed significantly to ambient concentrations.[73]

II. ANALYSIS OF STANDARDS

The proposed regulations for landfills were specified in §250.45-2 of the proposed hazardous waste regulations published at 43 FR 58946-59028. Interim Status Standards were published at 45 FR 33066-33285. This analysis of standards includes relevant comments received from both issuances. These proposed regulations incorporate the general policy of eliminating the uncontrolled and indiscriminate release of hazardous wastes.

1. Applicability - §264.300

A. Proposed Regulation and Rationale

N/A

B. Summary of Comments

N/A

C. Discussion

N/A

D. Regulatory Language

The regulations in this Subpart apply to owners and operators of facilities that dispose of hazardous waste in landfills, except as §264.1 provides otherwise.

2. General Design Requirements - §264.301

ISSUE: Leachate monitoring system

A. Proposed regulation and rationale

A leachate monitoring system was required in Parts 250.43-8 and 250.45-2 of the proposed regulations (18 December 1978, FR 59005-59011). These requirements, however, referred to a system

which was meant for a different location than the leachate monitoring system being required in the presently proposed regulations. The previously proposed system is not required in the current regulatory package for the same reasons it was not required in the Interim Status Standards (See 19 May 1980, 45 FR 3191-3196, Preamble to Subpart F). The Agency believes that the currently proposed leachate monitoring system is sufficiently different from the previously proposed system that no further reference to the old system is necessary.

B. Summary of Comments

N/A

C. Discussion

The need for a leachate monitoring system is created by the structure of the current regulatory package. The issuance of a permit to operate a hazardous waste landfill is primarily dependent upon a set of assessments required of the owner or operator of a facility. These assessments must collectively describe the rate and extent of contact between the products of the landfill and the environment - see §122.25(d). One of the predictions required is an assessment of the physical and chemical quality of all liquids expected to leach from the facility. A characterization of this leachate is fundamental to most of the other predictions required in §122.25(d). Therefore, an inadequate characterization of the leachate could cause error in the predicted "zone of containment" which is an important part of the permit conditions for a facility. By the time the error could be detected through ground-water monitoring, the facility might already be in violation of its

permit and damage to the environment and/or human health may already be irreversible or prohibitively expensive to correct. Therefore, the Agency believes that by requiring a leachate monitoring system in new landfills and new landfill cells, actual and predicted leachate quality can be compared and immediate action can be taken in the event of major incongruities. For example, an owner or operator may discover that the phenol concentration in his leachate is much higher than expected. He may then decide (1) to accept a lower tonage of phenol-laden waste, (2) to treat the phenol-laden waste before landfilling or, (3) that the higher phenol level will not increase the predicted "zone of containment" and no action is necessary. Any such actions must be reported to the Regional Administrator, and may require approval. Only new landfills and landfill cells are covered by this requirement because the Agency believes that severe human health and environmental consequences could result during attempts to retrofit existing facilities.

D. Regulatory language

(a) All new landfills and new landfill cells must have a leachate monitoring system capable of producing representative samples of leachate.

ISSUE: Liner systems

A. Proposed regulation and rationale

N/A

B. Summary of comments

N/A

C. Discussion

The Agency is not requiring the use of liners at landfills.

However, any liner system present at a landfill facility, must be installed and used in a manner which will allow a reasonable prediction of its efficiency and useful life. This is possible is by handling the liner according to the carefully controlled conditions referenced in §264.301(b) and in "Lining of Waste Impoundments and Disposal Facilities", EPA/870, September 1980. Unless the functional effect of a liner can be determined, compliance with the requirements in §122.25(d) would be very difficult.

D. Regulatory language

(b) Any liner systems present at the facility must be constructed:

(i) of materials which have appropriate chemical properties and strength and of sufficient thickness to prevent failure due to pressure head, physical contact with the waste to which they are exposed, climatic conditions, the stress of installation, and the stress of daily operation; and

(ii) on a foundation or base capable of providing support to the liner(s) and resistance to static head above the liner(s) to prevent failure of the liner(s) due to settlement or compression.

ISSUE: Leachate collection and removal systems

A. Proposed regulation and rationale

N/A

B. Summary of Comments

N/A

C. Discussion

The Agency is not requiring the use of a leachate collection and removal system. However, any leachate collection and removal system, present at a landfill must be installed and used in a manner

which will allow a reasonable prediction of its efficiency and useful life. Compliance with §264.301(c) and with manfacturer recommendations is one way of achieving the controlled conditions necessary to comply with §122.25(d). Further, the Agency believes that any landfill owner or operator who operates a leachate collection and removal system must, in the event that groundwater contamination has resulted in permit violations, be able to prevent as much further contamination as possible. This belief stems from the fact that leachate collection and removal systems are frequently associated with landfills located below the water table. This location creates a potential for extensive contamination of the saturated zone if initial predictions regarding the static head to be maintained at the facility are found to be invalid.

The capacity to control the leachate level at one foot or less at any point on the base of a landfill was required because the Agency believes that this level would sufficiently reduce the driving force and limit further contamination if the need arose. The Agency also believes that the one foot leachate maintainance level is readily achievable at most existing landfills equipped with leachate collection and removal systems.

D. Regulatory language

(c) Any leachate collection and removal system present at the facility must be constructed:

(i) of materials which have appropriate chemical properties and are of sufficient strength and thickness to resist collapse or clogging under the pressures exerted by the overlying wastes, waste cover materials and by any equipment used at the facility; and

(ii) with sufficient capacity to achieve and maintain a leachate depth of one foot or less at any point on the base of the landfill.

3. General Operating Requirements - §264.302

A. Proposed regulation and rationale

The discussion of the proposed regulation for §264.302(a) and (b) found on pages 82-84 of the 15 December 1978 Background Document Section 250.302(c) is on pages 56-57 of 2 May 1980 Background Document 40 CFR Part 265, Subpart N Interim Status Standards for Landfills.

B. Summary of comments

There were no significant comments on these requirements.

C. Discussion

The requirements in §264.302(a) and (b) are related to the control of surface water which results from precipitation at the facility. These requirements are that this water be controlled and not allowed to enter the active area of the landfill. Further, if the water has come in contact with the waste, the run-off is considered to be a potentially hazardous waste and must be collected and handled as a hazardous waste unless it can be shown that this material does not contain hazardous constituents.

EPA does not believe this is a stringent requirement and, did not receive substantial comment on these requirements. The control of water near an active facility is a common practice at almost all construction sites including landfills. The control of run-on minimizes the operational problems due to mud at the site and removes a source of water which could cause a leachate problem.

Since the run-off from active portions of a landfill could contain hazardous wastes there are obvious environmental benefits from managing this material properly.

In §264.302(c) EPA requires that methods be used to control the wind dispersal of hazardous wastes. EPA recognizes that the appropriate control method will be waste specific. In §264.45.2(b)(10) (43 FR 59010) there was a requirement for daily cover at hazardous waste landfills. The requirement for daily cover comes from the technology for the dispersal of municipal waste. EPA has reevaluated the need for the daily cover requirement and by allowing the owner or operator to specify the appropriate method to control wind dispersal, the requirement becomes more flexible.

D. Regulatory Language

§264.302 General operating requirements

(a) Run-on must be diverted away from the active portions of a landfill.

(b) Run-off from active portions of a landfill must be collected.

(c) The owner or operator of a landfill containing hazardous waste which is subject to dispersal by wind must cover or otherwise manage the landfill so that wind dispersal of the hazardous waste is controlled.

4. Inspections and testing - §264.306

ISSUE: Field inspection and testing - §264.306(a) and (b)

A. Proposed regulations and rationale

N/A

B. Summary of comments

N/A

C. Discussion

Landfills must be inspected each week to ensure that the environmental protection appurtenances are functioning properly. This inspection will consist primarily of a visual inspection of the control devices for run-on and run-off. The ordinary devices used for such control are ditches, channels, and other drainage structures which are subject to erosion. Failures are expected to be as a result of long-term exposure and use. Weekly inspections should enable problems to be identified when they are small so that they can be repaired before a major environmental incident can occur. Additional inspections are required after storms.

Since this regulation is applicable to new facilities, requirements for inspection and testing of the containment system during the construction period is both feasible and desirable. Liner systems are often key elements of design to achieve containment and improperly installed liners or liners containing imperfections will result in either immediate discharge of hazardous waste or premature liner failure and subsequent leakage. The regulation, therefore, requires that during construction or installation, liner systems must be inspected for uniformity, damage and imperfections (e.g., holes, thin spots, cracks, and foreign materials). Items such as holes, cracks, thin spots and foreign materials, can be inspected visually during testing depending on the type of material. This inspection is primarily to determine if the material is free from manufacturing defects.

Earthen material liner systems must be tested for compaction density, moisture content and permeability after placement. The proper moisture content is essential to the achievement of proper compaction density and low permeability. Testing of these factors after placement is called for specifically in the regulation since these are critical in determining how an earthen liner will perform.

D. Regulatory Language

§264.306 Inspections and testing

(a) Each landfill, including appurtenenances to control run-on and run-off, must be inspected once each week and after storms to detect evidence of deterioration.

(b)(1) During construction or installation, liner and cover systems must be inspected for uniformity, damage, and imperfections (e.g., holes, cracks, thin spots, and foreign materials).

(2) Earth material liner and cover systems must be tested for compaction density, moisture content, and permeability after placement.

(3) Manufactured liner and cover materials (e.g., membranes sheets, and coatings) must be inspected to ensure tight seams and joints and the absence of tears and blisters.

ISSUE: Leachate monitoring - §264.306(c)

A. Proposed regulation and rationale

N/A

B. Summary of comments

N/A

C. Discussion

An annual assessment of leachate quality will provide the minimum amount of information needed to test the predictions made in compliance with 122.25(d)(2). This sampling interval will also allow ample warning time for remedial action where necessary. More frequent leachate monitoring will allow the owner or operator to make increasingly accurate predictions about the rate and extent of leachate migration thus reducing the risk of expensive clean-up operations in the future.

D. Regulatory language

(c) Leachate samples must be collected and analyzed once each year and the results compared to the predictions required under §122.25(d)(2). These comparisons must be reported on an annual basis along with the monitoring results required under §264.94(b)(2).

5. Surveying and recordkeeping - §264.309

A. Proposed Regulation and rationale

The discussion of the proposed regulation is found on pages 62-63 in the 15 December 1978 Background Document for Section 250.45-2 - Standards for Landfills. These requirements are also discussed on pages 59-64 in the 2 May 1980 Background Document for 40 CFR Part 265, Subpart N Interim Status Standards for Landfills.

B. Summary of comments

° This standard requires recording the exact location of each hazardous waste and the dimensions of each cell with respect to permanently surveyed bench marks. It appears that it would be nearly impossible and also unnecessary to record the exact location of each hazardous waste. It is sufficient to know the contents of

each cell and the exact location of each cell.

° Landfills that receive only one type of waste whose composition does not vary significantly should be exempted from the requirement to record where different batches are placed.

° Include in the regulation that these requirements do not apply retroactively to existing landfills.

° There are other methods of operating landfills than by placing wastes in cells. For example, wastes may be blended with soils so that there are not isolated "cell" sections of landfills. These regulations should permit such operations.

° In order to facilitate waste material inventories for each landfill, a cross-referencing of the landfilled materials with appropriate manifest numbers should be required.

C. Discussion

After carefully considering comments on this standard, the Agency believes that identifying the specific location of each cell can be accomplished adequately by use of a three-dimensional grid system. However, recording the exact location of each waste within a cell would be an unreasonable and unnecessary task. Identifying "exact locations" would be extremely time consuming and technically difficult. Furthermore, over time, internal subsidence and/or shifting can be expected within a landfill, causing changes in "exact location." General locations will be adequate to facilitate remedial action, in-situ treatment, and resource recovery efforts, and to ensure that incompatible wastes do not come in contact with one another, and should not be unduly burdensome. For most circumstances at multi-waste landfills, the Agency believes that

3 meter accuracy should be sufficient for use with a grid system. However, the size of the units of the grid would generally be a function of each waste type at the facility.

In addition, EPA did not intend that the owner or operator of a landfill should record and report the location of each batch of waste disposed. The recording and reporting of the location of each waste type is all that is necessary.

It would obviously be difficult or impossible, unless adequate records exist, for existing facilities to record and report the location of waste types disposed prior to the effective date of these regulations, and this is not required. The Agency suggests, however, as a good management practice, that owners and operators record approximate waste or cell locations when such information is readily available.

EPA recognizes that there are other methods of operating a hazardous waste landfill than by placing wastes in cells as the term is commonly perceived, i.e., "isolated cell" sections of landfills. For this reason and in order to write regulations on a national scale which apply to a wide variety of operational techniques, EPA defined "cell" to mean "the discrete volume of a hazardous waste landfilll which uses a liner to provide isolation of waste from adjacent cells or waste.

An error of reference to §265.73 of the interim status standards instead of to §264.73 of the general status standards was made in the regulation as printed in the Federal Register. That error has been corrected in the regulatory language below.

D. Regulatory Language

§264.309 Surveying and recordkeeping

The owner or operator of a landfill must maintain the following items in the operating record required in §264.73:

(a) On a map, the exact location and dimensions, including depth, of each cell with respect to permanently surveyed benchmarks; and

(b) The contents of each cell and the approximate location of each hazardous waste type within each cell.

6. Closure and post-closure - §264.310

ISSUE: Final cover

A. Proposed regulation and rationale

On 18 December 1978, the Agency proposed very specific design requirements for final cover at landfills at 43 FR 59011.

A final cover requirement was also included in the Interim Status Standards, however, the specific design requirements were replaced by a more flexible system in which cover systems can be evaluated on a case by case basis. The Agency is retaining this more flexible approach in the present proposal for reasons found in the 2 May 1980 Background Document for 40 CFR Part 265, Subpart N, Interim Status Standards for Landfills.

B. Summary of Comments

N/A

C. Discussion

The Agency believes that placement of a final cover over closed portions of a landfill is necessary to (1) prevent infiltration of rainwater, (2) prevent dispersal of wastes by human, animal or

physical interactions and (3) minimize the need for further maintainance at the facility during post-closure and beyond. The types and amounts of cover material needed to accomplish these goals, however, are highly dependent on the location of the landfill. In areas of the country where evapotranspiration exceeds precipitation, the permeability of a cover material may not be as important as the proposed thickness. Other site-specific variables impacting final cover design are the acidity of rainwater and type of indigenous vegetation. The Agency has proposed a case-by-case system for evaluating cover materials to avoid unnecessary burdens on facilities located in areas which require minimal cover.

The proposed design, construction, and maintainance of a final cover will be evaluated in terms of the predictions submitted for compliance with §122.25(d). These predictions deal with rate and extent of mass transport of waste constituents in earth materials surrounding the facility. Placement of a final cover will have a substantial impact on these transport processes. Therefore, the owner or operator must demonstrate that the final cover will perform and be maintained in a manner which is consistent with these predictions. Due to this new approach, the Agency no longer sees the need to list all of the factors in the closure regulations which must be considered in designing a final cover (See the Interim Status Standards, 19 May 1980 at 45 FR 33241). Consideration of these factors is intrinsically required in §122.25(d). Detailed discussions on final cover systems may be found in "Evaluating Cover Systems for Solid and Hazardous Waste", EPA/867, September 1980.

The Agency believes that inspection and testing of the final cover are necessary to demonstrate compliance with the proposed permit requirements. All calculations and predictions made in compliance with §122.25(d) are contingent on the constant integrity of the final cover. Testing of the final cover is performed as it is installed to ensure that the design specifications are met. Inspections are to be performed on a weekly basis to ensure that the original specifications are maintained.

D. Regulatory Language

(a) As part of the closure and post-closure requirements of Subpart G of this part, the owner or operator must place a final cover over the landfill. The final cover must:

(1) be designed, constructed and maintained in a manner which is consistent with the permit issued for the facility; and

(2) be tested and inspected during closure and post-closure according to the requirements of §264.306.

ISSUE: Post-closure care

A. Proposed regulation and rationale

Detailed discussion of the proposed regulation and rationale may be found in the 15 December 1978 Background Document for Section 250.45-2, Standards for Landfills on pages 132-137.

B. Summary of Comments

N/A

C. Discussion

The post-closure care requirements in the current regulatory proposal are not substantially different than those originally proposed on 18 December 1978 at 43 FR 59011. For example, post-

closure operation and maintainance of a leachate monitoring system is required in both packages. However, the location and function of the leachate monitoring system has been changed. The presently proposed leachate monitoring system must be operated during the post-closure period for the same reasons that it must be operated during the active life of a landfill. A full discussion on the need for this system is found in Section 2 (General Design Requirements - §264.301) of this document.

Other differences between the original and current post-closure requirements are created by structural differences in the two regulatory approaches (See the 8 October 1980 supplemental notice of proposed rulemaking at 45 FR 66816-66823). These structural changes, however, have not resulted in any changes in the objectives of the post-closure care period.

D. Regulatory Language

(b) During the post-closure period, the owner or operator must:

(1) Maintain all containment structures and equipment at the facility in a manner which is consistent with the permit issued for facility; and

(2) Continue to operate the leachate monitoring system required by §264.301(a) and §264.306(c).

7. Special requirements for ignitable or reactive wastes - §264.312

A. Proposed regulation and rationale

The proposed regulation is discused on pages 73-77 of the 15 December 1978 Background Document - Section 250.45-2 Standards for Landfills and on pages 82-88 of the 2 May 1980 Background

Document for 40 CFR Part 265, Subpart N Interim Status Standards for Landfills.

B. Summary of Comments

There is no practical alternative to landfilling containers of ignitable or reactive wastes. The practice should be allowed.

C. Discussion

Responding to the comment advocating landfilling of containers of ignitable or reactive wastes is best answered by referring to §264.314. §264.314 deals with requirements for liquid wastes. Since most ignitable and reactive wastes are generated as liquids, landfilling of containers of ignitable and reactive wastes will not be allowed. Landfilling of ignitable and reactive wastes that are liquids will only be permitted if these wastes are either rendered non-ignitable or non-reactive.

The options available for proper handling of these materials are limited. EPA believes that the generator and disposer should work together in developing handling techniques which are safe and which will protect the workers who must handle such materials. In some cases, it may be desirable for the generator to treat the waste before shipment to the landfill such as solidifying the liquid wastes. In other cases, more effective treatment systems may be available at the disposal site.

D. Regulatory language

§264.312 Special requirements for ignitable or reactive waste

Ignitable or reactive waste must not be placed in a landfill, unless the waste is treated, rendered, or mixed before or immediately after placement in the landfill so that:

(a) the resulting waste, mixture or dissolution of material no longer meets the definition of ignitable or reactive waste under §261.21 or 261.23 of this Chapter, and

(b) §264.17(b) is complied with.

8. Special requirements for incompatible wastes - §264.313

A. Proposed regulation and rationale

Incompatible wastes shall be disposed of in separate landfill cells. The wastes accepted at hazardous waste disposal facilities are usually hazardous by themselves. However, if a waste were to come in contact with another waste which is incompatible with it, the consequences often create a more acutely hazardous situation than that posed by the reactants themselves. Furthermore, wastes can contact other incompatible materials during handling at a facility resulting in the same consequence. The lack of accurate information about the wastes, and the often indiscriminate handling of the wastes contribute to the high risk of contact of potentially incompatible substances at hazardous waste landfills.

The chemical reactions which result from such contact can cause secondary consequences such as injury, intoxication or death of workers, members of the public, wildlife, and domestic animals. The can also cause property and equipment damage, and contamination of air, water and land.

Persons involved in the handling and disposal of hazardous wastes should not create a situation whereby potentially incompatible wastes can come in contact with one another and result in: (1) heat generation, (2) pressure generation, (3) fire, (4) explosion or violent reaction, (5) formation of substances which are shock

sensitive, friction sensitive, or otherwise have the potential of reacting violently, (6) dispersal of toxic dusts and mists due to an explosion or violent reaction, (7) formation of toxic fumes, gases, or other toxic chemicals, (8) volatilization of flammable or toxic chemicals due to heat generation, and (9) solubilization of toxic substances. These incompatible reactions are those that are considered most important to be controlled through the mandatory separation of incompatible wastes in order to protect human health and the environment from their occurrences.

B. Summary of Comments

No substantial comments were received on this provision.

C. Discussion

See discussion on pages 90-92 of the 2 May 1980 Background Document for 40 CFR Part 265, Subpart N Interim Status Standards for Landfills.

D. Regulatory Language

§264.313 Special requirements for incompatible wastes

Incompatible wastes, or incompatible wastes and materials, (see Appendix V for example) must not be placed in the same landfill cell unless §264.17(b) is complied with.

9. Special Requirements for Liquid Waste - §264.314

ISSUE: Disposal of Bulk Liquids

A. Proposed regulation and rationale

The proposed standard specified that the owner or operator of a hazardous waste landfill could not directly dispose of bulk liquids, semi-solids, or sludges in the landfill. However, if the owner or operator pretreated and/or stabilized such liquid wastes

before landfilling or treated and/or stabilized the liquid in the landfill in a manner which reduced its liquid content or increased its solids content so that it reached a non flowing consistency, the owner or operator could dispose of bulk liquids, semi-solids, or sludges in a hazardous waste landfill.

The purpose of the proposed regulation is to reduce the presence of free liquids in a landfill. Free liquids migrating through a landfill may mobilize (e.g., solubilize) toxic substances. This leachate has the potential of migrating from the landfill and contaminating ground water. Free liquids also contribute to hydraulic head (hydrostatic pressure) which in turn, contributes to the rate of leachate to migration through a liner system. This phenomenon is explained by Darcy's Law which describes the movement of liquids through porous media. According to Darcy's Law, an increase in the hydraulic head, will cause an increase in the velocity of a liquid through a material. Thus, the disposal of bulk liquids, (or semi-solids and sludges containing free liquids) in hazardous waste landfills would supply both the fluid for leachate formation and increase the hydraulic head which is the driving force to cause leachate to pass through a liner system. This would increase the rate of movement of hazardous contaminants from the landfill. Many cases of ground and surface water contamination have been caused by the migration of wastes from landfills. The damage cases suggest that this is probably the most serious form of pollution created by landfills. EPA believes that its regulations restricting the landfilling of bulk liquids and wastes containing free liquids will substantially reduce this type of pollution.

B. Summary of Comments on Terms

There were no definitions for "liquids", "bulk liquids", "free liquids", "semi-solid", flowable", or "non-flowable" in the proposed regulations. The Agency received a number of comments on this subject:

° The terms bulk liquids, semi-solids and sludges are not defined in these regulations for proper interpretation of this section. The Agency has indicated that its concern is to limit the liquid content of the waste and prevent overload of the leachate collection and removal system. There are hazardous wastes that could be classified as semi-solids or sludges which have minimal liquid content and can be safely contained in the landfill specified in the regulations. It is recommended that the terms bulk liquid, semi-solids and sludges be properly defined for these regulations and this subpart be rewritten to allow the disposal of semi-solids and sludges with minimal liquid content in a secure landfill.

° Within this standard, EPA is concerned with the liquid nature of the waste. This concern does not justify the inclusion of semi-solids and sludges within this prohibition, especially semi-solids and sludges which are not water soluble.

° Finite parameters defining what is meant by modification and/or treatment to a non-flowing consistency are needed.

C. Discussion

These comments all imply the same basic concern about this standard, i.e., the need to include a degree of specificity in order to help in the interpretation and implementation of this

standard. The comments recommended that this can be done by defining the term "liquid", semi-solids" and "sludges" or defining a specific percentage of solids which must be attained prior to landfilling.

The Agency agrees with these comments but found it extremely difficult to provide specific definitions of these terms that are workable and broadly applicable. One problem is the wide variation among waste types. For example, a "sludge" or "semi-solid" of one type containing 20 percent solids may have very different flow, free liquids, and other characteristics than another sludge of the same solids content. Thus, to apply a limiting definition to such waste based on percent solids would not necessarily achieve the objective of the regulation (i.e., may be too restrictive or not restrictive enough), and would limilt the flexibility necessary for proper implementation of the regulation.

The terms "non-flowing" and "non-flowing consistency" also do not necessarily reflect the objective of the regulation. Even very dry materials such as dry sand or other granular materials can "flow" and this could lead to improper interpretation of the intent of the regulation. Thus, achieving a non-flowing consistency is not the intended objective. The objective is the elimination of the presence of free liquids and thereby reduction of the potential for producing leachate and increasing contaminant migration.

"Sludge" has been defined in the Act as any solid, semi-solid, or liquid waste resulting from pollution control facilities. Obviously, this definition is inadequate for the purposes of this section of the regulations. Any attempt to redefine the term could lead to confusion and potential conflict with the Act.

Furthermore, bulk liquids are readily and indisputably identifiable. Bulk liquids are large quantities (e.g., tanker truck loads) of liquids or fluids -- substances that exist as a continuum characterized by low resistance to flow and the tendency to assume the shape of its container.

The Agency believes that the real concern here is liquids within a waste which are free to migrate out of the waste and into the landfill, much as bulk liquids can. EPA has therefore decided to use the term "free liquids", defined as "liquids which readily separate from the solid portion of a waste under ambient temperature and pressure." This term and meaning best reflect the use to which this term is put, which is to distinguish when a waste contains liquids which will readily flow from the waste in a landfill to produce leachate. For sludges or semi-solids which are not obviously liquids, the following test may be used to determine if they contain "free liquids." Place a one to five kilogram (2.2 to 11.0 lbs.) sample of waste on a level or slightly sloping plate of glass or other similarly flat and smooth solid material for at least five minutes. If a liquid phase separation is observed, the waste contains "free liquids." The test must be performed at temperatures above freezing. EPA feels this test provides a practical way to test sludges and semi-solids and helps clarify the meaning of free liquids until a more rigorous test is devised.

The test is intended to simulate, in a simple way, the behavior of semi-solid wastes placed on the surface of a landfill. If liquids can be observed as a separate phase draining over an impermeable substrate from the base of a small sample of the waste,

such liquids can also be expected to drain from the waste itself when it is placed on the surface of the landfill, and will be free to migrate into the landfill much as liquid wastes would. The fact that liquids cannot be observed to migrate from a small sample after a few minutes does not, of course, assure that they will not migrate from a larger sample, or after a longer period of time, or when the waste is compressed by wastes placed over it. This test thus represents a rough minimum for the containment of free liquids. The Agency expects to study the problem of free liquids further and to attempt to devise tests which more accurately reflect the conditions of waste within a landfill.

The Agency intends that the definition and suggested test be a working guide to identify free liquids until a more formal test is devised. It clearly is not rigorous, but will provide a practical way of achieving the objective of this regulation. The Agency believes that the definition of free liquids adequately specifies the extent of pretreatment necessary for waste liquids, semi-solids, and wet sludge prior to disposal.

EPA has selected this test after consideration of a number of alternatives. A major flaw in the test procedure is that it does not account for pressures which will be encountered in a landfill, which will tend to squeeze liquids from absorbent mass. An anology is liquids which readily flow from a saturated sponge when the sponge is compressed. The Agency is currently evaluating other test procedures and will provide guidance if another test procedure is determined to be a better indicator of the performance in a landfill. One area of investigation was current State regulations.

Information was obtained from 32 States. This information is presented in the 2 May 1980 Background Document - 40 CFR Part 265, Subpart N Interim Status Standards for Landfills on pages 118-127.

D. Summary of Other Comments

- EPA should not prohibit disposal of bulk liquids in properly designed landfills which meet the high degree of security required by the proposed landfill standards. Furthermore, so long as the overall performance standards are met, the Agency should not be concerned with specific internal operating procedures. Also, placing bulk liquids in a landfill have tighter design requirements than surface impoundments. The prohibition of disposal of bulk liquids, semi-solids and sludges be deleted.
- Utilizing municipal refuse or other organic materials as a sorbent for liquid hazardous waste will not provide long term stabilization of hazardous waste. Organic materials will degrade and subsequently liberate the hazardous constituents.
- The standard should clarify if the injection, discharge, or disposal of liquids into a well or pit located in a landfill containing municipal refuse meets the requirements of eliminating the presence of free liquids prior to final disposal. It has been our experience that the garbage acts as an absorbent for liquids, and the practice has the advantage of conserving space by filling existing voids in the landfill. Also, the words "prior to" should be changed to "after" or upon" to allow the practice of in-situ absorption of liquids and municipal waste.

- Where the degree of risk is low, we do not believe it should be EPA policy to ban all liquid disposal in landfills, specifically if it can be demonstrated that health and environmental protection will not be compromised. Landfills can benefit from compaction if liquids are applied in proper quantities.
- The regulations should categorically ban all liquids from being landfilled or liquids that are either capable of being incinerated or are treatable.
- We are afraid that through EPA's encouragement the use of "fixation" techniques may be widely adopted, even though the process can result in a solid waste disposal cost increase of ten to one-hundred fold without a real need or concern regarding the cost-benefit relationship. Many wastes after "fixation" are now being safely disposed of at non-hazardous waste landfill facilities at a lower cost than the amount charges at hazardous waste landfills.
- This provision would require pretreating dried sludge prior to landfilling. Also this standard would preclude the use of sludge pipelines, the most economical method of transportation in some instances.
- Within this standard, EPA is concerned with the liquid nature of the waste. This concern does not justify the inclusion of semi-solids and sludges within this prohibition, especially semi-solids and sludges which are not water soluble. The restriction on disposing of semi-solid wastes which are soluble by regulation is arbitrary.

E. Discussion

The Agency received many comments suggesting that all liquids be banned from landfills. These commenters believed that liquids should be incinerated or treated by alternative methods, not landfilled. EPA believes that an across-the-board ban of any liquid waste disposal in a landfill is not a practical alternative at the present time.

The suggestion that the Agency require that all liquid waste be either incinerated or treated rather than landfilled has been rejected. Liquid wastes are a large portion of total hazardous waste. To eliminate a major disposal method for liquid waste and to require that a large percentage of this waste be incinerated or treated would far exceed the existing capacity of incinerators and treatment facilities. Some wastes, particularly sludges, may not be amenable to incineration or other treatment. The environmental impacts of incinerating liquid wastes cannot simply be assumed, without study, to be less than pretreatment and disposal in a landfill. However, the Agency believes that requiring liquids, semi-solids and sludges to be treated is practical.

Further, the Agency believes that there are conditions under which liquids in landfills can be beneficial. The conditions include the use of a secure liner of low permeability, and continuous operation of an effective leachate collection and removal system over a long period of time. Under this scheme the leachate is removed from the landfill continuously to prevent build-up of a hydraulic head, and a low liner permeability and low head result in a very slow (insignificant) rate of migration through the liner.

The leachate must be either treated and discharged under NPDES permit, recycled back to the facility, or treated, disposed, or stored as a hazardous waste. Over time, leaching potential of the waste may be reduced and the contents of the landfill may present less of an environmental problem. The landfill, in essence, may become a treatment system. In order for the Agency to approve this type of landfill operation, the nature of the waste, the liner, and leachate collection system would need to be carefully evaluated. This type of approach is allowed under §264.314(a).

Comment was received concerning the issue of municipal waste used for absorbing liquids within the landfill. Some comments suggested that EPA should further clarify and encourage their use; other comments recommended that this approach recommended that this approach be discouraged. The latter comments stated that mixing with municipal waste or other organic matter will not provide long-term stabilization.

EPA believes that mixing liquid hazardous waste with biodegradable municipal waste is not a desirable means of reducing free liquids within the landfill. Such a practice would require that municipal wastes be placed in hazardous landfills with the result that volumes of hazardous landfill space will be taken up by non-hazardous municipal waste. More importantly, as commenters stated, it is probable that when municipal waste degrades, the hazardous waste would be released.

Data were supplied which indicate that municipal refuse has a capacity to absorb "free liquids" to some extent. This capacity is diminished but not eliminated due to biodegradation. The information

was supplied by the County Sanitation Districts of Los Angeles County. While these data are helpful to those who may wish to use municipal solid waste as an absorbent material, it does not alter EPA's cautious attitude toward the widespread use of municipal refuse as an absorbent material. The data were generated for an arid area and are of limited value for areas which receive significant rainfall. EPA does not intend to change this requirement to allow in-situ absorption at this time. Furthermore, the disposal of bulk hazardous liquids in any municipal landfill that does not have liners and leachate collection systems is not allowed under §265.314(a)(2) unless it is demonstratable that all wastes containing free liquids are solidified so as to eliminate the presence of free liquids before disposal.

Commenters also suggested that the practice of mixing liquid hazardous waste with municipal waste could take place in sanitary landfills which are not designed and constructed for disposal of hazardous wastes. This approach is not practical under the regulations even if it were assumed that it would adequatey protect the environment. The Act requires that hazardous wastes must be managed in permitted hazardous waste management facilities. If they are permitted, they would have to meet the criteria for a hazardous waste landfill.

Comments were also received recommending the deletion of the prohibition or restriction on disposal of bulk liquids, semi-solids and sludges. One reason that was given was that the prohibition was unnecessary in properly designed landfills which meet the high degree of security required in the proposed regulations. EPA is in limited

agreement with this comment. The regulations allow bulk liquids to be placed in landfills when stabilization is enhanced and the landfill has a liner physically and chemically resistant to the liquid added and with a continuously operated leachate collection and removal system with sufficient capacity to accomodate all the leachate produced. In landfilling bulk liquids, the owner or operator should consider the moisture regime for the specific site. The various sources of free liquids including precipitation, groundwater infiltration, and the amount of bulk liquids to be added must be balanced against the ability of the leachate collection and removal system to remove the liquids, evapotranspiration, and surface run-off.

A commenter suggested that performance standards would make operating standards such as this one unnecessary. The enviromental performance of a landfill is much more difficult to measure than performance of an effluent treatment process or air pollution control device. Sampling a stack or an effluent discharge gives immediate performance feedback. Sampling of ground water provides relatively slow feedback because of the time required for contaminants to reach ground water. Thus, the Agency feels that it is necessary to specify both operating and design criteria that will minimize the potential for waste migration.

Comments were also received suggesting that in-situ treatment (absorption) of liquid wastes be allowed i.e., mixing liquids with wastes already in the landfill. The Agency feels that it is preferable for free liquids to be eliminated <u>before</u> wastes are placed in the landfill. This provides greater assurance that the

liquid will be fully absorbed. However, the uncertainty of in-situ absorption can be tolerated when the landfill has a functioning liner and leachate collection and removal system.

Some commenters were concerned that this standard would necessitate pretreating dried sludges before landfilling. This is a misinterpretation of the standards. The objective of this standard is to minimize free liquids in landfills. Wastes, such as dried sludges, which have no free liquids do not require further treatment prior to landfilling.

The EPA also sees no reason why this standard would preclude the use of sludge pipelines. As long as liquids, semi-solids and sludges are pretreated prior to disposal to minimize free liquids, or the wastes are placed in a lined landfill with leachate collection at on-site facilities.

ISSUE: Containerized Liquids

A. Proposed Regulation and Rationale

The proposed standard required the owner or operator of a hazardous waste landfill to surround each container of liquid hazardous waste with an amount of sorbent inert material capable of absorbing all of the liquid contents in the container.

The primary purpose of the proposed regulation was to control the presence of free liquids in a landfill that would result from ruptured or leaking containers. The problems inherent with "free liquids" in landfills have been discussed above. The sorbent material to hold the liquid waste could reduce the leachate production.

However, the proposed option has significant drawbacks. One drawback is that the ability of the sorbent material to absorb the liquids is not certain. Thus, some liquid could escape, particularly if the sorbent is poorly placed. The seepage of appreciable amounts of liquid waste or leachate may also cause a rise in the water table and the development of a groundwater mound. As the mound increases in size, the unsaturated zone becomes progressively thinner and thus opportunity for natural attenuation is reduced. Sorbent material would tend to retain liquid waste lost from ruptured containers and reduce the formation of this groundwater mound and the subsequent reduction in natural attenuation.

B. Summary of Comments

- This standard only allows for the external use of inert sorbert material surrounding a container of liquid hazardous waste. It is recommended the Agency provide for the placement of the sorbent material inside the waste container for economics of operation.
- Opening drummed liquids can lead to greated worker exposure, air pollution from volatile waste, and increased potential for fire or explosion.
- Drums containing primarily solids with a small amount of free liquid (20%) should be allowed in landfills. The small amount of liquid would not be a significant leachate generation problem nor would long term settlement be great.
- Small containers (one gallon, 1 liter) of liquid waste should be allowed for disposal in landfills. (Another commenter suggested a small volume variance of 1000 tons per year)

° Drummed liquids should be allowed in landfills if containers are surrounded by sufficient soil or other absorbent material to absorb any free liquid.

C. Discussion

Commenters suggested that the proposed regulation only allowed external use of sorbent material and recommended that it be allowable to place the sorbent in the container prior to landfilling. This is a misunderstanding of the regulation since the Agency has never intended to discourage this type of disposal operation. The liquid waste must be mixed with sorbent material to eliminate free liquids before the filled container can be landfilled. There is no prohibition against landfilling containers which do not contain free liquids.

The Agency agrees that there are many potential problems associated with the opening of drummed liquids. However, these problems can be overcome with appropriate technology. The problems associated with the burial of containers are long-term and do not lend themselves to simple solutions since the time of release is unknown and could occur after the post-closure period. The Agency admits that the potential problems of worker safety are very serious and must be considered in facility operations. There are facilities which currently handle these types of materials safely. Special safety precautions can be used such as providing adequate ventilation, respirators, or using enclosed handling systems.

There is no rationale to exclude drums which contain relatively small quantities of "free liquids" from this regulation. The concern which led to the ban of the disposal of drums containing "free liquids" is the long term release of hazardous constituents.

There is no way to assure that these liquids would be absorbed when the drum ultimately failed. The method that a landfill operator uses to detect the presence of "free liquids" in a drum is an operational problem. Site investigations have shown that this can be done and that there is not excessive burden placed on the site operator. In some cases, the landfill operator has passed the requirement back to the generator to solidify all liquid wastes.

Allowing a variance for a particular size of small container is a difficult problem. EPA has allowed exemptions for containers of liquid such as capacitors and batteries because these containers serve a useful purpose other than for transportation or storage and the container is not designed to be opened easily. An exemption is also given for containers which are very small in volume such as ampules. One gallon or one liter containers do not meet these criteria. In general, these containers are designed to be opened and if only a small quantity are to be handled, there would not be an excessive burden on the generator or disposer to empty the containers. Conversely, a large number of small containers could contain a large volume of liquid waste which could significantly increase the hydraulic head in a landfill cell. To control this potential increase of the head in the landfill, EPA believes it is necessary to require that these containers be emptied.

To allow a limited volume of liquid waste to be placed in any landfill is a difficult approach to administer. Due to the wide variety of site conditions which could be encountered, it would be impossible to establish reasonable criteria which would be applicable on a national basis.

The comment requesting that containerized liquids be allowed if the containers are surrounded by absorbent material was the basic approach proposed in December 1978. The reasons for not reproposing this approach are discussed above.

D. Regulatory language

§264.314 Special requirements for liquid waste

(a) Bulk or non-containerized liquid waste or waste containing free liquids must not be placed in a landfill; unless:

(1) The added liquid is shown to enhance stabilization of the landfill, and

(2) The landfill has a liner which is chemically and physically resistant to the added liquid, and a functioning leachate collection and removal system with a capacity sufficient to remove all leachate produced.

(b) A container holding liquid waste or waste containing free liquids must not be placed in a landfill, unless:

(1) The container is designed to hold liquids or free liquids for a use other than storage, such as a battery or capacitor; or

(2) The container is very small, such as an ampule.

10. Special requirements for containers - §264.315

A. Proposed regulation and rationale

N/A

B. Summary of comments

Considerable comment was received on the subject of empty containers. The comments were not directed toward the disposal of empty containers but rather toward how to make the determination of when a container is considered empty.

C. Discussion

A technical amendment to the regulation (TAR) was issued to clarify the intent of the regulation (45 FR 78524-29). In summary, the TAR defines an empty container as a container which contains one inch or less of residue on the bottom (for containers holding gas empty means the pressure approaches atmospheric).

The intent of these regulations is to eliminate all voids in containers either empty (by interpretation of the new definition) or partially empty. The language makes this clear. The regulation also allow the containers to be filled in order to eliminate voids. However, the added material must be compatible with the wastes already in the container. "Full or filled container" and "partially empty container" have been defined in the regulation.

D. Regulatory language

§264.315 Special requirements for containers

(a) An empty container must be crushed flat, shredded, or similarly reduced in volume or filled with solids before it is buried beneath the surface of a landfill. A partially empty container must be:

(1) filled with solids compatible with the wastes already in the container or;

(2) crushed to eliminate void spaces; or

(3) emptied and the empty container crushed flat, shredded, or similarly reduced in volume before it is buried beneath the surface of the landfill.

(b) "Full or filled container" means the materials in the container:

(ii) occupy 90 percent or more of the volume of the container, whichever results in the lesser void space.

(c) "Partially empty container" means a container that is neither empty nor full.

11. Special requirements for classes of facilities

ISSUE: Distance from the historical high water table

A. Proposed Regulation and Rationale

Detailed discussion of the proposed regulation and rationale can be found in the 15 December 1978 Background Document for Section 250.45-2, Standards for Landfills on pages 50-53.

B. Summary of comments

- Several commenters stated that this requirement would prevent the location of secure landfills in many areas of the country, particularly along waterways and coastal regions such as the Gulf Coast where the water table is often near the surface. It was suggested the separation requirement between landfill and water table be based on specific site conditions such as an hydrologic analysis indicating contamination of an aquifer would result.
- This requirement would preclude the location of landfills in formations consisting of saturated clay or clay shale deposits. These deposits exhibit permeabilities less than 10^{-7} cm/sec. and can provide effective seepage control.
- Allow exemptions for existing facilities if the permit applicant can meet the Human Health and Environmental Standards.
- Leachate monitoring systems will not be able to be retrofitted for many sites. Recommend that leachate monitoring systems

not be a requirement for existing sites with separation distances of less than five feet.

- This requirement would prohibit the design of landfills using the "inward gradient" principle (i.e., maintaining leachate head levels below ground water levels to contain, collect, and remove leachate).
- Hazardous waste landfills should not be located over usable groundwater. The landfill must be naturally capable of preventing movement of the leachate and gases to the ground water. A 30-40 foot separation distance is recommended.
- The criteria should be that the water table historically has not been high enough to cause floating of emplaced liners. It is the liner, not the soil that prevents migration. Once the liner has been penetrated, the soil between it and the ground water would be only a minor flow barrier.
- This provision rules out the use of a dewatering system between the bottom of the landfill and the saturated zone.
- Direct contact of the landfill with ground water should be selectively permitted, where due to unique soil characteristics, harmful contamination will not occur and there is no endangerment of human health or the environment.
- Vertical isolation according to Act 641 P.A., 1978 will require 12 feet to natural water table and 7 feet to artificially depressed water table.
- Revise the note to read "The bottom of any liner system or any natural in-place soil barrier may be located less than five feet above the historical high water table or below the

historical high water table provided the owner/operator can demonstrate to the Regional Administrator at the time a permit is issued pursuant to Subpart E that the landfill is located in sediments or other earth materials which are sufficiently impermeable and homogenous (i.e., saturated clay or clay shale deposits) that they do not constitute an underground drinking water source and that the structural stability of seepage control characteristic of any emplaced or natural in-place soil liner would not be adversely affected by direct contact with the water table."

° The provision should be modified to state that the facility should be located so that the bottom of the landfill does not come in contact with ground water. However, if the site conditions make this impossible, then other measures should be taken to ensure the integrity of the liner.

C. Discussion

The previously proposed regulations required a minimum of 1.5 meters between the lowest level of construction for a landfill and the historical high water table. The reproposed regulations require a minimum of "2 meters" between the lowest level of construction for a landfill and the water table "for a water table aquifer or the bottom of the confining soils for an artesian aquifer".

The confining soils of an artesian aquifer are also included in the new proposal. At any given location, artesian aquifers exhibit historical variations in piezometric head. During periods of high piezometric head, ground water in some artesian systems may be forced above the confining soils. A buffer zone, between a

landfill and an artesian confining zone, lowers the probability of artesian water seepage into the landfill.

The distance factor of 1.5 meters was changed to 2 meters in the current proposal. The Agency made this change after recognizing that there is limited existing data on historical high ground water levels for most areas of the country. The increased distance factor will allow an added measure of safety to the uncertainty which will surround most designations of the historical high water table. Undoubtedly, this designation will often be based on only one or two years of data. The Agency believes, however, that any increase of the proposed distance (to 3 meters for example) would unnecessarily reduce the number of potentially acceptable landfill sites.

D. Regulatory language

New landfills, regardless of class (See 264.19), must have a minimum of two meters between the leachate detection, collection, and removal system liner, other liner, or waste, whichever is lower, and the historical high water table for a water table aquifer, or the bottom of the confining soils for an artesian aquifer.

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