STATE OF MICHIGAN

JOHN ENGLER, Governor

DEPARTMENT OF ENVIRONMENTAL QUALITY

HOLLISTER BUILDING, PO BOX 30473, LANSING MI 48909-7973

INTERNET: http://www.deq.state.mi.us

RUSSELL J. HARDING, Director

REPLY TO

DETROIT OFFICE
SUITE 3600
300 RIVER PLACE
DETROIT MI 48207

July 1, 1997

Mr. Robert Buckley, OSC
United States Environmental Protection Agency
Region 5
Emergency Response Branch
9311 Groh Road, Room 216
Grosse Ile, MI 48138-1697

Re: **Applicable or Relevant and Appropriate Requirements (ARARs) for: Metro Plating Site, Detroit, Wayne County, MI**

Dear Mr. Buckley:

Pursuant to your requests for ARARs for the above referenced site, please find enclosed MDEQ Environmental Response Division Operational Memoranda #8, Revision 4 (June 5, 1995) and #14, Revision 2 (June 6, 1995). These memoranda cover generic land-use based clean-up criteria developed to meet requirements under Part 201 of the Natural Resources and Environmental Protection Act (NREPA), 1994 PA 451, as amended. The criteria described represent acceptable limits for soil and groundwater contamination in certain settings. Other pertinent exposure pathways should also be considered when establishing remediation strategies including inhalation and acute dermal contact. I have also enclosed a copy of Part 201 of NREPA for your reference.

In addition, Mr. Dave Anderson, of your office, recently completed a removal action at the Comet Chrome Plating Site which was similar to the Metro Plating facility. Mr. Anderson may be able to assist you in selecting a remediation target levels for the hazardous materials of concern for the Metro Plating Removal..

If you have any questions regarding this matter, please contact me at (313) 392-6528.

Sincerely,

Jon E. Russell
Environmental Quality Analyst

cc: Ms. Mary Vanderlaan, MDEQ

EPA Region 5 Records Ctr.
236734

PART 201

OF THE

NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION ACT
ACT 451 OF 1994
as amended

ENVIRONMENTAL REMEDIATION

Printed and distributed by:

DEQ

Michigan Department of Environmental Quality
Environmental Response Division

Revised
September 1996

Michigan Department of Environmental Quality
Environmental Response Division
September 1996

This document contains Part 201 of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended. Part 201, entitled "Environmental Remediation" was formerly known as the Michigan Environmental Response Act (MERA), 1982 PA 307, as amended. This document replaces and updates the revised June 1996 printing of Part 201 in its entirety to now include the June 5 and June 29, 1995 amendments (71 PA 1995; 117 PA 1995 respectively), the March 6, 1996 amendments (115 PA 1996), and the July 24, 1996 amendments (380 PA 1996; 383 PA 1996) to Part 201.

For further information contact:

ENVIRONMENTAL RESPONSE DIVISION
MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
PO BOX 30426
LANSING MICHIGAN 48909
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PREFACE

The *Natural Resources and Environmental Protection Act (Excerpts)* is reprinted under the editorial direction of the Legislative Service Bureau from the text of the *Michigan Compiled Laws*, supplemented through Act 385 of the 1996 Regular Session of the Michigan Legislature.

Materials in boldface type, particularly catchlines and annotations to the statutes, are not part of the statutes as enacted by the Legislature.

Legal Editing and Law Publications Division
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TABLE OF CONTENTS

NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION ACT
Act 451 of 1994 (EXCERPTS)

PART 201: ENVIRONMENTAL REMEDIATION

324.20101 Definitions.

324.20101a Participation in management of facility by lender; "workout" defined.

324.20101b Liability of lender as fiduciary or representative for disabled person; responsibilities.

324.20102 Legislative finding and declaration.

324.20102a Applicability of provisions in effect on May 1, 1995 to certain actions; incorporation by reference; approval of changes in response activity plan.

324.20103 Federal assistance.

324.20104 Coordination of activities; rules; damages; use of nonuse valuation methods; applicability of provisions to certain bankruptcy actions or claims.

324.20104a Brownfield redevelopment board; creation; membership; quorum; business conducted at public meeting; writings subject to freedom of information act; duties and responsibilities.

324.20105 Duties of department; notification of inclusion on list; removal of site from list; "list" defined.

324.20105a Sites receiving state funds to conduct response activities; compilation, arrangement, and submission of list.

324.20106 Level of funding; recommendation of governor.

324.20107 Tearing down, removing, or destroying sign or notice as misdemeanor; penalty.

324.20107a Duties of owner or operator having knowledge of facility; liability for costs and damages; compliance with section; applicability of subsection (1).

324.20108 Cleanup and redevelopment fund; creation; deposit of assets into fund; subaccounts; unexpended balance to be carried forward.

324.20108a Revitalization revolving loan fund; creation; deposit of assets into fund; investment; interest and earnings; carrying forward unexpended balance; lump-sum appropriation; expenditure.

324.20108b Revitalization revolving loan program.

324.20108c State site cleanup fund; creation; deposit of assets into fund; investment; interest and earnings; money remaining in fund; lapse; use of money; state sites cleanup program; establishment; purpose; expenditure; list of facilities with state liability; prioritized list; payment for necessary response activities; carrying forward unexpended funds; compliance with § 18.1451; report.

324.20109 Repealed.

324.20109a Municipal landfill cost-share grant program

324.20110-324.20112 Repealed.

324.20112a Report to legislature.

324.20113 Appropriation; purposes; request to governor; list of sites; use of fund; expenditures; limitation; providing list of projects to governor and legislative committees.

324.20114 Owner or operator of facility; duties; response activity without prior approval; easement; applicability of subsections (1) and (3); completion of response activities; document; failure to notify department or submission of false or misleading information; civil fine; limitations; approval of plan.

324.20114a Person subject to civil fine; exception.

324.20115 Notice to department of agriculture; information; "substance regulated by the department of agriculture" defined; response activities to be consistent with §324.8714(2).

324.20115a Release or threat of release from underground storage tank system; corrective actions.

324.20115b Release from disposal area; corrective actions; exception.

324.20116 Transfer of interest in real property; notice; certification; disclosure of restrictions.

324.20117 Information required to be furnished; requirements; right to enter public or private property; purposes; duties of person entering public or private property; copies of sample analyses, photographs, or videotapes; completion of inspections and investigations; refusing entry or information; powers of attorney general; injunction; civil fine; availability of information to public; protection of information; administrative subpoena; witness fees and mileage; court order; contempt; "information" defined.

324.20118 Response activity; purposes of remedial action; alternatives; referred remedial actions; approval of plan; conditions; record; analysis of source control measures; liability; aquifer monitoring plan; innovative cleanup technologies.

324.20119 Action to abate danger or threat; administrative order; noncompliance; liability; petition for reimbursement; action in court of claims; evidence.

324.20120 Repealed.

324.20120a Cleanup criteria.

TABLE OF CONTENTS

324.20120b Remedial action plan.

324.20120c Relocation of soil.

324.20120d Public meeting; notice; publication; summary document; administrative record; comments or information not included in record.

324.20121-324.20125 Repealed.

324.20126 Liability under part.

324.20126a Joint several liability; costs of amounts recoverable; interest; recovery; permitted release; action by attorney general; action brought by state or other person.

324.20127 Repealed.

324.20128 Liability of response activity contractor; effect of warranty; liability of employer to employee; governmental employee exempt from liability; definitions; liability of person in rendering care, assistance, or advice on release of petroleum; effect of exception under subsection (6); burden of establishing liability.

324.20129 Divisibility of harm and apportionment of liability; liability for indivisible harm; contribution; factors in allocating response activity costs and damages; reallocation of uncollectible amount; effect of consent order; resolution of liability in approved settlement; contribution protection; effect of state obtaining less than complete relief; contribution from person not party to consent order; subordinate rights in action for contribution.

324.20129a Exemption from liability.

324.20130 Indemnification, hold harmless, or similar agreement or conveyance; subrogation.

324.20131 Limitations on liability; circumstances requiring total costs and damages.

324.20132 Covenant not to sue generally; future enforcement action.

324.20133 Redevelopment or reuse of facility; covenant not to sue; conditions; demonstration; limitation; reservation of right to assert claims; irrevocable right of entry; monitoring compliance.

324.20134 Consent order; settlement.

324.20134a Repealed.

324.20135 Civil action; jurisdiction; conditions; notice; awarding costs and fees; rights not impaired; venue.

324.20135a Access to property; action by court.

324.20136 Repealed.

324.20137 Additional relief; providing copy of complaint to attorney general; jurisdiction; judicial review; intervenor.

324.20138 Unpaid costs and damages as lien on facility; priority; commencement and sufficiency of lien; petition; notice of hearing; increased value as lien; perfection, duration, and release of lien; document stating completion of response activities.

324.20139 Applicability of penalties; conduct constituting felony; penalties; jurisdiction; criminal liability for substantial endangerment to public health, safety, or welfare; determination; knowledge attributable to defendant; award; rules; definition.

324.20140 Limitation periods.

324.20141 Repealed.

324.20142 Compliance as bar to certain claims; exceptions.

NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION ACT
Act 451 of 1994

AN ACT to protect the environment and natural resources of the state; to codify, revise, consolidate, and classify laws relating to the environment and natural resources of the state; to regulate the discharge of certain substances into the environment; to regulate the use of certain lands, waters, and other natural resources of the state; to prescribe the powers and duties of certain state and local agencies and officials; to provide for certain charges, fees, and assessments; to prescribe penalties and provide remedies; to repeal certain parts of this act on a specific date; and to repeal certain acts and parts of acts.

History: 1994, Act 451, Eff. Mar. 30, 1995.

The People of the State of Michigan enact:

PART 201 ENVIRONMENTAL REMEDIATION

324.20101 Definitions.

Sec. 20101. (1) As used in this part:

(a) "Act of God" means an unanticipated grave natural disaster or other natural phenomenon of an exceptional, inevitable, and irresistible character, the effects of which could not have been prevented or avoided by the exercise of due care or foresight.

(b) "Agricultural property" means real property used for farming in any of its branches, including cultivating of soil; growing and harvesting of any agricultural, horticultural, or floricultural commodity; dairying; raising of livestock, bees, fish, fur-bearing animals, or poultry; turf and tree farming; and performing any practices on a farm as an incident to, or in conjunction with, these farming operations. Agricultural property does not include property used for commercial storage, processing, distribution, marketing, or shipping operations.

(c) "Attorney general" means the department of the attorney general.

(d) "Baseline environmental assessment" means an evaluation of environmental conditions which exist at a facility at the time of purchase, occupancy, or foreclosure that reasonably defines the existing conditions and circumstance at the facility so that, in the event of a subsequent release, there is a means of distinguishing the new release from existing contamination.

(e) "Board" means the brownfield redevelopment board created in section 20104a.

(f) "Department" means the director of the department of environmental quality or his or her designee to whom the director delegates a power or duty by written instrument.

(g) "Director" means the director of the department of environmental quality.

(h) "Directors" means the directors or their designees of the departments of environmental quality, community health, agriculture, and state police.

(i) "Disposal" means the discharge, deposit, injection, dumping, spilling, leaking, or placing of any hazardous substance into or on any land or water so that the hazardous substance or any constituent of the hazardous substance may enter the environment or be emitted into the air or discharged into any groundwater or surface water.

(j) "Enforcement costs" means court expenses, reasonable attorney fees of the attorney general, and other reasonable expenses of an executive department that are incurred in relation to enforcement under this part or rules promulgated under this part, or both.

(k) "Environment" or "natural resources" means land, surface water, groundwater, subsurface, strata, air, fish, wildlife, or biota within the state.

(*l*) "Environmental contamination" means the release of a hazardous substance, or the potential release of a discarded hazardous substance, in a quantity which is or may become injurious to the environment or to the public health, safety, or welfare.

(m) "Evaluation" means those activities including, but not limited to, investigation, studies, sampling, analysis, development of feasibility studies, and administrative efforts that are needed to determine the nature, extent, and impact of a release or threat of release and necessary response activities.

(n) "Exacerbation" means the occurrence of either of the following caused by an activity undertaken by the person who owns or operates the property, with respect to existing contamination:

(*i*) Contamination that has migrated beyond the boundaries of the property which is the source of the release at levels above cleanup criteria specified in section 20120a(1)(a) unless a criterion is not relevant because exposure is reliably restricted pursuant to section 20120b.

(*ii*) A change in facility conditions that increases response activity costs.

(o) "Facility" means any area, place, or property where a hazardous substance in excess of the concentrations which satisfy the requirements of section 20120a(1)(a) or (17) or the cleanup criteria for unrestricted residential use under part 213 has been released, deposited, disposed of, or otherwise comes to be located. Facility does not include any area, place, or property at which response activities have been completed which satisfy the cleanup criteria for the residential category provided for in section 20120a(1)(a) and (17) or at which corrective action has been completed under part 213 which satisfies the cleanup criteria for unrestricted residential use.

(p) "Feasibility study" means a process for developing, evaluating, and selecting appropriate response activities.

(q) "Foreclosure" means possession of a property by a lender on which it has foreclosed on a security interest or the expiration of a lawful redemption period, whichever occurs first.

(r) "Free product" means a hazardous substance in a liquid phase equal to or greater than 1/8 inch of measurable thickness that is not dissolved in water and that has been released into the environment.

(s) "Fund" means the cleanup and redevelopment fund established in section 20108.

(t) "Hazardous substance" means 1 or more of the following, but does not include fruit, vegetable, or field crop residuals or processing by-products, or aquatic plants, that are applied to the land for an agricultural use or for use as an animal feed, if the use is consistent with generally accepted agricultural management practices developed pursuant to the Michigan right to farm act, Act No. 93 of the Public Acts of 1981, being sections 286.471 to 286.474 of the Michigan Compiled Laws:

(*i*) Any substance that the department demonstrates, on a case by case basis, poses an unacceptable risk to the public health, safety, or welfare, or the environment, considering the fate of the material, dose-response, toxicity, or adverse impact on natural resources.

(*ii*) Hazardous substance as defined in the comprehensive environmental response, compensation, and liability act of 1980, Public Law 96-510, 94 Stat. 2767.

(*iii*) Hazardous waste as defined in part 111.

(*iv*) Petroleum as described in part 213.

(u) "Interim response activity" means the cleanup or removal of a released hazardous substance or the taking of other actions, prior to the implementation of a remedial action, as may be necessary to prevent, minimize, or mitigate injury to the public health, safety, or welfare, or to the environment. Interim response activity also includes, but is not limited to, measures to limit access, replacement of water supplies, and temporary relocation of people as determined to be necessary by the department. In addition, interim response activity means the taking of other actions as may be necessary to prevent, minimize, or mitigate a threatened release.

(v) "Lender" means any of the following:

(*i*) A state or nationally chartered bank.

(*ii*) A state or federally chartered savings and loan association or savings bank.

(*iii*) A state or federally chartered credit union.

(*iv*) Any other state or federally chartered lending institution or regulated affiliate or regulated subsidiary of any entity listed in this subparagraph or subparagraphs (*i*) to (*iii*).

(*v*) An insurance company authorized to do business in this state pursuant to the insurance code of 1956, Act No. 218 of the Public Acts of 1956, being sections 500.100 to 500.8302 of the Michigan Compiled Laws.

(*vi*) A motor vehicle finance company subject to the motor vehicle finance act, Act No. 27 of the Extra Session of 1950, being sections 492.101 to 492.141 of the Michigan Compiled Laws, with net assets in excess of $50,000,000.00.

(*vii*) A foreign bank.

(*viii*) A retirement fund regulated pursuant to state law or a pension fund regulated pursuant to federal law with net assets in excess of $50,000,000.00.

(*ix*) A state or federal agency authorized by law to hold a security interest in real property or a local unit of government holding a reversionary interest in real property.

(*x*) A nonprofit tax exempt organization created to promote economic development in which a majority of the organization's assets are held by a local unit of government.

(*xi*) Any other person who loans money for the purchase of or improvement of real property.

(*xii*) Any person who retains or receives a security interest to service a debt or to secure a performance obligation.

(w) "Local health department" means that term as defined in section 1105 of the public health code, Act No. 368 of the Public Acts of 1978, being section 333.1105 of the Michigan Compiled Laws.

(x) "Local unit of government" means a county, city, township, or village, an agency of a local unit of government, an authority or any other public body or entity created by or pursuant to state law. Local unit of government does not include the state or federal government or a state or federal agency.

(y) "Operator" means a person who is in control of or responsible for the operation of a facility. Operator does not include either of the following:

(*i*) A person who holds indicia of ownership primarily to protect the person's security interest in the facility, unless that person participates in the management of the facility as described in section 20101a.

(*ii*) A person who is acting as a fiduciary in compliance with section 20101b.

(z) "Owner" means a person who owns a facility. Owner does not include either of the following:

(*i*) A person who holds indicia of ownership primarily to protect the person's security interest in the facility, including, but not limited to, a vendor's interest under a recorded land contract, unless that person participates in the management of the facility as described in section 20101a.

(*ii*) A person who is acting as a fiduciary in compliance with section 20101b.

(aa) "Permitted release" means 1 or more of the following:

(*i*) A release in compliance with an applicable, legally enforceable permit issued under state law.

(*ii*) A lawful and authorized discharge into a permitted waste treatment facility.

(*iii*) A federally permitted release as defined in the comprehensive environmental response, compensation, and liability act of 1980, Public Law 96-510, 94 Stat. 2767.

(bb) "Release" includes, but is not limited to, any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing of a hazardous substance into the environment, or the abandonment or discarding of barrels, containers, and other closed receptacles containing a hazardous substance. Release does not include any of the following:

(*i*) A release that results in exposure to persons solely within a workplace, with respect to a claim that these persons may assert against their employers.

(*ii*) Emissions from the engine exhaust of a motor vehicle, rolling stock, aircraft, or vessel.

(*iii*) A release of source, by-product, or special nuclear material from a nuclear incident, as those terms are defined in the atomic energy act of 1954, chapter 1073, 68 Stat. 919, if the release is subject to requirements with respect to financial protection established by the nuclear regulatory commission under section 170 of chapter 14 of title I of the atomic energy act of 1954, chapter 1073, 71 Stat. 576, 42 U.S.C. 2210, or any release of source by-product or special nuclear material from any processing site designated under section 102(a)(1) of title I or 302(a) of title III of the uranium mill tailings radiation control act of 1978, Public Law 95-604, 42 U.S.C. 7912 and 7942.

(*iv*) If applied according to label directions and according to generally accepted agricultural and management practices, the application of a fertilizer, soil conditioner, agronomically applied manure, or pesticide, or fruit, vegetable, or field crop residuals or processing by-products, aquatic plants, or a combination of these substances. As used in this subparagraph, fertilizer and soil conditioner have the meaning given to these terms in part 85, and pesticide has the meaning given to that term in part 83.

(*v*) A release does not include fruits, vegetables, field crop processing by-products, or aquatic plants, that are applied to the land for an agricultural use or for use as an animal feed, if the use is consistent with generally accepted agricultural and management practices developed pursuant to the Michigan right to farm act, Act No. 93 of the Public Acts of 1981, being sections 286.471 to 286.474 of the Michigan Compiled Laws.

(cc) "Remedial action" includes, but is not limited to, cleanup, removal, containment, isolation, destruction, or treatment of a hazardous substance released or threatened to be released into the environment, monitoring, maintenance, or the taking of other actions that may be necessary to prevent, minimize, or mitigate injury to the public health, safety, or welfare, or to the environment.

(dd) "Remedial action plan" means a work plan for performing remedial action under this part.

(ee) "Response activity" means evaluation, interim response activity, remedial action, demolition, or the taking of other actions necessary to protect the public health, safety, or welfare, or the environment or the natural resources. Response activity also includes health assessments or health effect studies carried out under the supervision, or with the approval of, the department of public health and enforcement actions related to any response activity.

(ff) "Response activity costs" or "costs of response activity" means all costs incurred in taking or conducting a response activity, including enforcement costs.

(gg) "Security interest" means any interest, including a reversionary interest, in real property created or established for the purpose of securing a loan or other obligation. Security interests include, but are not limited to, mortgages, deeds of trusts, liens, and title pursuant to lease financing transactions. Security interests may also arise from transactions such as sale and leasebacks, conditional sales, installment sales, trust receipt transactions, certain assignments, factoring agreements, accounts receivable financing arrangements, consignments, or any other transaction in which evidence of title is created if the transaction creates or establishes an interest in real property for the purpose of securing a loan or other obligation.

(hh) "Site" means the location of environmental contamination.

(ii) "Threatened release" or "threat of release" means any circumstance that may reasonably be anticipated to cause a release.

(2) As used in this part, the phrase "a person who is liable" includes a person who is described as being subject to liability in section 20126. The phrase "a person who is liable" does not presume that liability has been adjudicated.

History: 1994, Act 451, Eff. Mar. 30, 1995;—Am. 1995, Act 71, Imd. Eff. June 5, 1995;—Am. 1995, Act 117, Imd. Eff. June 29, 1995;—Am. 1996, Act 115, Imd. Eff. Mar. 6, 1996;—Am. 1996, Act 380, Imd. Eff. July 24, 1996;—Am. 1996, Act 383, Imd. Eff. July 24, 1996.

324.20101a Participation in management of facility by lender; "workout" defined.

Sec. 20101a. (1) For purposes of this part, a lender holding a security interest in a facility participates in the management of the facility if that lender engages in acts of facility management that constitute actual participation in the management or operational affairs of a facility and that exceed the mere capacity to influence, or ability to influence, or the unexercised right to control facility operations. A lender holding a security interest is participating in the management of a facility, while the borrower is still in possession of the facility encumbered by the security interest, if the lender holding a security interest does any of the following:

(a) Exercises decision making control over the borrower's environmental compliance.

(b) Undertakes responsibility for the borrower's hazardous substance handling or disposal practices.

(c) Exercises control at a level comparable to that of a manager of the borrower's enterprise, such that the holder has assumed or manifested responsibility for the overall management of the enterprise encompassing the day-to-day decision making of the enterprise with respect to either or both of the following:

(*i*) Environmental compliance.

(*ii*) All, or substantially all, of the operational aspects of the enterprise other than environmental compliance. As used in this subparagraph, "operational aspects of the enterprise" includes functions such as that of facility or plant manager, operations manager, chief operating officer, or chief executive officer. Operational aspects of the enterprise do not include the financial or administrative aspects of the enterprise such as that of credit manager, accounts payable or receivable manager, personnel manager, controller, chief financial officer, or similar functions.

(2) For purposes of this part, the following do not constitute participation in the management of a facility by a lender holding a security interest in the facility:

(a) The mere capacity to influence, or ability to influence, or the unexercised right to control facility operations.

(b) An act or omission prior to the time that indicia of ownership are held primarily to protect a security interest.

(c) Undertaking or requiring an environmental inspection of the facility in which indicia of ownership are to be held, or requiring a prospective borrower to undertake response activities at a facility or to comply or come into compliance, whether prior or subsequent to the time that indicia of ownership are held primarily to protect a security interest, with any applicable law, rule, or regulation.

(d) Actions that are consistent with holding ownership indicia primarily to protect a security interest. The authority of the lender holding a security interest to take such actions may, but need not, be contained in contractual or other documents specifying requirements for financial, environmental, and other warranties, covenants, conditions, representations, or promises from the borrower. Loan policing and workout activities cover and include all activities up to foreclosure and its equivalents.

(e) Engaging in policing activities prior to foreclosure if the lender holding a security interest does not by such actions participate in the management of the facility as described in subsection (1)(a) to (c). Permissible actions include, but are not limited to, requiring the borrower to undertake response activities at the facility during the term of the security interest; requiring the borrower to comply or come into compliance with applicable federal, state, and local environmental and other laws, rules, and regulations during the term of the security interest; and securing or exercising authority to monitor or inspect the facility in which indicia of ownership are maintained, including on-site inspections, or the borrower's business or financial condition, during the term of the security interest. A lender holding a security interest that engages in workout activities prior to foreclosure and its equivalents will remain within the exemption if the lender holding a security interest does not by such action participate in the management of the facility.

(3) As used in this section, "workout" refers to those actions by which a lender holding a security interest, at any time prior to foreclosure or its equivalent, seeks to prevent, cure, or mitigate a default by the borrower or obligor or to preserve, or prevent the diminution of, the value of the security. Workout activities include, but are not limited to, restructuring or renegotiating the terms of the security interest; requiring payment of additional rent or interest; exercising forbearance; requiring or exercising rights pursuant to an assignment of accounts or other amounts owing to an obligor; requiring or exercising rights pursuant to an escrow agreement pertaining to amounts owing to an obligor; and providing specific or general financial or other advice, suggestions, counseling, or guidance.

History: 1994, Act 451, Eff. Mar. 30, 1995;—Am. 1995, Act 71, Imd. Eff. June 5, 1995.

324.20101b Liability of lender as fiduciary or representative for disabled person; responsibilities.

Sec. 20101b. (1) A lender or other person who has not participated in the management of a property as described in section 20101a prior to assuming ownership or control of the property as a fiduciary, as defined by section 5 of the revised probate code, Act No. 642 of the Public Acts of 1978, being section 700.5 of the Michigan Compiled Laws, or in a representative capacity for a disabled person under section 495 of Act No. 642 of the Public Acts of 1978, being section 700.495 of the Michigan Compiled Laws, and that is acting or has acted in a capacity permitted by the revised probate code, Act No. 642 of the Public Acts of 1978, being sections 700.1 to 700.993 of the Michigan Compiled Laws, is not personally liable as an owner or operator of the property under this part. This subsection does not do either of the following:

(a) Relieve the fiduciary from personal liability as the result of the fiduciary's assumption of personal liability, or negligence, gross negligence, or reckless, willful, or intentional misconduct.

(b) Prevent claims against the assets that are part of or all of the estate or trust that contains the facility; any other estate or trust of the decedent, grantor, ward, or other person whose estate or trust contains the facility that is administered by the lender or other person; or any other estate or trust of the decedent, grantor, ward, or other person whose estate or trust contains the facility. Such claims may be asserted against the fiduciary in its representative capacity, whether or not the fiduciary is personally liable.

(2) A lender that has not participated in the management of a property as described in section 20101a prior to assuming ownership or control of the property in a fiduciary capacity, and under a fiduciary agreement entered into on or before August 1, 1990 owns or controls the property in a fiduciary capacity that is authorized by the banking code of 1969, Act No. 319 of the Public Acts of 1969, being sections 487.301 to 487.598 of the Michigan Compiled Laws, or the national bank act, chapter 106, 13 Stat. 99, is not personally liable as an owner or operator of the property under this part. This subsection does not do either of the following:

(a) Relieve the fiduciary from personal liability as the result of the fiduciary's assumption of personal liability, negligence, gross negligence, or reckless, willful, or intentional misconduct.

(b) Prevent claims against the assets that are part of or all of the estate or trust that contains the facility; any other estate or trust of the decedent, grantor, ward, or other person whose estate or trust contains the facility that is administered by the lender; or any other estate or trust of the decedent, grantor, ward, or other person whose estate or trust contains the facility. Such claims may be asserted against the fiduciary in its representative capacity, whether or not the fiduciary is personally liable.

(3) A lender that has not participated in the management of a property as described in section 20101a prior to assuming ownership or control of the property in a fiduciary capacity, and pursuant to a fiduciary agreement entered into after August 1, 1990 owns or controls the property in a fiduciary capacity that is authorized by Act No. 319 of the Public Acts of 1969, or the national bank act, chapter 106, 13 Stat. 99, that has served only in an administrative, custodial, or financial capacity with respect to the property, and has not exercised sufficient involvement to control the owner's or operator's handling of a hazardous substance, is not personally liable as an owner or operator of the property under this part. This subsection does not do either of the following:

(a) Relieve the fiduciary from personal liability as the result of the fiduciary's assumption of personal liability, negligence, gross negligence, or reckless, willful, or intentional misconduct.

(b) Prevent claims against the assets that are part of or all of the estate or trust that contains the facility; any other estate or trust of the decedent, grantor, ward, or other person whose estate or trust contains the facility that is administered by the lender; or any other estate or trust of the decedent, grantor, ward, or other person whose estate or trust contains the facility. Such claims may be asserted against the fiduciary in its representative capacity, whether or not the fiduciary is personally liable.

History: Add. 1995, Act 71, Imd. Eff. June 5, 1995.

324.20102 Legislative finding and declaration.

Sec. 20102. The legislature hereby finds and declares:

(a) That there exist in this state certain facilities containing hazardous substances that pose a danger to the public health, safety, or welfare, or to the environment of this state.

(b) That there is a need to provide for a method of eliminating the danger of environmental contamination caused by the existence of hazardous substances at facilities within the state.

(c) That it is the purpose of this part to provide for appropriate response activity to eliminate unacceptable risks to public health, safety, or welfare, or to the environment from environmental contamination at facilities within the state.

(d) That there is a need for additional administrative and judicial remedies to supplement existing statutory and common law remedies.

(e) That the responsibility for the cost of response activities pertaining to a release or threat of release and repairing injury, destruction, or loss to natural resources caused by a release or threat of release should not be placed upon the public except when funds cannot be collected from, or a response activity cannot be undertaken by, a person liable under this part.

(f) That liability for response activities to address environmental contamination should be imposed upon those persons who are responsible for the environmental contamination.

(g) That to the extent possible, consistent with requirements under this part and rules promulgated under this part, response activities shall be undertaken by persons liable under this part.

(h) That this part is intended to provide remedies for facilities posing any threat to the public health, safety, or welfare, or to the environment, regardless of whether the release or threat of release of a hazardous substance occurred before or after October 13, 1982, the effective date of the former environmental response act, Act No. 307 of the Public Acts of 1982, and for this purpose this part shall be given retroactive application. However, criminal and civil penalties provided in this part shall apply to violations of this part that occur after July 1, 1991.

(i) That a facility that is owned by the federal government, the state, or a local unit of government, or a facility where a release or threat of release is caused by the federal government, the state, or a local unit of government, should not be treated differently in terms of the expenditure of money for response activities than any facility.

(j) That if a person who is liable under section 20126 is the state or a local unit of government, this part should be enforced by the attorney general and the department in the same manner as it would be for any other person who is liable under section 20126.

(k) That this part is not intended to impose penalties or exemplary damages upon parties conducting response activities pursuant to a decree or order to which the United States is a party.

(*l*) That this part is intended to foster the redevelopment and reuse of vacant manufacturing facilities and abandoned industrial sites that have economic development potential, if that redevelopment or reuse assures the protection of the public health, safety, welfare, and the environment.

(m) That it is the intent of the legislature that, in implementing this part, the department shall act reasonably in its exercise of professional judgment.

History: 1994, Act 451, Eff. Mar. 30, 1995;—Am. 1995, Act 71, Imd. Eff. June 5, 1995.

324.20102a Applicability of provisions in effect on May 1, 1995 to certain actions; incorporation by reference; approval of changes in response activity plan.

Sec. 20102a. (1) Notwithstanding any other provision of this part, the following actions shall be governed by the provisions of this part that were in effect on May 1, 1995:

(a) Any judicial action or claim in bankruptcy that was initiated by any person on or before May 1, 1995 under this part.

(b) An administrative order that was issued on or before May 1, 1995 pursuant to section 20119.

(c) An enforceable agreement with the state entered into on or before May 1, 1995 by any person under this part.

(2) For purposes of this section, the provisions of this part that were in effect on May 1, 1995 are hereby incorporated by reference.

(3) Notwithstanding subsection (1), upon request of a person implementing response activity, the department shall approve changes in a plan for response activity to be consistent with sections 20118 and 20120a.

History: Add. 1995, Act 71, Imd. Eff. June 5, 1995.

324.20103 Federal assistance.

Sec. 20103. The department shall seek federal assistance for response activities required at facilities in this state.

History: 1994, Act 451, Eff. Mar. 30, 1995.

324.20104 Coordination of activities; rules; damages; use of nonuse valuation methods; applicability of provisions to certain bankruptcy actions or claims.

Sec. 20104. (1) The department shall coordinate all activities required under this part and shall promulgate rules to provide for the performance of response activities, to provide for the assessment of damages for injury to, destruction of, or loss of natural resources resulting from a release, and to implement the powers and duties of the department under this part, and as otherwise necessary to carry out the requirements of this part.

(2) Claims for natural resource damages may be pursued prior to promulgation of rules but only in accordance with principles of scientific and economic validity and reliability. Contingent nonuse valuation methods or similar nonuse valuation methods shall not be utilized and damages shall not be recovered for nonuse values unless and until rules are promulgated that establish an appropriate means of determining such damages.

(3) A contingent nonuse valuation method or similar nonuse valuation method shall not be utilized for natural resource damage calculations unless a determination is made by the department that such a method satisfies principles of scientific and economic validity and reliability and rules for utilizing a contingent nonuse valuation method or a similar nonuse valuation method are subsequently promulgated.

(4) The provisions in this section related to natural resource damages as added by the 1995 amendatory act that amended this section do not apply to any judicial or administrative action or claim in bankruptcy initiated on or before March 1, 1995.

History: 1994, Act 451, Eff. Mar. 30, 1995;—Am. 1995, Act 71, Imd. Eff. June 5, 1995.

324.20104a Brownfield redevelopment board; creation; membership; quorum; business conducted at public meeting; writings subject to freedom of information act; duties and responsibilities.

Sec. 20104a. (1) The brownfield redevelopment board is created within the department of environmental quality.

(2) The board shall consist of the following members:

(a) The director of the department of environmental quality or his or her designee.

(b) The director of the department of management and budget or his or her designee.

(c) The chief executive officer of the jobs commission or his or her designee.

(3) A majority of the members of the board constitute a quorum for the transaction of business at a meeting of the board.

(4) The business which the board may perform shall be conducted at a public meeting of the board held in compliance with the open meetings act, Act No. 267 of the Public Acts of 1976, being sections 15.261 to 15.275 of the Michigan Compiled Laws.

(5) A writing prepared, owned, used, in the possession of, or retained by the board in the performance of an official function is subject to the freedom of information act, Act No. 442 of the Public Acts of 1976, being sections 15.231 to 15.246 of the Michigan Compiled Laws.

(6) The board shall implement the duties and responsibilities as provided in this part and as otherwise provided by law.

History: Add. 1996, Act 383, Imd. Eff. July 24, 1996.

324.20105 Duties of department; notification of inclusion on list; removal of site from list; "list" defined.

Sec. 20105. (1) The department shall do all of the following:

(a) Upon discovery of a site, identify and evaluate the site for the purpose of assigning to the site a priority score for response activities. Upon assignment to the site of a priority score for response activity, the site shall retain the same score assignment unless a substantial body of data is provided to or available to the department indicating to the department that a substantial change in the score is warranted, and a person requests rescoring for a site during the annual public comment period following the publication of the list, or the department determines that rescoring is appropriate.

(b) Develop 1 or more numerical risk assessment models for assessing the relative present and potential hazards posed to the public health, safety, or welfare, or to the environment by each site identified pursuant to subdivision (a). The model, or models if more than 1 is developed, shall provide a fair and objective site specific numerical score designating the relative risk posed to the public health, safety, or welfare, or to the environment of each site.

(c) Include in rules promulgated under this part the numerical risk assessment model or models if more than 1 is developed. The numerical risk assessment model or models shall be reviewed annually by the department to identify potential improvements.

(d) Except as provided in subsection (9), submit to the legislature in November of each fourth year a list strictly derived from the numerical risk assessment model or models provided for in this section that does all of the following:

(*i*) Includes all sites.

(*ii*) Categorizes sites according to the response activity at the site at the time of listing and according to categories established by rules.

(*iii*) Indicates whether the owner of a site is the federal government, the state, or a local unit of government.

(*iv*) Indicates a change in the status of a site since the last previously prepared list.

(e) Maintain and make available to the public upon request records regarding sites where remedial actions have been completed, including sites where land use restrictions have been imposed, if the records are not otherwise protected from disclosure by law.

(f) Submit the list for public hearings geographically dispersed throughout the state. These hearings shall be completed at least 30 days before the governor's annual budget recommendations to the legislature.

(g) Report to the legislature and the governor those sites that have been removed from the list pursuant to this section and rules promulgated under this part and the source of the funds used to undertake the response activity at each of the sites.

(h) Publish a notice each fourth year in the Michigan register of the availability of, and submit to the standing committees of the senate and the house of representatives that primarily consider issues pertaining to the protection of natural resources and the environment, a report describing the response activity that is undertaken at each site where response activity is or has occurred during the reporting period and the nature of the contamination that resulted in the necessity for that response activity.

(2) Following July 1, 1991, if the department has information identifying the owner of property that may be listed as a site, the department shall make reasonable efforts to notify in writing the owner of the property and the local health department and the municipality in which the site is located prior to including the site on the list. This subsection does not provide a defense to liability.

(3) A site shall be removed from the list when the department's review of a site shows that the site does not meet the criteria specified in rules promulgated under this part. A site shall not be removed from this list until any necessary response activity that meets the standards specified in rules promulgated under this part is complete.

(4) A person may request that a site be removed from the list by submitting a petition to the department. A petition shall include all of the following information:

(a) A description and history of the site.

(b) A description of the nature and extent of the environmental contamination that existed at the site at the time the site was included on the list.

(c) A description of the response activity undertaken to remedy the release or threat of a release, consistent with rules promulgated under this part, or a description of the investigation conducted that supports the person's petition that the site should be removed from the list without further response activity.

(d) An analysis of the effectiveness of the response activity undertaken to remediate the release or threat of release. The analysis shall include site specific analytical data that documents the effectiveness of the response activity.

(e) Other site-specific information required by the department.

(5) A person seeking the removal of a site from the list shall prepare and submit to the department the documentation required by subsection (4). If response activities have been conducted by the department at the site, the department shall prepare the documentation required by subsection (4).

(6) Within 30 days after receipt of the petition, the department shall determine whether a petition submitted under subsection (4) is administratively complete. Within 60 days after a determination that a petition is administratively complete, the petitioner shall be notified by the department of the department's intent to remove the site from the list, or the petitioner shall be notified that the petition for removal of the site from the list does not meet the criteria for removal of the site from the list as determined by rule. Removal of sites from the list shall be accomplished as part of the process described in rules promulgated under this part. However, if the department concludes pursuant to subsection (3) that the circumstances warrant removal of the site from the list before or at the next regularly scheduled hearing to be held in accordance with rules promulgated under this part, the department shall prepare a notice of intent to remove the site from the list. A notice of intent shall include information considered appropriate by the department and shall be published in at least 1 newspaper of general circulation that serves the area of the site and the notice of intent shall be provided to the local health department and the municipality in which the site is located. Public comment on the notice of intent to remove the site from the site list shall be accepted for a period of not less than 30 days from the date of publication. The department may hold a public hearing on the proposed action.

(7) The department shall make a final determination whether to include the site on the next list. The department shall consider any comments received in response to the notice described in subsection (6).

(8) The department shall notify the person that requested that the site be removed from the list, the local health department, and the municipality in which the site is located of the decision within 45 days of the end of the public comment period provided for in the notice published pursuant to subsection (6).

(9) If the department provides the information required to be included on the list prepared under this section on a computer data base that is accessible through public access computer terminals in each county in the state, the department need not prepare a printed copy of the list.

(10) As used in this section, "list" means the list described in subsection (1)(d).

History: 1994, Act 451, Eff. Mar. 30, 1995;—Am. 1995, Act 71, Imd. Eff. June 5, 1995.

Compiler's note: For transfer of authority, powers, duties, functions, and responsibilities of the Environmental Response Division to the Director of the Michigan Department of Environmental Quality, see E.R.O. No. 1995-16, compiled at § 324.99901 of the Michigan Compiled Laws.

324.20105a Sites receiving state funds to conduct response activities; compilation, arrangement, and submission of list.

Sec. 20105a. The department shall annually compile a list of sites that are receiving state funds to conduct response activities. This list shall be arranged in alphabetical order. The department shall annually submit this list to the legislature.

History: Add. 1995, Act 71, Imd. Eff. June 5, 1995.

324.20106 Level of funding; recommendation of governor.

Sec. 20106. (1) The governor shall include in his or her annual budget recommendations to the legislature a recommended level of funding to provide for the activities necessary to implement this part.

(2) The governor's recommendations under this section shall be accompanied by a site specific description of the extent of known or suspected environmental contamination, the recommended response activities to be undertaken, and an estimate of cost of those response activities.

History: 1994, Act 451, Eff. Mar. 30, 1995.

324.20107 Tearing down, removing, or destroying sign or notice as misdemeanor; penalty.

Sec. 20107. A person who willfully tears down, removes, or destroys any sign or notice warning of the presence of hazardous substances or marking boundaries of a facility subject to response activity under this part is guilty of a misdemeanor punishable by imprisonment for not more than 90 days or a fine of not more than $500.00, or both.

History: 1994, Act 451, Eff. Mar. 30, 1995;—Am. 1995, Act 71, Imd. Eff. June 5, 1995.

324.20107a Duties of owner or operator having knowledge of facility; liability for costs and damages; compliance with section; applicability of subsection (1).

Sec. 20107a. (1) A person who owns or operates property that he or she has knowledge is a facility shall do all of the following with respect to hazardous substances at the facility:

(a) Undertake measures as are necessary to prevent exacerbation of the existing contamination.

(b) Exercise due care by undertaking response activity necessary to mitigate unacceptable exposure to hazardous substances, mitigate fire and explosion hazards due to hazardous substances, and allow for the intended use of the facility in a manner that protects the public health and safety.

(c) Take reasonable precautions against the reasonably foreseeable acts or omissions of a third party and the consequences that foreseeably could result from those acts or omissions.

(2) Notwithstanding any other provision of this part, a person who violates subsection (1) is liable for response activity costs and natural resource damages attributable to any exacerbation of existing contamination and any fines or penalties imposed under this part resulting from the violation of subsection (1) but is not liable for performance of additional response activities unless the person is otherwise liable under this part for performance of additional response activities. The burden of proof in a dispute as to what constitutes exacerbation shall be borne by the party seeking relief.

(3) Compliance with this section does not satisfy a person's obligation to perform response activities as otherwise required under this part.

(4) Subsection (1) does not apply to the state or to a local unit of government that is not liable under section 20126(3)(a), (b), (c), or (e) or to a local unit of government that acquired property by purchase, gift, transfer, or condemnation prior to the effective date of this section or to a person who is exempt from liability under section 20126(4)(c).

(5) Subsection (1) does not apply to a person who is exempt from liability under section 20126(3)(c) or (d) except with regard to that person's activities at the facility.

History: Add. 1995, Act 71, Imd. Eff. June 5, 1995;—Am. 1996, Act 115, Imd. Eff. Mar. 6, 1996;—Am. 1996, Act 380, Imd. Eff. July 24, 1996;—Am. 1996, Act 383, Imd. Eff. July 24, 1996.

324.20108 Cleanup and redevelopment fund; creation; deposit of assets into fund; subaccounts; unexpended balance to be carried forward.

Sec. 20108. (1) The cleanup and redevelopment fund is created in the state treasury.

(2) The state treasurer may receive money or other assets from any source for deposit into the fund. The state treasurer shall direct the investment of the fund. The state treasurer shall credit to the fund interest and earnings from fund investments.

(3) In addition to the money received under subsection (2), the fund shall receive as revenue money collected by the attorney general in actions filed under this part, collected by the state under this part, or collected by a person under section 20135(2). Money collected and placed into the fund under this subsection may be earmarked by the department for use at specific sites.

(4) The state treasurer may establish subaccounts within the fund, and shall establish a subaccount for all money in the former environmental response fund on the effective date of the 1996 amendments to this section. Proceeds of all cost recovery actions taken and settlements entered into pursuant to this part, excluding natural resource damages, by the department or the attorney general, or both, shall be credited to this subaccount.

(5) An unexpended balance within the fund at the close of the fiscal year shall be carried forward to the following fiscal year.

History: 1994, Act 451, Eff. Mar. 30, 1995;—Am. 1996, Act 380, Imd. Eff. July 24, 1996.

324.20108a Revitalization revolving loan fund; creation; deposit of assets into fund; investment; interest and earnings; carrying forward unexpended balance; lump-sum appropriation; expenditure.

Sec. 20108a. (1) The revitalization revolving loan fund is created within the state treasury.

(2) The state treasurer may receive money or other assets from any source for deposit into the revitalization revolving loan fund. The state treasurer shall direct the investment of the revitalization revolving loan fund. The state treasurer shall credit to the revitalization revolving loan fund interest and earnings from revitalization revolving loan fund investments.

(3) An unexpended balance within the revitalization revolving loan fund at the close of the fiscal year shall be carried forward to the following fiscal year.

(4) The department shall annually submit to the governor a request for a lump-sum appropriation from the revitalization revolving loan fund for loans pursuant to the revitalization revolving loan program under section 20108b.

(5) The department shall expend money from the revitalization revolving loan fund, upon appropriation, only for the revitalization loan program created in section 20108b.

History: Add. 1996, Act 380, Imd. Eff. July 24, 1996.

324.20108b Revitalization revolving loan program.

Sec. 20108b. (1) The department shall create a revitalization revolving loan program for the purpose of making loans to certain local units of government to provide for eligible activities at certain properties in order to promote economic redevelopment.

(2) To be eligible for a loan, applications must meet the following requirements:

(a) The applicant is a county, city, township, or village, or an authority established pursuant to the brownfield redevelopment financing act, provided that the municipality which created the authority pursuant to the brownfield redevelopment financing act commits to secure the loan with a pledge of the municipality's full faith and credit.

(b) The application is for eligible activities at a property within the applicant's jurisdiction that is a facility or is suspected to be a facility based on current or historic use.

(c) The application is complete and submitted on a form provided by the department.

(d) The application is received by the deadline established by the department.

(e) The application is for eligible activities only as provided for in subsection (3).

(3) Eligible activities are limited to evaluation and demolition at the property or properties in an area-wide zone, and interim response activities required to facilitate evaluation and demolition conducted prior to redevelopment of a property or properties in an area-wide zone. Eligible activities include only those necessary to facilitate redevelopment. Eligible activities do not include activities necessary only to design or complete a remedial action that fully complies with the requirements of section 20120a. All eligible activities must be consistent with a work plan or remedial action plan approved in advance by the department under this part or pursuant to section 15 of the brownfield redevelopment financing act. Unless otherwise approved by the director, only activities carried out and costs incurred after execution of a loan agreement are eligible.

(4) The department shall provide for at least 1 application cycle per fiscal year. Prior to each application cycle, the department shall develop written instructions for prospective applicants including the criteria that will be used in application review and approval.

(5) Final application decisions shall be made by the department within 4 months of the application deadline.

(6) A complete application shall include the following:

(a) A description of the proposed eligible activities.

(b) An itemized budget for the proposed eligible activities.

(c) A schedule for the completion of the proposed eligible activities.

(d) Location of the property.

(e) Current ownership and ownership history of the property.

(f) Current use of the property.

(g) A detailed history of the use of the property.

(h) Existing and proposed future zoning of the property.

(i) If the property is not owned by the applicant, a draft of an enforceable agreement between the property owner and the applicant that commits the property owner to cooperate with the applicant, including a commitment to allow access to the property to complete at a minimum the proposed activities.

(j) A description of the property's economic redevelopment potential.

(k) A resolution from the local governing body of the applicant committing to repayment of the loan according to the terms of this section.

(*l*) Other information as specified by the department in its written instructions.

(7) To receive loan funds, approved applicants must enter into a loan agreement with the department. At a minimum, the loan agreement shall contain all of the following:

(a) The approved eligible activities to be undertaken with loan funds.

(b) The loan interest rate, terms, and repayment schedule as determined by the department pursuant to subsection (10).

(c) A commitment that the loan is secured by a full faith and credit pledge of the applicant, or if the applicant is an authority established pursuant to the brownfield redevelopment financing act, the commitment shall be from the municipality that created the authority pursuant to that act.

(d) An implementation schedule.

(e) Reporting requirements, including at a minimum the following:

(*i*) The recipient shall submit a progress status report to the department every 6 months during the implementation schedule.

(*ii*) The recipient shall provide a final report within 3 months of completion of the loan funded activities that includes documentation of project costs and expenditures, including invoices and proof of payment.

(f) If the property is not owned by the recipient, an executed agreement that has been approved by the department that meets the requirements of subsection (6)(i).

(g) Other provisions as considered appropriate by the department.

(8) If an approved applicant fails to sign a loan agreement within 90 days of a written loan offer by the department, the department may cancel the loan offer. The applicant may not appeal or contest a cancellation pursuant to this subsection.

(9) The department may terminate a loan agreement and require immediate repayment of the loan if the recipient uses loan funds for any purpose other than for the approved eligible activities specified in the loan agreement. The department shall provide written notice 30 days prior to the termination.

(10) Loans shall have the following terms:

(a) A loan interest rate of not more than 50% of the prime rate as determined by the department as of the date of approval of the loan.

(b) Loan recipients shall repay loans in equal annual installments of principal and interest beginning not later than 5 years after execution of a loan agreement and concluding not later than 15 years after execution of a loan agreement.

(11) Loan payments and interest shall be deposited back into the revitalization revolving loan fund created in section 20108a.

(12) Upon default of a loan, as determined by the department, or upon the request of the loan recipient as a method to repay the loan, the department of treasury shall withhold state payments from the loan recipient in amounts consistent with the repayment schedule in the loan agreement until the loan is repaid. The department of treasury shall deposit these withheld funds into the revitalization revolving loan fund created in section 20108a until the loan is repaid.

History: Add. 1996, Act 383, Imd. Eff. July 24, 1996.

324.20108c State site cleanup fund; creation; deposit of assets into fund; investment; interest and earnings; money remaining in fund; lapse; use of money; state sites cleanup program; establishment; purpose; expenditure; list of facilities with state liability; prioritized list; payment for necessary response activities; carrying forward unexpended funds; compliance with § 18.1451; report.

Sec. 20108c. (1) The state site cleanup fund is created within the state treasury.

(2) The state treasurer may receive money or other assets from any source for deposit into the state site cleanup fund. The state treasurer shall direct the investment of the state site cleanup fund. The state treasurer shall credit to the state site cleanup fund interest and earnings from fund investments.

(3) Money in the state site cleanup fund at the close of the fiscal year shall remain in the fund and shall not lapse to the general fund.

(4) Money in the state site cleanup fund shall be used for the state sites cleanup program established under this section.

(5) The department shall establish a state sites cleanup program for the purpose of expending money in the state sites cleanup fund, including the $20,000,000.00 appropriated by the legislature for state site cleanup pursuant to Act No. 265 of the Public Acts of 1994.

(6) The department shall expend money appropriated for state site cleanup only for response activities at facilities where the state is liable as an owner or operator under section 20126 or where the state has licensure or decommissioning obligations as an owner or possessor of radioactive materials that are regulated by the nuclear regulatory commission. Money expended for the state sites cleanup program shall not be used to pay fines, penalties, or damages.

(7) Six months after the effective date of this section, and annually thereafter by October 1 of each year, each state executive department and agency shall provide to the department a detailed list of all facilities where the state executive department or agency is liable as an owner or operator under section 20126. Subsequent lists do not need to include facilities identified in a previous list. This list shall include the following information for each facility:

(a) The facility name.

(b) Location.

(c) Use history of the facility.

(d) A detailed summary of available information regarding the source, nature, and extent of the contamination at the facility.

(e) A detailed summary of available information on any public health or environmental impacts at the facility.

(f) A detailed summary of available information on the resale and redevelopment potential of the facility.

(g) A description of and estimated cost of the response activities needed at the facility, if known.

(8) Within 12 months after the effective date of this section and by February 1 of each year thereafter, the board shall develop a prioritized list of the facilities identified pursuant to subsection (3). Sites posing the greatest risk to the public health, safety, welfare, or the environment and those having high resale and redevelopment potential shall be given the highest priority. The list shall include the following information for each facility:

(a) The facility's priority order.

(b) Response activities to be completed at the facility.

(c) Estimated cost of the response activities.

(d) The state executive department or agency that is liable as an owner or operator under section 20126.

(9) All state executive departments and agencies that are liable as an owner or operator under section 20126 are responsible for undertaking and paying for all necessary response activities that cannot be addressed with money appropriated to the department for state site cleanup as described in subsection (1) or any money appropriated to the department specifically for the purpose of response activities at facilities for which the state is liable as an owner or operator. The existence of these funds does not affect the liability of any person under this part or any state or federal law.

(10) The $20,000,000.00 appropriated pursuant to Act No. 265 of the Public Acts of 1994 and to be expended pursuant to this section shall carry over to succeeding fiscal years. The unexpended portion of the appropriation is considered a work project appropriation, and any unencumbered or unallotted funds are carried forward to the succeeding fiscal year. The following is in compliance with section 451(3) of the management and budget act, Act No. 431 of the Public Acts of 1984, being section 18.1451 of the Michigan Compiled Laws:

(a) The purpose of the project to be carried forward is to provide for contaminated site cleanups.

(b) The project will be accomplished by contracts.

(c) The total estimated cost of the project will be $20,000,000.00.

(d) The tentative completion date is September 30, 1999.

(11) The department shall submit an annual report to the governor and the legislature on the status of the response activities being conducted with money appropriated to the department to implement this section and the need for additional funds to conduct future response activities.

History: Add. 1996, Act 380, Imd. Eff. July 24, 1996.

324.20109 Repealed. 1996, Act 380, Imd. Eff. July 24, 1996.

Compiler's note: The repealed section pertained to Michigan unclaimed bottle fund.

324.20109a Municipal landfill cost-share grant program.

Sec. 20109a. (1) A municipal landfill cost-share grant program is established for the purpose of making grants to reimburse local units of government for a portion of the response activity costs at certain municipal solid waste landfills as provided in this section.

(2) The municipal landfill cost-share grant program shall be administered by the board. The board shall provide for at least 1 application cycle per fiscal year. Prior to each application cycle, the board shall develop written instructions for prospective applicants including the criteria that will be used in application review and approval.

(3) To be eligible for a cost-share grant under this section, the following requirements shall be met:

(a) The applicant is a local unit of government.

(b) The application is only for eligible response activity costs at a municipal solid waste landfill.

(c) The application is complete and submitted on a form provided by the board.

(d) The application is submitted by the deadline established by the board.

(4) A complete application shall include the following:

(a) The landfill name and brief history.

(b) The rationale that explains why the applicant incurred the response activity costs.

(c) An analysis of the local unit of government's insurance coverage for the response activity costs at the landfill and any available documentation that supports the analysis.

(d) A brief narrative description of the overall response activities completed or to be completed at the landfill.

(e) A list and narrative description of all eligible costs incurred by the applicant for which it is seeking a grant, including all of the following:

(*i*) A demonstration that each eligible cost is consistent with a work plan or remedial action plan that has been approved by the department or the United States environmental protection agency or has been ordered by a state or federal court. The demonstration shall relate each cost for which reimbursement is being sought to a specific element of the approved work plan or remedial action plan. A copy of the plan and documentation of approval or court order of the plan shall be included with the application.

(*ii*) Documentation that the costs have been incurred by the applicant, including itemized invoices that clearly list each cost and proof of payment of each invoice by the applicant.

(*iii*) A resolution passed by the governing body for the local unit of government attesting that it has not received reimbursement for any of the costs for which it is seeking a grant from any other sources.

(f) A list of persons the applicant believes may be liable under section 20126 or the comprehensive environmental response, compensation, and liability act of 1980, Public Law 96-510, 94 Stat. 2767 for a substantial portion of the response activity costs at the landfill and any available supporting documentation.

(5) The board shall allocate the funds available for cost-share grants under this section to eligible facilities according to the following criteria, which are listed in priority order:

(a) Facilities posing a risk to public health.

(b) Facilities posing a risk to the environment.

(c) Facilities in which the local unit of government has taken steps to identify environmental contamination at the facility or caused by the facility or facilities in which remedial action measures have been implemented in accordance with a remedial action plan approved by the department or the United States environmental protection agency.

(d) Facilities in which the local unit of government has implemented appropriate measures to effect proper closure of the facility.

(6) Once a complete application has been submitted and approved by the board, applications submitted by the same applicant for the same landfill, in subsequent application cycles shall only include updated information that was not in the original application, including all of the following:

(a) An updated list of eligible costs incurred by the applicant for which the applicant is seeking a grant and for which the applicant was not approved to receive grant funds in a preceding grant cycle.

(b) Supporting documentation that the costs have been incurred as described in subsection (4)(e)(*ii*).

(c) Any other information needed to update information in the original application.

(7) A cost-share grant under this section shall not exceed 50% of the total eligible costs.

(8) A local unit of government may not receive more than 1 grant for the same municipal landfill during each application cycle.

(9) A recipient of a cost-share grant under this section has an obligation to do all of the following:

(a) Provide timely notification to the department if it receives money or any other form of compensation from any other source to pay for or compensate the local unit of government for any of the response activity costs for which it is liable. Sources of money or compensation include, but are not limited to, the federal government, other liable persons, or insurance policies. The notice shall include all of the following:

(*i*) Source of the money or compensation.

(*ii*) Amount of money or dollar value of the compensation.

(*iii*) Why the local unit of government received the money or compensation.

(*iv*) Any conditions or terms associated with the money or compensation.

(*v*) A detailed estimate of the total eligible response costs at the landfill for which the local unit of government is seeking a grant that are consistent with a work plan or remedial action plan that has been approved by the department or the United States environmental protection agency or has been ordered by a state or federal court and documentation of those costs that have been incurred.

(*vi*) Documentation of the costs incurred by the local unit of government to obtain the funds or compensation.

(*vii*) The amount of money to be repaid to the state based on the formula in subdivision (b).

(b) If the recipient receives money or compensation from any other source as described in subdivision (a), the recipient shall repay the department an amount of money not to exceed the grant amount based on the following formula:

(A minus B) multiplied by (C divided by D)

with A, B, C, and D defined as follows:

A = The total amount of money received from the other source or dollar value of the compensation.

B = All reasonable costs incurred by the recipient to obtain the money or compensation.

C = The total amount of grant funds received.

D = The total amount of response activity costs that the applicant has or will incur that meet all of the following requirements:

(*i*) The costs are for response activities, excluding fees for the services of a licensed attorney.

(*ii*) The costs are required to implement a work plan or remedial action plan for the landfill that has been approved by the department or the United States environmental protection agency or ordered by a state or federal court. The work plan or remedial action plan can be a plan update that was approved or ordered subsequent to the plan that was included in the local unit of government's grant application.

(*iii*) The costs were or will be incurred by the local unit of government after the date of enactment of the amendatory act that added this section.

(*iv*) The department has determined that the costs incurred by a local unit of government are reasonable taking into consideration the rationale provided in the application, the existence of other persons liable under section 20126 or the comprehensive environmental response, compensation, and liability act of 1980, Public Law 96-510, 94 Stat. 2767, and the need for the local unit of government to proceed with the response activity.

(*v*) The costs are for response activities that are or will be all or part of a cost-effective remedy consistent with this part.

(*vi*) The costs were or will be incurred for work that was competitively bid.

(*vii*) The costs, once incurred, can be documented with invoices and proof of payment by the local unit of government.

(c) All documentation of costs and the calculations and assumptions used by the recipient to determine the amount of money to be repaid shall be submitted to the board and are subject to review and approval by the board. The money shall be repaid to the department within 60 days of board approval of the documentation, calculations, and assumptions.

(d) Funds repaid to the department under this section shall be placed into the fund.

(10) To receive a cost-share grant under this section, approved applicants shall enter into an agreement with the board. The agreement shall contain at a minimum all of the following:

(a) A list of board-approved eligible costs for which the recipient will be reimbursed up to 50%.

(b) The agreement period.

(c) A resolution passed by the governing body for the local unit of government committing to make reasonable efforts to pursue any insurance coverage for the eligible costs.

(d) Grant repayment provisions under subsection (9).

(11) Upon execution of a grant agreement, grant funds shall be disbursed by the department within 45 days.

(12) If a local unit of government fails to sign a grant agreement within 90 days of a written grant offer by the board, the board may cancel the grant offer. The local unit of government may not appeal or contest cancellation of a grant pursuant to this subsection.

(13) The existence of this grant program does not in any way affect the liability of any person under this part or any other state or federal law. The state, the board, and the fund are not liable or in any way obligated to make grants for eligible costs, if funds are not appropriated by the legislature for this purpose or if the funds are insufficient. The availability of this program shall not be used by any liable person as a basis to delay necessary response activities.

(14) Funds granted to local units of government under this section shall be considered response activity costs incurred by the state. The state may pursue recovery or a claim for contribution of the grant funds from persons other than the grant recipient who are liable under section 20126. In addition, a local unit of government may pursue recovery or a claim for contribution from persons liable under section 20126 for the costs it has incurred but for which it has not received grant

funds. This subsection does not in any way affect a local unit of government's eligibility to make a claim for insurance for any response activity costs, including the costs for which it received a grant.

(15) As used in this section:

(a) "Municipal solid waste landfill" means a landfill that as of the effective date of this section is on the national priority list or is proposed by the governor for inclusion on the national priority list.

(b) "National priority list" has the meaning attributed to this term in section 105(a)(8)(b) of the comprehensive environmental response, compensation, and liability act of 1980, Public Law 96-510, 94 Stat. 2767.

(c) "Eligible costs" or "eligible response activity costs" means response activity costs, excluding all fees for the services of a licensed attorney, that meet all of the following criteria:

(*i*) The costs have been incurred by a local unit of government after the date of enactment of the amendatory act that added this section.

(*ii*) The costs incurred by a local unit of government are reasonable taking into consideration the rationale provided in the application, the existence of other persons liable under section 20126 or the comprehensive environmental response, compensation, and liability act of 1980, Public Law 96-510, 94 Stat. 2767, and the need for the local unit of government to proceed with the response activity.

(*iii*) The costs are consistent with a work plan or remedial action plan that was approved by the department or the United States environmental protection agency or was ordered by a state or federal court prior to the work being conducted.

(*iv*) The costs were incurred for response activities that are part of a cost-effective remedy consistent with the requirements of this part.

(*v*) The costs were incurred for work that was competitively bid.

(16) This section shall not take effect until the earlier of the 2 following dates:

(a) The effective date of reauthorization of the comprehensive environmental response, compensation, and liability act of 1980, Public Law 96-510, 94 Stat. 2767.

(b) Twelve months after the date of enactment of the amendatory act that added this section.

(17) Following reauthorization of the comprehensive environmental response, compensation, and liability act of 1980, Public Law 96-510, 94 Stat. 2767, if a federal cost-share program is established that is similar to the program in this section, a grant under this section shall not be made for any response activity cost until the United States environmental protection agency makes a final determination that the response activity cost will not be paid for under the federal program.

History: Add. 1996, Act 383, Imd. Eff. July 24, 1996.

324.20110, 324.20111 Repealed. 1996, Act 380, Imd. Eff. July 24, 1996.

Compiler's note: The repealed sections pertained to long-term maintenance trust fund board and long-term maintenance trust fund.

324.20112 Repealed. 1995, Act 71, Imd. Eff. June 5, 1995.

Compiler's note: The repealed section pertained to study of cleanup costs.

324.20112a Report to legislature.

Sec. 20112a. Within 2 years after the effective date of this section and biennially thereafter, the department shall report to the legislature on the effectiveness of the amendatory act that added this section in restoring the economic value of sites of environmental contamination. The report shall include but not be limited to an examination of the effectiveness of the categorical cleanup criteria and liability provisions in encouraging the redevelopment of sites of environmental contamination. In preparing this report, the department shall consult the chairpersons of the senate and house of representatives standing committees with jurisdiction over issues pertaining to natural resources and the environment.

History: Add. 1995, Act 71, Imd. Eff. June 5, 1995.

324.20113 Appropriation; purposes; request to governor; list of sites; use of fund; expenditures; limitation; providing list of projects to governor and legislative committees.

Sec. 20113. (1) Money required to implement the programs described under this part and to pay for response activities recommended under this part shall be appropriated from the fund and any other source the legislature considers necessary to implement the requirements of this part.

(2) Money from the fund shall be appropriated only for response activities at sites that have been subjected to the risk assessment process described in section 20105.

(3) The department shall annually submit to the governor a request for appropriation from the fund. The request will include a lump sum amount for the purposes of subsection (4)(a) and a lump sum amount for the purposes of subsection (4)(f). For the purposes set forth in subsection (4)(b), (c), (d), and (e), the request shall include a list of sites where the department is proposing to expend funds. The list shall include the following information for each site: the common name of the site, the response activities that are planned to be conducted, and the estimated amount of money that is needed to conduct the response activities. The legislature shall approve by law the list of sites to be addressed and shall provide a lump sum appropriation for these sites based on the total estimated amount needed for the approved sites.

(4) Money from the fund may be used, upon appropriation, for the following as determined by the department:

(a) National priority list municipal landfill cost-share grants to be approved by the board pursuant to section 20109a.

(b) Superfund match, which includes funding for any response activity that is required to match federal dollars at a Superfund site as required under the comprehensive environmental response, compensation, and liability act of 1980, Public Law 96-510, 94 Stat. 2767.

(c) Response activities to address actual or potential public health or environmental problems.

(d) Completion of response activities initiated by the state using environmental protection bond funds or completion of response activities at facilities initiated by a person who was liable under this part prior to Public Act 71 of 1995 but is not liable under section 20126 of this part, where such response activities have ceased.

(e) Response activities at sites that will facilitate redevelopment.

(f) Emergency response actions for sites to be determined by the department.

(5) Money in the fund shall be expended first for the purposes described in subsection (4)(b) and (f) and health or environmental problems under subsection (4)(c) that are related to acute health or environmental problems. Following these expenditures, not less than 50% of the remaining money expended under this section shall be expended for response activities that facilitate redevelopment of urbanized areas. All additional expenditures under this section shall be expended following the expenditures described in this subsection. As used in this subsection, "urbanized area" means an urbanized area as determined by the economics and statistics administration, United States bureau of census, according to the 1990 census.

(6) The total amount of funds expended by the department for national priority list municipal landfill cost-share grants shall not exceed the lesser of 12% of the funds appropriated from the fund in a fiscal year or $6,000,000.00 in a fiscal year.

(7) Not later than December 31 of each year, the department shall provide to the governor, the senate and house of representatives standing committees with jurisdiction over issues pertaining to natural resources and the environment, and the senate and house of representatives appropriations committees a list of all projects financed under this part through the preceding fiscal year. The list shall include the project site and location, the nature of the project, the total amount of money authorized, the total amount of money expended, and project status.

History: 1994, Act 451, Eff. Mar. 30, 1995;—Am. 1995, Act 71, Imd. Eff. June 5, 1995;—Am. 1996, Act 380, Imd. Eff. July 24, 1996;—Am. 1996, Act 383, Imd. Eff. July 24, 1996.

324.20114 Owner or operator of facility; duties; response activity without prior approval; easement; applicability of subsections (1) and (3); completion of response activities; document; failure to notify department or submission of false or misleading information; civil fine; limitations; approval of plan.

Sec. 20114. (1) Except as provided in subsection (4), an owner or operator of property who has knowledge that the property is a facility and who is liable under section 20126 shall do all of the following:

(a) Determine the nature and extent of a release at the facility.

(b) Report the release to the department within 24 hours after obtaining knowledge of the release. The requirements of this subdivision shall apply to reportable quantities of hazardous substances established pursuant to 40 C.F.R. 302.4 and 302.6 (1989), unless the department establishes through rules alternate or additional reportable quantities as necessary to protect the public health, safety, or welfare, or the environment.

(c) Immediately stop or prevent the release at the source.

(d) Immediately implement source control or removal measures to remove or contain hazardous substances that are released after the effective date of the 1995 amendments to this section if those measures are technically practical, cost effective, and provide protection to the environment. At a facility where hazardous substances are released after the effective date of the 1995 amendments to this section, and those hazardous substances have not affected groundwater but are likely to, groundwater contamination shall be prevented if it can be prevented by measures that are technically practical, cost effective, and provide protection to the environment.

(e) Immediately identify and eliminate any threat of fire or explosion or any direct contact hazards.

(f) Immediately initiate removal of a hazardous substance that is in a liquid phase, that is not dissolved in water, and that has been released.

(g) Diligently pursue response activities necessary to achieve the cleanup criteria specified in this part and the rules promulgated under this part. For a period of 2 years after the effective date of the 1995 amendments to this section, fines and penalties shall not be imposed under this part for a violation of this subdivision.

(h) Upon written request by the department, take the following actions:

(*i*) Provide a plan for and undertake interim response activities.

(*ii*) Provide a plan for and undertake evaluation activities.

(*iii*) Take any other response activity determined by the department to be technically sound and necessary to protect the public health, safety, welfare, or the environment.

(*iv*) Submit to the department for approval a remedial action plan that, when implemented, will achieve the cleanup criteria specified in this part and the rules promulgated under this part.

(*v*) Implement an approved remedial action plan in accordance with a schedule approved by the department pursuant to this part.

(2) A person may undertake response activity without prior approval by the department unless that response activity is being done pursuant to an administrative order or agreement or judicial decree which requires prior department approval. Any such action shall not relieve any person of liability for further response activity as may be required by the department.

(3) Except as provided in subsection (4), a person who holds an easement interest in a portion of a property who has knowledge that there may be a release within that easement shall report the release to the department within 24 hours after obtaining knowledge of the release. Unless the department establishes through rules alternate or additional reportable quantities as necessary to protect the public health, safety, or welfare, or the environment, this subsection shall apply to reportable quantities of hazardous substances established pursuant to 40 C.F.R. 302.4 and 302.6 (1989).

(4) The requirements of subsections (1) and (3) do not apply to a permitted release or a release in compliance with applicable federal, state, and local air pollution control laws.

(5) Upon a determination by the department that a person has completed all response activity at a facility pursuant to an approved remedial action plan prepared and implemented in compliance with this part and the rules promulgated under this part, the department, upon request of a person, shall execute and present a document stating that all response activities required in the approved remedial action plan have been completed.

(6) An owner or operator of a facility from which a hazardous substance is released that is determined to be reportable under subsection (1)(b), other than a permitted release, who fails to notify the department within 24 hours after obtaining knowledge of the release or who submits in such notification any information that the person knows to be false or misleading, is subject to a civil fine of not more than $25,000.00 for each day in which the violation occurs or the failure to comply continues. A fine imposed under this subsection shall be based upon the seriousness of the violation and any good faith efforts by the violator to comply with this subsection.

(7) This section does not do either of the following:

(a) Limit the authority of the department to take or conduct response activities pursuant to this part.

(b) Limit the liability of a person who is liable under section 20126.

(8) Any request for approval of a plan shall be granted or denied within 6 months of submittal of the information necessary or required for the department to make its decision. If the department does not approve the plan, the reasons for the denial shall be provided by the department in writing with a complete and specific statement of the conditions or requirements necessary to obtain approval. The department may not add additional items to this statement after it has been issued. Failure of the department to act within the specified time period shall result in the request being considered approved. The time frame for decision may be extended by the mutual consent of the department and the person submitting the plan.

History: 1994, Act 451, Eff. Mar. 30, 1995;—Am. 1995, Act 71, Imd. Eff. June 5, 1995.

324.20114a Person subject to civil fine; exception.

Sec. 20114a. (1) A person who, after June 5, 1995, is responsible for an activity causing a release in excess of the concentrations that satisfy the criteria established pursuant to section 20120a(1)(a) through (e), as appropriate for the use of the property, is subject to a civil fine as provided in this part unless a fine or penalty has already been imposed for the release under another part of this act. However, a civil fine shall not be imposed under this section against a person who made a good faith effort to prevent the release and to comply with the provisions of this part.

(2) This section does not apply to a release from an underground storage tank system as defined in part 213.

History: Add. 1995, Act 71, Imd. Eff. June 5, 1995;—Am. 1996, Act 115, Imd. Eff. Mar. 6, 1996.

324.20115 Notice to department of agriculture; information; "substance regulated by the department of agriculture" defined; response activities to be consistent with § 324.8714(2).

Sec. 20115. (1) The department, upon confirmation of a release or threat of release of a substance that is regulated by the department of agriculture, shall notify the department of agriculture. The department of agriculture shall undertake or ensure the initiation of the necessary response activity to immediately stop or prevent further releases at the site. The department of agriculture shall consult with the department in the development of response activities if a release or threat of a release of a substance regulated by the department of agriculture occurs. The department of agriculture shall provide to the department information necessary to identify substances regulated by the department of agriculture. This information shall include but is not limited to the list of state registered pesticides.

(2) As used in this section, "substance regulated by the department of agriculture" means a fertilizer or soil conditioner as defined in part 85, or a pesticide as defined in part 83.

(3) Response activities conducted under this section shall be consistent with the requirements of section 8714(2).

History: 1994, Act 451, Eff. Mar. 30, 1995;—Am. 1995, Act 71, Imd. Eff. June 5, 1995;—Am. 1995, Act 117, Imd. Eff. June 29, 1995.

324.20115a Release or threat of release from underground storage tank system; corrective actions.

Sec. 20115a. (1) Notwithstanding any other provision of this part, if a release or threat of release at a facility is solely the result of a release or threat of release from an underground storage tank system regulated under part 213, the response activities implemented at the facility shall be the corrective actions required under part 213, and the requirements of section 20114 shall not apply to that release.

(2) Notwithstanding any other provision of this part, if a release or threat of release at a facility is not solely the result of a release or threat of release from an underground storage tank system, the owner or operator of the underground storage tank system as defined in part 213 may choose to conduct corrective actions of the release from the underground storage tank system pursuant to part 213, and the requirements of section 20114 shall not apply to that release.

History: Add. 1996, Act 115, Imd. Eff. Mar. 6, 1996.

324.20115b Release from disposal area; corrective actions; exception.

Sec. 20115b. Notwithstanding any other provision of this part, if a release at a disposal area licensed under part 115 is solely a release from that disposal area and the release is discovered through the disposal area's hydrogeological monitoring plan, the response activities implemented at the disposal area shall be the corrective actions required under part 115. This section does not apply to releases from a disposal area after completion of the postclosure monitoring period of the disposal area.

History: Add. 1996, Act 358, Eff. Oct. 1, 1996.

324.20116 Transfer of interest in real property; notice; certification; disclosure of restrictions.

Sec. 20116. (1) A person who has knowledge or information or is on notice through a recorded instrument that a parcel of his or her real property is a facility shall not transfer an interest in that real property unless he or she provides written notice to the purchaser or other person to which the property is transferred that the real property is a facility and discloses the general nature and extent of the release.

(2) The owner of real property for which a notice required in subsection (1) has been recorded may, upon completion of all response activities for the facility as approved by the department, record with the register of deeds for the appropriate county a certification that all response activity required in an approved remedial action plan has been completed.

(3) A person shall not transfer an interest in real property unless the person fully discloses any land or resource use restrictions that apply to that real property as a part of remedial action that has been or is being implemented in compliance with section 20120a.

History: 1994, Act 451, Eff. Mar. 30, 1995;—Am. 1995, Act 71, Imd. Eff. June 5, 1995.

324.20117 Information required to be furnished; requirements; right to enter public or private property; purposes; duties of person entering public or private property; copies of sample analyses, photographs, or videotapes; completion of inspections and investigations; refusing entry or information; powers of attorney general; injunction; civil fine; availability of information to public; protection of information; administrative subpoena; witness fees and mileage; court order; contempt; "information" defined.

Sec. 20117. (1) To determine the need for response activity or selecting or taking a response activity or otherwise enforcing this part or a rule promulgated under this part, the directors or their authorized representatives may upon reasonable notice require a person to furnish any information that the person may have relating to any of the following:

(a) The identification, nature, and quantity of materials that have been or are generated, treated, stored, handled, or disposed of at a facility or transported to a facility.

(b) The nature or extent of a release or threatened release at or from a facility.

(2) Upon reasonable notice, a person required to furnish information pursuant to subsection (1) shall either:

(a) Grant the directors or their authorized representatives access at all reasonable times to any place, property, or location to inspect and copy the related information.

(b) Copy and furnish to the directors or their authorized representatives the related information.

(3) If there is a reasonable basis to believe that there may be a release or threat of release, the directors or their authorized representatives have the right to enter at all reasonable times any public or private property for any of the following purposes:

(a) Identifying a facility.

(b) Investigating the existence, origin, nature, or extent of a release or threatened release.

(c) Inspecting, testing, taking photographs or videotapes, or sampling of any of the following: soils, air, surface water, groundwater, suspected hazardous substances, or any containers or labels of suspected hazardous substances.

(d) Determining the need for or selecting any response activity.

(e) Taking or monitoring implementation of any response activity.

(4) A person that enters public or private property pursuant to subsection (3) shall present credentials; make a reasonable effort to contact the person in charge of the facility or that person's designee; describe the nature of the activities authorized under subsection (3) to be undertaken; and inform the person that is in charge of the facility that he or she is entitled to participate in the collection of split samples, and is entitled to a copy of the results of any analysis of samples and a copy of any photograph or videotape taken. The person in charge or his or her agent may accompany the directors or their authorized representatives during the activities authorized under subsection (3) that take place and may participate in the collection of any split samples on the property. The absence or unavailability of the person in charge or that person's agent shall not delay or limit the authority of the directors or their authorized representatives to enter the property or proceed with the activities authorized under subsection (3).

(5) If the directors or their authorized representatives obtain any samples, before leaving the property they shall give to the person in charge of the property from which the samples were obtained a receipt describing the sample. A copy of the results of any analysis of the samples shall upon request be furnished promptly to the person in charge. A copy of any photograph or videotape taken pursuant to subsection (3)(c) shall upon request be furnished promptly to the person in charge.

(6) All inspections and investigations undertaken by the directors or their authorized representatives under this section shall be completed with reasonable promptness.

(7) If refused entry or information under subsections (1) to (4), for the purposes of enforcing the information gathering and entry authority provided in this section, the attorney general, on behalf of the state, may do either of the following:

(a) Petition the court of appropriate jurisdiction for a warrant authorizing access to property or information pursuant to this section.

(b) Commence a civil action to compel compliance with a request for information or entry pursuant to this section, to authorize information gathering and entry provided for in this section, and to enjoin interference with the exercise of the authority provided in this section.

(8) In a civil action brought pursuant to subsection (7), if there is a reasonable basis to believe there may be a release or a threatened release, the court shall in the case of interference or noncompliance with information requests pursuant to subsection (1), or with entry or inspection requests pursuant to subsection (3), enjoin interference with and direct compliance with the requests unless the defendant establishes that, under the circumstances of the case, the request is arbitrary and capricious, an abuse of discretion, or otherwise not in accordance with law.

(9) In a civil action brought pursuant to subsection (7), if there is a reasonable basis to believe there may be a release or a threatened release, the court may assess a civil fine not to exceed $25,000.00 for each day of noncompliance against a person that unreasonably fails to comply with subsection (1), (2), or (3).

(10) Information obtained by the directors or their authorized representatives as authorized under subsection (1) or (2) shall be available to the public to the extent provided by the freedom of information act, Act No. 442 of the Public Acts of 1976, being sections 15.231 to 15.246 of the Michigan Compiled Laws. A person who provides information pursuant to subsection (1) or (2), or the person in charge of a facility at which photographs or videotapes are taken pursuant to subsection (3), may designate the information that the person believes to be entitled to protection as if the information was exempt from disclosure as being either trade secrets or information of a personal nature under section 13(1)(a) or (g) of the freedom of information act, Act No. 442 of the Public Acts of 1976, being section 15.243 of the Michigan Compiled Laws, and submit that specifically designated information separately from other information required to be provided under this section.

(11) Notwithstanding subsection (10), the following information obtained by the directors or their authorized representatives as required by this section shall be available to the public:

(a) The trade name, common name, or generic class or category of the hazardous substance.

(b) The physical properties of a hazardous substance, including its boiling point, melting point, flash point, specific gravity, vapor density, solubility in water, and vapor pressure at 20 degrees Celsius.

(c) The hazards to the public health, safety, or welfare, or the environment posed by a hazardous substance, including physical hazards, such as explosion, and potential acute and chronic health hazards.

(d) The potential routes of human exposure to the hazardous substance at the facility being investigated, entered, or inspected under this section.

(e) The location of disposal of any waste stream released or threatened to be released from the facility.

(f) Monitoring data or analysis of monitoring data pertaining to disposal activities related to the facility.

(g) Hydrogeologic data.

(h) Groundwater monitoring data.

(12) To collect information for the purpose of identifying persons who are liable under section 20126 or to otherwise enforce this part or a rule promulgated under this part, the attorney general may by administrative subpoena require the attendance and testimony of witnesses and production of papers, reports, documents, answers to questions, and other information the attorney general considers necessary. Witnesses shall be paid the same fees and mileage that are paid witnesses in the courts of this state. If a person fails or refuses to obey the administrative subpoena, the circuit court for the county of Ingham or for the county in which that person resides has jurisdiction to order that person to comply with the subpoena. A failure to obey the order of the court is punishable by the court as contempt.

(13) As used in this section, "information" includes, but is not limited to, documents, materials, records, photographs, and videotapes.

History: 1994, Act 451, Eff. Mar. 30, 1995;—Am. 1995, Act 71, Imd. Eff. June 5, 1995.

324.20118 Response activity; purposes of remedial action; alternatives; referred remedial actions; approval of plan; conditions; record; analysis of source control measures; liability; aquifer monitoring plan; innovative cleanup technologies.

Sec. 20118. (1) The department may take response activity or approve of response activity proposed by a person that is consistent with this part and the rules promulgated under this part relating to the selection and implementation of response activity that the department concludes is necessary and appropriate to protect the public health, safety, or welfare, or the environment.

(2) Remedial action undertaken under subsection (1) at a minimum shall accomplish all of the following:

(a) Assure the protection of the public health, safety, and welfare, and the environment.

(b) Except as otherwise provided in subsections (5) and (6), attain a degree of cleanup and control of hazardous substances that complies with all applicable or relevant and appropriate requirements, rules, criteria, limitations, and standards of state and federal environmental law.

(c) Except as otherwise provided in subsections (5) and (6), be consistent with any cleanup criteria incorporated in rules promulgated under this part.

(3) The cost effectiveness of alternative means of complying with this section shall be considered by the department only in selecting among alternatives that meet all of the criteria of subsection (2).

(4) Remedial actions that permanently and significantly reduce the volume, toxicity, or mobility of the hazardous substances are to be preferred.

(5) The department may select or approve of a remedial action plan meeting the criteria provided for in section 20120a that does not attain a degree of control or cleanup of hazardous substances that complies with R 299.5705(5) or R 299.5705(6) of the Michigan administrative code, or both, if the department makes a finding that the remedial action is protective of the public health, safety, and welfare, and the environment. Notwithstanding any other provision of this subsection, the department shall not approve of a remedial action plan that does not attain a degree of control or cleanup of hazardous substances that complies with R 299.5705(5) or R 299.5705(6) of the Michigan administrative code if the remedial action plan is being implemented by a person who is liable under section 20126 and the release was grossly negligent or intentional, unless attaining that degree of control is technically infeasible, or the adverse environmental impact of implementing a remedial action to satisfy the rule would exceed the environmental benefit of that remedial action.

(6) A remedial action plan may be selected or approved pursuant to subsection (5) with regard to R 299.5705(5) or R 299.5705(6), or both, of the Michigan administrative code, if the department determines, based on the administrative record, that 1 or more of the following conditions are satisfied:

(a) Compliance with R 299.5705(5) or R 299.5705(6), or both, of the Michigan administrative code is technically impractical.

(b) The remedial action selected or approved will, within a reasonable period of time, attain a standard of performance that is equivalent to that required under R 299.5705(5) or R 299.5705(6) of the Michigan administrative code.

(c) The adverse environmental impact of implementing a remedial action to satisfy R 299.5705(5) or R 299.5705(6), or both, of the Michigan administrative code would exceed the environmental benefit of the remedial action.

(d) The remedial action provides for the reduction of hazardous substance concentrations in the aquifer through a naturally occurring process that is documented to occur at the facility and both of the following conditions are met:

(*i*) It has been demonstrated that there will be no adverse impact on the environment as the result of migration of the hazardous substances during the remedial action, except for that part of the aquifer specified in and approved by the department in the remedial action plan.

(*ii*) The remedial action includes enforceable land use restrictions or other institutional controls necessary to prevent unacceptable risk from exposure to the hazardous substances, as defined by the cleanup criteria approved as part of the remedial action plan.

(7) If the department approves of a remedial action plan pursuant, in part, to subsections (5) and (6), the administrative record for the facility shall include a complete explanation of the basis of the department's decision under subsections (5) and (6). In addition, the intent of and the basis for the exercise of authority provided for in subsections (5) and (6) shall be part of an analysis of the recommended alternatives if 1 is required pursuant to R 299.5605(1)(a) of the Michigan administrative code.

(8) A remedial action plan approved by the department shall include an analysis of source control measures already implemented or proposed, or both. A remedial action plan may incorporate by reference an analysis of source control measures provided in a feasibility study.

(9) Any liability a person may have under this part shall be unaffected by a decision of the department pursuant to subsection (5), (6), or (7), including liability for natural resources damages pursuant to section 20126a(1)(c).

(10) An aquifer monitoring plan shall be part of all remedial action plans that address aquifer contamination. The aquifer monitoring plan shall include all of the following:

(a) Information addressed by R 299.5519(2)(a) to (*l*) of the Michigan administrative code.

(b) Identification of points of compliance for judging the effectiveness of the remedial action.

(c) Identification of points of compliance if standards based on section 20120a(1)(a) are required to be met as part of the remedial action.

(11) The department may determine that a monitoring plan is not required pursuant to subsection (10) if the person conducting the remedial action demonstrates that the horizontal and vertical extent of hazardous substance concentrations in the aquifer above those allowed by the criteria based on section 20120a(1)(a) will not significantly increase in the absence of active removal of those hazardous substances from the aquifer. The department's determination pursuant to this subsection shall be based on the administrative record and include an explanation of the basis for the determination.

(12) The department shall encourage the use of innovative cleanup technologies. Before July 1, 1995, the department shall undertake 3 pilot projects to demonstrate innovative cleanup technologies at facilities where money from the fund is used.

History: 1994, Act 451, Eff. Mar. 30, 1995;—Am. 1995, Act 71, Imd. Eff. June 5, 1995.

324.20119 Action to abate danger or threat; administrative order; noncompliance; liability; petition for reimbursement; action in court of claims; evidence.

Sec. 20119. (1) In accordance with this section, if the department determines that there may be an imminent and substantial endangerment to the public health, safety, or welfare, or the environment, because of a release or threatened release, the department may require persons who are liable under section 20126 to take necessary action to abate the danger or threat.

(2) The department may issue an administrative order to a person identified by the department as a person who is liable under section 20126 requiring that person to perform response activity relating to a facility for which that person is liable or to take any other action required by this part. An order issued under this section shall state with reasonable specificity the basis for issuance of the order and specify a reasonable time for compliance.

(3) Within 30 days after issuance of an administrative order under this section, a person to which the order was issued shall indicate in writing whether the person intends to comply with the order.

(4) A person who, without sufficient cause, violates or fails to properly comply with an administrative order issued under this section is liable for either or both of the following:

(a) A civil fine of not more than $25,000.00 for each day in which the violation occurs or the failure to comply continues. A fine imposed under this subsection shall be based upon the seriousness of the violation and any good faith efforts by the violator to comply with the administrative order.

(b) Exemplary damages in an amount at least equal to the amount of any costs of response activity incurred by the state as a result of a failure to comply with an administrative order but not more than 3 times the amount of these costs.

(5) A person, to which an administrative order was issued under this section and that complied with the terms of the order, who believes that the order was arbitrary and capricious or unlawful may petition the department, within 60 days after completion of the required action, for reimbursement from the fund for the reasonable costs of the action plus interest at the rate described in section 20126a(3) and other necessary costs incurred in seeking reimbursement under this subsection. If the department refuses to grant all or part of the petition, the petitioner may, within 30 days of receipt of the refusal, file an action against the department in the court of claims seeking this relief. A failure by the department either to grant or deny all or any part of a petition within 120 days of receipt constitutes a denial of that part of the petition, which denial is reviewable as final agency action in the court of claims. To obtain reimbursement, the petitioner shall establish by a preponderance of the evidence that the petitioner is not liable under section 20126 or that the action ordered was arbitrary and capricious or unlawful, and in either instance that costs for which the petitioner seeks reimbursement are reasonable in light of the action required by and undertaken pursuant to the relevant order.

History: 1994, Act 451, Eff. Mar. 30, 1995;—Am. 1995, Act 71, Imd. Eff. June 5, 1995.

324.20120 Repealed. 1995, Act 71, Imd. Eff. June 5, 1995.

Compiler's note: The repealed section pertained to schedule of remedial action plans.

324.20120a Cleanup criteria.

Sec. 20120a. (1) The department may establish cleanup criteria and approve of remedial actions in the categories listed in this subsection. The cleanup category proposed shall be the option of the person proposing the remedial action, subject to department approval, considering the appropriateness of the categorical criteria to the facility. The categories are as follows:

(a) Residential.

(b) Commercial.

(c) Recreational.

(d) Industrial.

(e) Other land use based categories established by the department.

(f) Limited residential.

(g) Limited commercial.

(h) Limited recreational.

(i) Limited industrial.

(j) Other limited categories established by the department.

(2) The department may approve a remedial action plan based on site specific criteria that satisfy the applicable requirements of this part and the rules promulgated under this part. The department shall utilize only reasonable and relevant exposure pathways in determining the adequacy of a site specific criterion. Additionally, the department may approve a remedial action plan for a designated area-wide zone encompassing more than 1 facility, and may consolidate remedial actions for more than 1 facility.

(3) The department shall develop cleanup criteria pursuant to subsection (1) based on generic human health risk assessment assumptions determined by the department to appropriately characterize patterns of human exposure associated with certain land uses. The department shall utilize only reasonable and relevant exposure pathways in determining these assumptions. The department may prescribe more than 1 generic set of exposure assumptions within each category described in subsection (1). If the department prescribes more than 1 generic set of exposure assumptions within a category, each set of exposure assumptions creates a subcategory within a category described in subsection (1). The department shall specify site characteristics that determine the applicability of criteria derived for these categories or subcategories.

(4) If a hazardous substance poses a carcinogenic risk to humans, the cleanup criteria derived for cancer risk under this section shall be the 95% upper bound on the calculated risk of 1 additional cancer above the background cancer rate per 100,000 individuals using the generic set of exposure assumptions established under subsection (3) for the appropriate category or subcategory. If the hazardous substance poses a risk of an adverse health effect other than cancer, cleanup criteria shall be derived using appropriate human health risk assessment methods for that adverse health effect and the generic set of exposure assumptions established under subsection (3) for the appropriate category or subcategory. A hazard quotient of 1.0 shall be used to derive noncancer cleanup criteria. For the noncarcinogenic effects of a hazardous substance present in soils, the intake shall be assumed to be 100% of the protective level, unless compound and site-specific data are available to demonstrate that a different source contribution is appropriate. If a hazardous substance poses a risk of both cancer and 1 or more adverse health effects other than cancer, cleanup criteria shall be derived under this section for the most sensitive effect.

(5) If a cleanup criterion derived under subsection (4) for groundwater in an aquifer differs from either: (a) the state drinking water standard established pursuant to section 5 of the safe drinking water act, Act No. 399 of the Public Acts of 1976, being section 325.1005 of the Michigan Compiled Laws, or (b) criteria for adverse aesthetic characteristics derived pursuant to R 299.5709 of the Michigan administrative code, the cleanup criterion shall be the more stringent of (a) or (b) unless the department determines that compliance with this rule is not necessary because the use of the aquifer is reliably restricted pursuant to section 20120b(4) or (5).

(6) The department shall not approve of a remedial action plan in categories set forth in subsection (1)(b) to (j), unless the person proposing the plan documents that the current zoning of the property is consistent with the categorical criteria being proposed, or that the governing zoning authority intends to change the zoning designation so that the proposed criteria are consistent with the new zoning designation, or the current property use is a legal nonconforming use. The department shall not grant final approval for a remedial action plan that relies on a change in zoning designation until a final determination of that zoning change has been made by the local unit of government. The department may approve of a remedial action that achieves categorical criteria that is based on greater exposure potential than the criteria applicable to current zoning. In addition, the remedial action plan shall include documentation that the current property use is consistent with the current zoning or is a legal nonconforming use. Abandoned or inactive property shall be considered on the basis of zoning classifications as described above.

(7) Cleanup criteria from 1 or more categories in subsection (1) may be applied at a facility, if all relevant requirements are satisfied for application of a pertinent criterion.

(8) Except as provided in subsection (4) and subsections (9) to (13), compliance with the residential category in subsection (1)(a) shall be based on R 299.5709 through R 299.5711(4), R 299.5711(6) through R 299.5715 and R 299.5727 of the Michigan administrative code. R 299.5711(5), R 299.5723, and R 299.5725 of the Michigan administrative code shall not apply for calculations of residential criteria under subsection (1)(a).

(9) The need for soil remediation to protect an aquifer from hazardous substances in soil shall be determined by R 299.5711(2) of the Michigan administrative code, considering the vulnerability of the aquifer or aquifers potentially affected if the soil remains at the facility. Migration of hazardous substances in soil to an aquifer is a pertinent pathway if appropriate based on consideration of site specific factors.

(10) The department may establish cleanup criteria for a hazardous substance using a biologically based model developed or identified as appropriate by the United States environmental protection agency if the department determines all of the following:

(a) That application of the model results in a criterion that more accurately reflects the risk posed.

(b) That data of sufficient quantity and quality are available for a specified hazardous substance to allow the scientifically valid application of the model.

(c) The United States environmental protection agency has determined that application of the model is appropriate for the hazardous substance in question.

(11) If the cleanup criterion for a hazardous substance determined by R 299.5707 of the Michigan administrative code is greater than a cleanup criterion developed for a category pursuant to subsection (1), the criterion determined pursuant to R 299.5707 of the Michigan administrative code shall be the cleanup criterion for that hazardous substance in that category.

(12) In determining the adequacy of a land-use based response activity to address sites contaminated by polychlorinated biphenyls, the department shall not require response activity in addition to that which is subject to and complies with applicable federal regulations and policies that implement the toxic substances control act, Public Law 94-469, 15 U.S.C. 2601 to 2629, 2641 to 2656, 2661 to 2671, and 2681 to 2692.

(13) Response activity to address the release of uncontaminated mineral oil satisfies R 299.5709 for groundwater or R 299.5711 for soil under the Michigan administrative code if all visible traces of mineral oil are removed from groundwater and soil.

(14) Approval by the department of a remedial action plan based on 1 or more categorical standard in subsection (1)(a) to (e) shall be granted only if the pertinent criteria are satisfied in the affected media. The department shall approve the use of probabilistic or statistical methods or other scientific methods of evaluating environmental data when determining compliance with a pertinent cleanup criterion if the methods are determined by the department to be reliable, scientifically valid, and best represent actual site conditions and exposure potential.

(15) If a remedial action allows for venting groundwater, the discharge shall comply with requirements of part 31, and the rules promulgated under that part or an alternative method established by rule. If the discharge of venting groundwater is provided for in a remedial action plan that is approved by the department, a permit for the discharge is not required. As used in this subsection, "venting groundwater" means groundwater that is entering a surface water of the state from a facility.

(16) A remedial action plan shall provide response activity to meet the residential categorical criteria, or provide for acceptable land use or resource use restrictions pursuant to section 20120b.

(17) A remedial action plan that relies on categorical cleanup criteria developed pursuant to subsection (1) shall also consider other factors necessary to protect the public health, safety, and welfare, and the environment as specified by the department, if the department determines based on data and existing information that such considerations are relevant to a specific facility. These factors include, but are not limited to, the protection of surface water quality and consideration of ecological risks if pertinent to the facility based on the requirements of R 299.5717 of the Michigan administrative code.

(18) The department shall annually evaluate and revise, if appropriate, the cleanup criteria derived under this section. The evaluation shall incorporate knowledge gained through research and studies in the areas of fate and transport and risk assessment. The department shall prepare and submit to the legislature a report detailing revisions made to cleanup criteria under this section.

History: Add. 1995, Act 71, Imd. Eff. June 5, 1995.

324.20120b Remedial action plan.

Sec. 20120b. (1) If a remedial action plan is selected or approved by the department based on criteria for the residential category provided for in section 20120a(1)(a), land use restrictions or monitoring are not required once those standards have been achieved by the remedial action.

(2) If a remedial action plan is selected or approved by the department based on criteria in categories provided for in section 20120a(1)(b) to (e), a notice of approved environmental remediation shall be recorded with the register of deeds for the county in which the facility is located within 21 days after selection or approval by the department of the remedial action, or within 21 days after completion of construction of the remedial action as appropriate to the circumstances. A notice shall be filed pursuant to this section only by the property owner or by another person who has the express written permission of the property owner. The form and content of the notice are subject to approval by the state. Any restrictions contained in the notice shall be binding on the owner's successors, assigns, and lessees, and shall run with the land. A notice of environmental remediation recorded pursuant to this subsection shall state which of the categories of land use specified in section 20120a(1)(b) to (d) are consistent with the environmental conditions at the property to which the notice applies, and that a change from that land use or uses may necessitate further evaluation of potential risks to the public health, safety, or welfare, or the environment. The notice of approved environmental remediation shall include a survey and property description that define the areas addressed by the remedial action plan if land use or resource use restrictions apply to less than the entire parcel or if different restrictions apply to different areas of a parcel, and the scope of any land use or resource use limitations. Additional requirements for financial assurance, monitoring, or operation, and maintenance do not apply if a remedial action complies with criteria provided for in section 20120a(1)(b) to (e), unless monitoring or operation and maintenance are required to assure the compliance with criteria that apply outside the boundary of the property that is the source of the release.

(3) If a remedial action plan is selected or approved by the department based on criteria provided for in section 20120a(1)(f) to (j) or (2), provisions concerning subdivisions (a) through (e) shall be stipulated in a legally enforceable agreement with the department. If the department concurs with an analysis provided in a remedial action plan that 1 or more of the requirements specified in subdivisions (b) to (e) is not necessary to protect the public health, safety, or welfare, or the environment and to assure the effectiveness and integrity of the remedial action, that element may be omitted from the agreement. If provisions for any of the following, determined by the department to be applicable for a facility, lapse or are not complied with as provided in the agreement or remedial action plan, the department's approval of the remedial action plan is void from the time of the lapse or violation, unless the lapse or violation is corrected to the satisfaction of the department:

(a) Land use or resource use restrictions.

(b) Monitoring.

(c) Operation and maintenance.

(d) Permanent markers to describe restricted areas of the site and the nature of any restrictions.

(e) Financial assurance, in a mechanism acceptable to the department to pay for monitoring, operation and maintenance, oversight, and other costs determined by the department to be necessary to assure the effectiveness and integrity of the remedial action.

(4) If a remedial action plan relies in whole or in part on cleanup criteria approved pursuant to section 20120a(1)(f) to (j) or (2), land use or resource use restrictions to assure the effectiveness and integrity of any containment, exposure barrier, or other land use or resource use restrictions necessary to assure the effectiveness and integrity of the remedy shall be described in a restrictive covenant. The restrictive covenant shall be recorded with the register of deeds for the county in which the property is located within 21 days of the department's selection or approval of the remedial action plan, or within 21 days of the completion of construction of the containment or barrier, as appropriate to the

circumstances. The restrictive covenant shall be filed by the property owner or with the express written permission of the property owner. The restrictions shall run with the land and be binding on the owner's successors, assigns, and lessees. Such restrictions shall apply until the department determines that hazardous substances that are controlled by the barrier or contained no longer present an unacceptable risk to the public health, safety, or welfare, or the environment as defined by the cleanup criteria and exposure control requirements set forth in the remedial action plan. The restrictive covenant shall include a survey and property description that define the areas addressed by the remedial action plan and the scope of any land use or resource use limitations. The form and content of the restrictive covenant are subject to approval by the department and shall include provisions to accomplish all of the following:

(a) Restrict activities at the facility that may interfere with a remedial action, operation and maintenance, monitoring, or other measures necessary to assure the effectiveness and integrity of the remedial action.

(b) Restrict activities that may result in exposures above levels established in the remedial action plan.

(c) Require notice to the department of the owner's intent to convey any interest in the facility 14 days prior to consummating the conveyance. A conveyance of title, an easement, or other interest in the property shall not be consummated by the property owner without adequate and complete provision for compliance with the terms and conditions of the agreement described in subsection (3) and the prevention of releases and exposures described in subdivision (b).

(d) Grant to the department the right to enter the property at reasonable times for the purpose of determining and monitoring compliance with the remedial action plan, including the right to take samples, inspect the operation of the remedial action measures, and inspect records.

(e) Allow the state to enforce the restriction set forth in the covenant by legal action in a court of appropriate jurisdiction.

(f) Describe generally the uses of the property that are consistent with the categorical criteria and limitations approved as part of a remedial action plan.

(5) If the department determines that exposure to hazardous substances may be reliably restricted by an institutional control in lieu of a restrictive covenant, and that imposition of land use or resource use restrictions through restrictive covenants is impractical, the department may approve of a remedial action plan under section 20120a(1)(f) to (j) or (2) that relies on such institutional control. Mechanisms that may be considered under this subsection include, but are not limited to, an ordinance that prohibits the use of groundwater or an aquifer in a manner and to a degree that protects against unacceptable exposures as defined by the cleanup criteria approved as part of the remedial action plan. An ordinance that serves as an exposure control pursuant to this subsection shall be published and maintained in the same manner as zoning ordinances and shall include a requirement that the local unit of government notify the department at least 30 days prior to adopting a modification to the ordinance, or to the lapsing or revocation of the ordinance.

(6) Selection or approval by the department of a remedial action does not relieve a person who is liable under section 20126 of that person's responsibility to report and provide for response activity to address a subsequent release or threat of release at the facility.

(7) A remedial action shall not be considered approved by the department unless a remedial action plan is submitted to the department and the department approves the plan. Implementation by any person of response activity without department approval does not relieve that person of an obligation to undertake response activity or limit the ability of the department to take action to require response activity necessary to comply with this act by a person who is liable under section 20126.

(8) A person shall not file a notice of approved environmental remediation indicating approval or a determination of the department unless the department has approved of the filing of the notice.

(9) A person who implements a remedial action plan approved by the department pursuant to subsections (2) to (5) shall provide notice of the land use restrictions that are part of the remedial action plan to the zoning authority for the local unit of government in which the facility is located within 30 days of approval of the plan.

(10) The state, with the approval of the state administrative board, may place restrictive covenants related to land or resource use on deeds of state owned property.

History: Add. 1995, Act 71, Imd. Eff. June 5, 1995.

324.20120c Relocation of soil.

Sec. 20120c. (1) An owner or operator shall not remove soil, or allow soil to be removed, from a facility to an off-site location unless that person determines that the soil can be lawfully relocated without posing a threat to the public health, safety, or welfare, or the environment. The determination shall consider whether the soil is subject to regulation pursuant to part 111.

(2) For the purposes of subsection (1), soil poses a threat to the public health, safety, or welfare, or the environment if concentrations of hazardous substances in the soil exceed the cleanup criterion determined pursuant to section 20120a(1) or (2) that apply to the location to which the soil will be moved or relocated, except that if the soil is to be removed from the facility for disposal or treatment, the soil shall satisfy the appropriate regulatory criteria for disposal or treatment. Any land use restrictions that would be required for the application of a criterion pursuant to section 20120a(1) or (2) shall be in place at the location to which the soil will be moved. Soil may be relocated only to another location that is similarly contaminated, considering the general nature, concentration, and mobility of hazardous substances present at the location to which contaminated soil will be moved. Contaminated soil shall not be moved to a location that is not a facility unless it is taken there for treatment or disposal in conformance with applicable laws and regulations.

(3) An owner or operator shall not relocate soil, or allow soil to be relocated, within a site of environmental contamination where a remedial action plan has been approved unless that person assures that the same degree of control required for application of the criteria of section 20120a(1) or (2) is provided for the contaminated soil.

(4) The prohibition in subsection (3) against relocation of contaminated soil within a site of environmental contamination does not apply to soils that are temporarily relocated for the purpose of implementing response activity or utility construction if the response activity or utility construction is completed in a timely fashion and the short-term hazards are appropriately controlled.

(5) If soil is being moved off-site from, moved to, or relocated on-site at a facility where a remedial action plan has been approved by the department based on a categorical cleanup criterion in section 20120a(1)(f) to (j) or (2), the soil shall not be moved without prior department approval.

(6) If soil is being relocated in a manner not addressed by subsection (5), the owner or operator of the facility from which soil is being moved must provide notice to the department within 14 days after the soil is moved. The notice shall include all of the following:

(a) The location from which soil will be removed.

(b) The location to which the soil will be taken.

(c) The volume of soil to be moved.

(d) A summary of information or data on which the owner or operator is basing the determination required in subsection (2) that the soil does not present a threat to the public health, safety, or welfare, or the environment.

(e) If land use restrictions would apply pursuant to section 20120a(1) to the soil when it is relocated, the notice shall include documentation that those restrictions are in place.

(7) The determination required by subsections (1) and (3) shall be based on knowledge of the person undertaking or approving of the removal or relocation of soil, or on characterization of the soil for the purpose of compliance with this section.

(8) This section does not apply to soil that is designated as an inert material pursuant to section 11507(3) of the natural resources and environmental protection act, Act No. 451 of the Public Acts of 1994, being section 324.11507 of the Michigan Compiled Laws.

History: Add. 1995, Act 71, Imd. Eff. June 5, 1995.

324.20120d Public meeting; notice; publication; summary document; administrative record; comments or information not included in record.

Sec. 20120d. (1) At a facility where state funds will be spent to develop or implement a remedial action plan or where the department determines there is a significant public interest, within 30 days after the completion of a remedial investigation for the facility, the department shall provide the county and the township, city, or village in which the facility is located a notice of the completion of the remedial investigation, a summary of the remedial investigation, and notice of an opportunity for the people in the local unit of government to meet with the department regarding the remedial investigation and any proposed feasibility study for the facility. Upon a request for a public meeting by the governing body of the local unit of government or by 25 citizens of the local unit of government, the department shall, within 30 days of the request, meet with persons in the local unit of government. The person or persons requesting the public meeting shall publicize and provide accommodations for the meeting. The meeting shall be held in the local unit of government in which the facility is located. The department shall provide copies of the notices and summary required in this subsection to the governing body of the local unit of government, to the known persons who are liable under section 20126, and to the main public library of the local unit of government in which the facility is located. The department shall send representatives to the meeting who are familiar with the facility and who are involved with determining the appropriate remedial actions to be taken at the facility. Persons who are liable under section 20126 for the facility may send representatives to the meeting.

(2) The department shall maintain, and periodically publish, a list of remedial action plans submitted for approval that comply with the requirements of R 299.5515 of the Michigan administrative code.

(3) Before approval of a proposed remedial action plan which is to be implemented with money from the fund, or is based on categorical criteria provided for in section 20120a(1)(f) to (j) or (2), or if section 20118(5) or (6) applies, or the department determines that there is significant public interest, the department shall do all of the following:

(a) Publish a notice and brief summary of the proposed remedial action plan.

(b) Provide for public review and comment pertinent to documents relating to the proposed remedial action plan, including, if applicable, the feasibility study that outlines alternative remedial action measures considered.

(c) Provide an opportunity for a public meeting at or near the facility when any of the following occur:

(*i*) The department determines that there is a significant public interest or that for any other reason a public meeting is appropriate.

(*ii*) A city, township, or village in which the facility is located, by a majority vote of its governing body, requests a public meeting.

(*iii*) A local health department with jurisdiction in the area in which the facility is located requests a public meeting.

(d) Provide a document that summarizes the major issues raised by the public and how they are to be addressed by the final approved remedial action plan.

(4) For purposes of this section, publication shall include, at a minimum, publication in a local newspaper or newspaper of general circulation in this state. In addition, the administrative record shall be made available by the department for inspection by members of the public at or near the facility and in Lansing.

(5) The department shall prepare a summary document that explains the reasons for the selection or approval of a remedial action plan. In addition, the department shall compile an administrative record of the decision process that results in the selection of a remedial action plan. The administrative record shall contain all of the following:

(a) Remedial investigation data regarding the facility.

(b) If applicable, a feasibility study and potential remedial actions.

(c) If applicable, a summary document that explains the reasons why a remedial investigation or feasibility study was not conducted.

(d) Applicable comments and information received from the public, if any.

(e) If applicable, a document that summarizes the significant concerns raised by the members of the public and how they are to be addressed.

(f) Other information appropriate to the facility.

(6) If comments or information are submitted for inclusion in the administrative record that are not included in the administrative record, a brief explanation of why the information was not considered relevant shall be sent to the party by the department and included in the record.

History: Add. 1995, Act 71, Imd. Eff. June 5, 1995;—Am. 1996, Act 380, Imd. Eff. July 24, 1996;—Am. 1996, Act 383, Imd. Eff. July 24, 1996.

324.20121-324.20125 Repealed. 1995, Act 71, Imd. Eff. June 5, 1995.

Compiler's note: The repealed sections pertained to creation of office of environmental cleanup facilitation, creation and duties of science advisory council, report to legislature, and approval of remedial action plans.

324.20126 Liability under part.

Sec. 20126. (1) Notwithstanding any other provision or rule of law and except as provided in subsections (2), (3), (4), and (5) and section 20128, the following persons are liable under this part:

(a) The owner or operator of a facility if the owner or operator is responsible for an activity causing a release or threat of release.

(b) The owner or operator of a facility at the time of disposal of a hazardous substance if the owner or operator is responsible for an activity causing a release or threat of release.

(c) An owner or operator of a facility who becomes an owner or operator on or after June 5, 1995, unless the owner or operator complies with both of the following:

(*i*) A baseline environmental assessment is conducted prior to or within 45 days after the earlier of the date of purchase, occupancy, or foreclosure. For purposes of this section, accessing property to conduct a baseline environmental assessment does not constitute occupancy.

(*ii*) The owner or operator discloses the results of a baseline environmental assessment to the department and subsequent purchaser or transferee if the baseline environmental assessment confirms that the property is a facility.

(d) A person who by contract, agreement, or otherwise arranged for disposal or treatment, or arranged with a transporter for transport for disposal or treatment, of a hazardous substance owned or possessed by the person, by any other person, at a facility owned or operated by another person and containing the hazardous substance. This subdivision does not include either of the following:

(*i*) A person who arranges the sale or transport of a secondary material for use in producing a new product. As used in this subparagraph, secondary material means scrap metal, paper, plastic, glass, textiles, or rubber, which has demonstrated reuse or recycling potential and has been separated or removed from the solid waste stream for reuse or recycling, whether or not subsequent separation and processing is required, if substantial amounts of the material are consistently used in the manufacture of products which may otherwise be produced from a raw or virgin material.

(*ii*) A person who arranges the lawful transport or disposal of any product or container commonly used in a residential household, which is in a quantity commonly used in a residential household, and which was used in the person's residential household.

(e) A person who accepts or accepted any hazardous substance for transport to a facility selected by that person.

(f) The estate or trust of a person described in subdivisions (a) to (e).

(2) Subject to section 20107a, an owner or operator who complies with subsection (1)(c) is not liable for contamination existing at the facility at the earlier of the date of purchase, occupancy, or foreclosure, unless the person is responsible for an activity causing the contamination existing at the facility. Subsection (1)(c) does not alter a person's liability with regard to a subsequent release or threat of release at a facility if the person is responsible for an activity causing the subsequent release or threat of release.

(3) Notwithstanding subsection (1), the following persons are not liable under this part unless the person is responsible for an activity causing a release at the facility:

(a) The state or a local unit of government that acquired ownership or control of a facility involuntarily through bankruptcy, tax delinquency, abandonment, a transfer from a lender pursuant to subsection (7), or other circumstances in which the government involuntarily acquires title or control by virtue of its governmental function or as provided in this part, a local unit of government to which ownership or control of a facility is transferred by the state or by another local unit of government that is not liable under subsection (1), or the state or a local unit of government that acquired ownership or control of a facility by seizure, receivership, or forfeiture pursuant to the operation of law or by court order.

(b) A state or local unit of government that holds or acquires an easement interest in a facility, holds or acquires an interest in a facility by dedication in a plat, or by dedication pursuant to Act No. 283 of the Public Acts of 1909, being sections 220.1 to 239.6 of the Michigan Compiled Laws, or otherwise holds or acquires an interest in a facility for a transportation or utility corridor or public right of way.

(c) A person who holds an easement interest in a facility or holds a utility franchise to provide service, for the purpose of conveying or providing goods or services, including, but not limited to, utilities, sewers, roads, railways, and pipelines; or a person that acquires access through an easement.

(d) A person who owns severed subsurface mineral rights or severed subsurface formations or who leases subsurface mineral rights or formations.

(e) The state or a local unit of government that leases property to a person if the state or the local unit of government is not liable under this part for environmental contamination at the property.

(f) A person who owns or occupies residential real property if hazardous substance use at the property is consistent with residential use.

(g) A person who acquires a facility as a result of the death of the prior owner or operator of the facility, whether by inheritance, devise, or transfer from an inter vivos or testamentary trust.

(h) A person who did not know and had no reason to know that the property was a facility. To establish that the person did not know and did not have a reason to know that the property was a facility, the person shall have undertaken at the time of acquisition all appropriate inquiry into the previous ownership and uses of the property consistent with good commercial or customary practice. A determination of liability under this section shall take into account any specialized knowledge or experience on the part of the person, the relationship of the purchase price to the value of the property if uncontaminated by a hazardous substance, commonly known or reasonably ascertainable information about the property, the obviousness of the presence or likely presence of a release or threat of release at the property, and the ability to detect a release or threat of release by appropriate inspection.

(i) A utility performing normal construction, maintenance, and repair activities in the normal course of its utility service business. This subsection does not apply to property owned by the utility.

(j) A lessee who uses property for a retail, office, or commercial purpose.

(4) Notwithstanding subsection (1), the following persons are not liable under this part:

(a) The owner or operator of a hazardous waste treatment, storage, or disposal facility regulated pursuant to part 111 from which there is a release or threat of release solely from the treatment, storage, or disposal facility, or a waste management unit at the facility and the release or threat of release is subject to corrective action under part 111.

(b) A lender that engages in or conducts a lawful marshalling or liquidation of personal property if the lender does not cause or contribute to the environmental contamination. This includes holding a sale of personal property on a portion of the facility.

(c) The owner or operator of property onto which contamination has migrated unless that person is responsible for an activity causing the release that is the source of the contamination.

(d) A person who owns or operates a facility in which the release or threat of release was caused solely by 1 or more of the following:

(*i*) An act of God.

(*ii*) An act of war.

(*iii*) An act or omission of a third party other than an employee or agent of the person or a person in a contractual relationship existing either directly or indirectly with a person who is liable under this section.

(5) Notwithstanding any other provision of this part, the state or a local unit of government or a lender who has not participated in the management of the facility is not liable under this part for costs or damages as a result of response activity taken in response to a release or threat of release. For a lender, this subsection applies only to response activity undertaken prior to foreclosure. This subsection does not preclude liability for costs or damages as a result of gross negligence, including reckless, willful, or wanton misconduct, or intentional misconduct by the state or local unit of government.

(6) In establishing liability under this section, the department bears the burden of proof. If the department proves a prima facie case against a person, the person shall bear the burden of showing by a preponderance of the evidence that he or she is not liable under this section.

(7) A lender that is not responsible for an activity causing a release at a facility that establishes that it has met the requirements of subsection (1)(c)(*i*) and (*ii*) with respect to that facility may immediately transfer to the state the property on which there has been a release or a threat of a release if the lender complies with all of the following:

(a) Within 9 months following foreclosure and for a period of at least 120 days, the lender either lists the facility with a broker, dealer, or agent who deals with the type of property in question, or advertises the facility as being for sale or disposition on at least a monthly basis in either a real estate publication, a trade or other publication suitable for the facility in question, or a newspaper of general circulation of over 10,000 covering the area where the property is located.

(b) The lender has taken reasonable care in maintaining and preserving the real estate and permanent fixtures.

(c) The lender provides to the department all environmental information related to the facility that is available to the lender.

(d) If the department has issued an order pursuant to section 20119, the lender has complied with the order to the department's satisfaction.

(e) If conditions on the property pose a threat of fire or explosion or present an imminent hazard through direct contact with hazardous substances, the lender has undertaken appropriate response activities to abate the threat or hazard.

(8) The department shall establish minimum technical standards for baseline environmental assessments conducted under this section in guidelines pursuant to the administrative procedures act of 1969, Act No. 306 of the Public Acts of 1969, being sections 24.201 to 24.328 of the Michigan Compiled Laws.

(9) Notwithstanding subsection (1)(c), if the owner or operator of the facility became the owner or operator of the facility on or after June 5, 1995 and prior to the effective date of the amendatory act that added this subsection, and the facility contains an underground storage tank system as defined in part 213, that owner or operator is liable under this part only if the owner or operator is responsible for an activity causing a release or threat of release.

History: 1994, Act 451, Eff. Mar. 30, 1995;—Am. 1995, Act 71, Imd. Eff. June 5, 1995;—Am. 1996, Act 115, Imd. Eff. Mar. 6, 1996.

324.20126a Joint several liability; costs of amounts recoverable; interest; recovery; permitted release; action by attorney general; action brought by state or other person.

Sec. 20126a. (1) Except as provided in section 20126(2), a person who is liable under section 20126 is jointly and severally liable for all of the following:

(a) All costs of response activity lawfully incurred by the state relating to the selection and implementation of response activity under this part.

(b) Any other necessary costs of response activity incurred by any other person consistent with rules relating to the selection and implementation of response activity promulgated under this part.

(c) Damages for the full value of injury to, destruction of, or loss of natural resources, including the reasonable costs of assessing the injury, destruction, or loss resulting from the release.

(2) The costs of response activity recoverable under subsection (1) shall also include all of the following:

(a) All costs of response activity reasonably incurred by the state prior to the promulgation of rules relating to the selection and implementation of response activity under this part, excepting those cases where cost recovery actions have been filed before July 12, 1990. A person challenging the recovery of costs under this subdivision has the burden of

establishing that the costs were not reasonably incurred under the circumstances that existed at the time the costs were incurred. Recoverable costs include costs incurred reasonably consistent with the rules relating to the selection and implementation of response activity in effect on July 12, 1990.

(b) Any other necessary costs of response activity reasonably incurred by any other person prior to the promulgation of rules relating to the selection and implementation of response activity under this part. A person seeking recovery of these costs has the burden of establishing that the costs were reasonably incurred under the circumstances that existed at the time the costs were incurred.

(3) The amounts recoverable in an action under this section shall include interest. This interest shall accrue from the date payment is demanded in writing, or the date of the expenditure or damage, whichever is later. The rate of interest on the outstanding unpaid balance of the amounts recoverable under this section shall be the same rate as is specified in section 6013(5) of the revised judicature act of 1961, Act No. 236 of the Public Acts of 1961, being section 600.6013 of the Michigan Compiled Laws.

(4) In the case of injury to, destruction of, or loss of natural resources under subsection (1)(c), liability shall be to the state for natural resources belonging to, managed by, controlled by, appertaining to, or held in trust by the state or a local unit of government. Sums recovered by the state under this part for natural resource damages shall be retained by the department, for use only to restore, repair, replace, or acquire the equivalent of the natural resources injured or acquire substitute or alternative resources. There shall be no double recovery under this part for natural resource damages, including the costs of damage assessment or restoration, rehabilitation, replacement, or acquisition, for the same release and natural resource.

(5) A person shall not be required under this part to undertake response activity for a permitted release. Recovery by any person for response activity costs or damages resulting from a permitted release shall be pursuant to other applicable law, in lieu of this part. With respect to a permitted release, this subsection does not affect or modify the obligations or liability of any person under any other state law, including common law, for damages, injury, or loss resulting from a release of a hazardous substance or for response activity or the costs of response activity.

(6) If the department determines that there may be an imminent and substantial endangerment to the public health, safety, or welfare, or to the environment because of an actual or threatened release from a facility, the attorney general may bring an action against any person who is liable under section 20126 or any other appropriate person to secure the relief that may be necessary to abate the danger or threat. The court has jurisdiction to grant such relief as the public interest and the equities of the case may require.

(7) The costs recoverable under this section may be recovered in an action brought by the state or any other person.

History: Add. 1995, Act 71, Imd. Eff. June 5, 1995.

324.20127 Repealed. 1995, Act 71, Imd. Eff. June 5, 1995.

Compiler's note: The repealed section pertained to liability.

324.20128 Liability of response activity contractor; effect of warranty; liability of employer to employee; governmental employee exempt from liability; definitions; liability of person in rendering care, assistance, or advice on release of petroleum; effect of exception under subsection (6); burden of establishing liability.

Sec. 20128. (1) Except as otherwise provided in this section, a person who is a response activity contractor for any release or threatened release is not liable to any person for injuries, costs, damages, expenses, or other liability, including, but not limited to, claims for indemnification or contribution and claims by third parties for death, personal injuries, illness, or loss of or damages to property or economic loss that result from the release or threatened release. This subsection does not apply if a release or threatened release is caused by conduct of the response activity contractor that is negligent, grossly negligent, or that constitutes intentional misconduct.

(2) Subsection (1) does not affect the liability of a person under any warranty under federal, state, or common law. This subsection does not affect the liability of an employer who is a response activity contractor to any employee of the employer under law, including any law relating to worker's compensation.

(3) An employee of this state or a local unit of government who provides services relating to a response activity while acting within the scope of his or her authority as a governmental employee has the same exemption from liability as is provided to the response activity contractor under subsection (1).

(4) Except as provided in this section, this section does not affect the liability under this part or under any other federal or state law of any person.

(5) As used in subsections (1) to (4):

(a) "Response activity contract" means a written contract or agreement entered into by a response activity contractor with 1 or more of the following:

(*i*) The department.

(*ii*) The department of public health.

(*iii*) A person who is arranging for response activity under this part.

(b) "Response activity contractor" means 1 or both of the following:

(*i*) A person who enters into a response activity contract with respect to a release or threatened release and is carrying out the terms of a contract.

(*ii*) A person who is retained or hired by a person described in subparagraph (*i*) to provide any service relating to a response activity.

(6) Notwithstanding any other provision of law, a person is not liable for response activity costs or damages that result from an act or a failure to act in the course of rendering care, assistance, or advice with respect to a release of petroleum into or on the surface waters of the state or on the adjoining shorelines to the surface waters of the state if the act or failure to act was consistent with the national contingency plan or as otherwise directed by the federal on-scene coordinator or the director. This subsection does not apply to any of the following:

(a) A person who is liable under section 20126 who is a responsible party.

(b) An action with respect to personal injury or wrongful death.

(c) A person that is grossly negligent or engages in willful misconduct.

(7) A person who is liable under section 20126 who is a responsible party is liable for any response activity costs and damages that another person is relieved of under subsection (6).

(8) As used in this subsection and subsections (6) and (7):

(a) "Damages" means damages of any kind for which liability may exist under the laws of this state resulting from, arising out of, or related to the release or threatened release of petroleum.

(b) "Federal on-scene coordinator" means the federal official predesignated by the United States environmental protection agency or the United States coast guard to coordinate and direct federal responses under the national contingency plan, or the official designated by the lead agency to coordinate and direct response activity under the national contingency plan.

(c) "National contingency plan" means the national contingency plan prepared and published under section 311 of title III of the federal water pollution control act, chapter 758, 86 Stat. 862, 33 U.S.C. 1321.

(d) "Petroleum" means that term as it is defined in part 213.

(e) "Responsible party" means a responsible party as defined under section 1001 of title I of the oil pollution act of 1990, Public Law 101-380, 33 U.S.C. 2701.

(9) This section does not affect a plaintiff's burden of establishing liability under this part.

History: 1994, Act 451, Eff. Mar. 30, 1995;—Am. 1995, Act 71, Imd. Eff. June 5, 1995.

324.20129 Divisibility of harm and apportionment of liability; liability for indivisible harm; contribution; factors in allocating response activity costs and damages; reallocation of uncollectible amount; effect of consent order; resolution of liability in approved settlement; contribution protection; effect of state obtaining less than complete relief; contribution from person not party to consent order; subordinate rights in action for contribution.

Sec. 20129. (1) If 2 or more persons acting independently are liable under section 20126 and there is a reasonable basis for division of harm according to the contribution of each person, each person is subject to liability under this part only for the portion of the total harm attributable to that person. However, a person seeking to limit his or h r liability on the grounds that the entire harm is capable of division has the burden of proof as to the divisibility of the harm and as to the apportionment of liability.

(2) If 2 or more persons are liable under section 20126 for an indivisible harm, each person is subject to liability for the entire harm.

(3) A person may seek contribution from any other person who is liable under section 20126 during or following a civil action brought under this part. This subsection does not diminish the right of a person to bring an action for contribution in the absence of a civil action by the state under this part. In a contribution action brought under this part, the court shall consider all of the following factors in allocating response activity costs and damages among liable persons:

(a) Each person's relative degree of responsibility in causing the release or threat of release.

(b) The principles of equity pertaining to contribution.

(c) The degree of involvement of and care exercised by the person with regard to the hazardous substance.

(d) The degree of cooperation by the person with federal, state, or local officials to prevent, minimize, respond to, or remedy the release or threat of release.

(e) Whether equity requires that the liability of some of the persons should constitute a single share.

(4) If, in an action for contribution under subsection (3), the court determines that all or part of a person's share of liability is uncollectible from that person, then the court may reallocate any uncollectible amount among the other liable

persons according to the factors listed in subsection (3). A person whose share is determined to be uncollectible continues to be subject to contribution and to any continuing liability to the state.

(5) A person who has resolved his or her liability to the state in an administrative or judicially approved consent order is not liable for claims for contribution regarding matters addressed in the consent order. The consent order does not discharge any of the other persons liable under section 20126 unless the terms of the consent order provide for this discharge, but the potential liability of the other persons is reduced by the amount of the consent order.

(6) A person who is not liable under this part, including a person who is issued a written determination under section 20129a affirming that the person meets the criteria for an exemption from liability, and who is otherwise in compliance with section 20107a, shall be considered to have resolved his or her liability to the state in an administratively approved settlement under the comprehensive environmental response, compensation, and liability act of 1980, Public Law 96-510, 94 Stat. 2767 and shall by operation of law be granted contribution protection under section 113(f)(2) of title I of the comprehensive environmental response, compensation, and liability act of 1980, Public Law 96-510, 42 U.S.C. 9613 and under this part in the same manner that contribution protection is provided pursuant to subsection (5).

(7) If the state obtains less than complete relief from a person who has resolved his or her liability to the state in an administrative or judicially approved consent order under this part, the state may bring an action against any other person liable under section 20126 who has not resolved his or her liability.

(8) A person who has resolved his or her liability to the state for some or all of a response activity in an administrative or judicially approved consent order may seek contribution from any person who is not a party to the consent order described in subsection (5).

(9) In an action for contribution under this section, the rights of any person who has resolved his or her liability to the state is subordinate to the rights of the state, if the state files an action under this part.

History: 1994, Act 451, Eff. Mar. 30, 1995;—Am. 1995, Act 71, Imd. Eff. June 5, 1995.

324.20129a Exemption from liability.

Sec. 20129a. (1) A person may petition the department within 6 months after completion of a baseline environmental assessment for a determination that that person meets the requirements for an exemption from liability under section 20126(1)(c) and, in conjunction with that exemption, a determination that the proposed use of the facility satisfies the person's obligations under section 20107a. This request may be made by a prospective purchaser or transferee prior to actual transfer of ownership or other interest to that person or by a lender prior to foreclosure. The request shall be submitted on a form provided by the department along with the fee provided in subsection (4). The person petitioning the department under this subsection shall attach the baseline environmental assessment, a detailed description of the proposed use of the facility, a plan for any response activities that are necessary to assure that the proposed use of the facility satisfies the requirements of section 20107a, if a determination regarding compliance with that section is requested, and the qualifications of the environmental professionals who have made the recommendations.

(2) Within 15 business days after receipt of a petition under subsection (1), the department shall issue a written determination to the person submitting the petition which does either of the following:

(a) Affirms that the criteria for obtaining the exemption have been met and affirms that the proposed use of the facility would satisfy the person's obligations under section 20107a provided that the person complies with the plan for the proposed use of the facility submitted under subsection (1).

(b) Provides that the criteria for obtaining the exemption have not been met, or that the proposed use of the facility does not satisfy the person's obligation under section 20107a, the specific reasons for the denial, and how the applicant could meet the criteria and satisfy the person's obligations under section 20107a, if possible.

(3) A determination by the department under this section may be conditioned on completion of response activities described in the petition.

(4) Until 2 years after the effective date of this section, a petition submitted under subsection (1) shall be accompanied by a fee of $750.00. The department shall deposit all fees collected under this section into the fund. Not later than 18 months after the effective date of this section, the department shall submit a report to the legislature that details all of the following:

(a) The number of petitions received pursuant to this section.

(b) The average length of time which the department has taken to issue written determinations pursuant to this section.

(c) The number of times in which written determinations were not issued within the required time period.

(d) The approximate amount of department staff time necessary to issue a written determination under this section.

(5) A person who is provided an affirmative determination under this section is not liable for a claim for response activity costs, fines or penalties, natural resources damages, or equitable relief under part 17, part 31, or common law resulting from the contamination identified in the petition or from contamination existing on the property on the date in which ownership or control of the property was transferred to the person. The liability protection afforded in this

subsection does not extend to a violation of any permit issued under state law. This subsection does not alter a person's liability for a violation of section 20107a for a use or activity of property that is inconsistent with the determination.

History: Add. 1995, Act 71, Imd. Eff. June 5, 1995.

324.20130 Indemnification, hold harmless, or similar agreement or conveyance; subrogation.

Sec. 20130. (1) An indemnification, hold harmless, or similar agreement or conveyance is not effective to transfer from a person who is liable under section 20126 to the state for evaluation or response activity costs or damages for a release or threat of release to any other person the liability imposed under this part. This section does not bar an agreement to insure, hold harmless, or indemnify a party to the agreement for liability under this part.

(2) This part does not bar a cause of action that a person subject to liability under this part, or a guarantor, has or would have by reason of subrogation or otherwise against any person.

History: 1994, Act 451, Eff. Mar. 30, 1995;—Am. 1995, Act 71, Imd. Eff. June 5, 1995.

324.20131 Limitations on liability; circumstances requiring total costs and damages.

Sec. 20131. (1) Except as provided in subsection (2), the liability under this part for each release or threat of release shall not exceed the total of all the costs of response activities, fines, and exemplary damages, plus $50,000,000.00 damages for injury to, destruction of, or loss of natural resources resulting from the release or threat of release, including the reasonable costs of assessing the injury, destruction, or loss resulting from the release or threat of release.

(2) Notwithstanding the limitations in subsection (1), the liability of a person under this part shall be the full and total costs and damages listed in subsection (1), in either of the following circumstances:

(a) The release or threatened release of a hazardous substance was the result of willful misconduct or gross negligence of the party.

(b) The primary cause of the release or threat of release was a knowing violation of applicable safety, construction, or operating standards or regulations.

History: 1994, Act 451, Eff. Mar. 30, 1995.

324.20132 Covenant not to sue generally; future enforcement action.

Sec. 20132. (1) The state may provide a person with a covenant not to sue concerning any liability to the state under this part, including future liability, resulting from a release or threatened release addressed by response activities, whether that action is on a facility or off a facility, if each of the following is met:

(a) The covenant not to sue is in the public interest.

(b) The covenant not to sue would expedite response activity consistent with rules promulgated under this part.

(c) There is full compliance with a consent order under this part for response to the release or threatened release concerned.

(d) The response activity has been approved by the department.

(2) The state shall provide a person, to which the department is authorized under subsection (1) to issue a covenant not to sue for the portion of response activity described in subdivision (a) or (b), with a covenant not to sue with respect to future liability to the state under this part for a future release or threatened release, and a person provided the covenant not to sue is not liable to the state under section 20126 with respect to that release or threatened release at a future time. The portion of response activity to which the covenant not to sue pertains is either of the following:

(a) The transport and secure disposition off site of hazardous substances in a facility meeting the requirements of sections 3004(c), (d), (e), (f), (g), (m), (o), (p), (u), and (v) and 3005(c) of subtitle C of the solid waste disposal act, title II of Public Law 89-272, 42 U.S.C. 6924 and 6925, if the department has required off-site disposition and has rejected proposed remedial action that is consistent with the rules promulgated under this part and that does not include off-site disposition.

(b) The treatment of hazardous substances so as to destroy, eliminate, or permanently immobilize the hazardous constituents of the substances, so that, in the judgment of the department, the substances no longer present any current or currently foreseeable future significant risk to the public health, safety, or welfare, or the environment; no by-product of the treatment or destruction process presents any significant hazard to the public health, safety, or welfare, or the environment; and all by-products are themselves treated, destroyed, or contained in a manner that assures that the by-products do not present any current or currently foreseeable future significant risk to the public health, safety, or welfare, or the environment.

(3) A covenant not to sue concerning future liability to the state shall not take effect until the department certifies that remedial action has been completed in accordance with the requirements of this part at the facility that is the subject of the covenant.

(4) In assessing the appropriateness of a covenant not to sue granted under subsection (1) and any condition to be included in a covenant not to sue under subsection (1) or (2), the state shall consider whether the covenant or condition is in the public interest on the basis of factors such as the following:

(a) The effectiveness and reliability of the remedial action, in light of the other alternative remedial actions considered for the facility concerned.

(b) The nature of the risks remaining at the facility.

(c) The extent to which performance standards are included in the consent order.

(d) The extent to which the response activity provides a complete remedy for the facility, including a reduction in the hazardous nature of the substances at the facility.

(e) The extent to which the technology used in the response activity is demonstrated to be effective.

(f) Whether the fund or other sources of funding would be available for any additional response activities that might eventually be necessary at the facility.

(g) Whether response activity will be carried out, in whole or in significant part, by persons who are liable under section 20126.

(5) A covenant not to sue under this section is subject to the satisfactory performance by a person of his or her obligations under the agreement concerned.

(6) Except for the portion of the remedial action that is subject to a covenant not to sue under subsection (2), a covenant not to sue a person concerning future liability to the state shall include an exception to the covenant that allows the state to sue that person concerning future liability resulting from the release or threatened release that is the subject of the covenant if the liability arises out of conditions that are unknown at the time the department certifies under subsection (3) that remedial action has been completed at the facility concerned.

(7) In extraordinary circumstances, the state may determine, after assessment of relevant factors such as those referred to in subsection (4) and volume, toxicity, mobility, strength of evidence, ability to pay, litigative risks, public interest considerations, precedential value, and inequities and aggravating factors, not to include the exception in subsection (6) if other terms, conditions, or requirements of the agreement containing the covenant not to sue are sufficient to provide all reasonable assurances that the public health and the environment will be protected from any future releases at or from the facility.

(8) The state may include any provisions providing for future enforcement action under section 20119 or 20137 that in the discretion of the department are necessary and appropriate to assure protection of the public health, safety, welfare, and the environment.

History: 1994, Act 451, Eff. Mar. 30, 1995;—Am. 1995, Act 71, Imd. Eff. June 5, 1995.

324.20133 Redevelopment or reuse of facility; covenant not to sue; conditions; demonstration; limitation; reservation of right to assert claims; irrevocable right of entry; monitoring compliance.

Sec. 20133. (1) The state may provide a person who proposes to redevelop or reuse a facility, including a vacant manufacturing or abandoned industrial site, with a covenant not to sue concerning liability under section 20126 and 20107a, if all of the following conditions are met:

(a) The covenant not to sue is in the public interest.

(b) The covenant not to sue will yield new resources to facilitate implementation of response activity.

(c) The covenant not to sue would, when appropriate, expedite response activity consistent with the rules promulgated under this part.

(d) Based upon available information, the department determines that the redevelopment or reuse of the facility is not likely to do any of the following:

(*i*) Exacerbate or contribute to the existing release or threat of release.

(*ii*) Interfere with the implementation of response activities.

(*iii*) Pose health risks related to the release or threat of release to persons who may be present at or in the vicinity of the facility.

(e) The proposal to redevelop or reuse the facility has economic development potential.

(2) A person who requests a covenant not to sue under subsection (1) shall demonstrate to the satisfaction of the state all of the following:

(a) That the person is financially capable of redeveloping and reusing the facility in accordance with the covenant not to sue.

(b) That the person is not affiliated in any way with any person who is liable under section 20126 for a release or threat of release at the facility.

(3) A covenant not to sue issued under this section shall address only past releases or threats of release at a facility and shall expressly reserve the right of the state to assert all other claims against the person that proposes to redevelop or reuse the facility, including, but not limited to, those claims arising from any of the following:

(a) The release or threat of release of any hazardous substance resulting from the redevelopment or reuse of the facility to the extent such claims otherwise arise under this part.

(b) Interference with or failure to cooperate with the department, its contractors, or other persons conducting response activities approved by the department.

(c) Failure to comply with section 20107a.

(4) A covenant not to sue issued under this section shall provide for an irrevocable right of entry to the department, its contractors, or other persons performing response activity related to the release or threat of release addressed by the covenant not to sue for the purposes listed in section 20117(3)(a) through (e) and for monitoring compliance with the covenant not to sue.

History: 1994, Act 451, Eff. Mar. 30, 1995;—Am. 1995, Act 71, Imd. Eff. June 5, 1995.

324.20134 Consent order; settlement.

Sec. 20134. (1) The department and the attorney general may enter into a consent order with a person who is liable under section 20126 or any group of persons who are liable under section 20126 to perform a response activity if the department and the attorney general determine that the persons who are liable under section 20126 will properly implement the response activity and that the consent order is in the public interest, will expedite effective response activity, and will minimize litigation. The consent order may, as determined appropriate by the department and the attorney general, provide for implementation by a person or any group of persons who are liable under section 20126 of any portion of response activity at the facility. A decision of the attorney general not to enter into a consent order under this part is not subject to judicial review.

(2) Whenever practical and in the public interest, as determined by the department, the department and the attorney general shall as promptly as possible reach a final settlement with a person in an administrative or civil action under this part if this settlement involves only a minor portion of the response costs at the facility concerned and, in the judgment of the department and the attorney general, the conditions in either of the following are met:

(a) Both of the following are minimal in comparison to other hazardous substances at the facility:

(*i*) The amount of the hazardous substances contributed by that person to the facility.

(*ii*) The toxic or other hazardous effects of the substances contributed by that person to the facility.

(b) Except as provided in subsection (3), the person meets all of the following conditions:

(*i*) The person is the owner of the real property on or in which the facility is located.

(*ii*) The person did not conduct or permit the generation, transportation, storage, treatment, or disposal of any hazardous substance at the facility.

(*iii*) The person did not contribute to the release or threat of release of a hazardous substance at the facility through any action or omission.

(3) A settlement shall not be made under subsection (2)(b) if the person purchased the real property with actual or constructive knowledge that the property was used for the generation, transportation, storage, treatment, or disposal of a hazardous substance.

(4) A settlement under subsection (2) may be set aside if information obtained after the settlement indicates that the person settling does not meet the conditions set forth in subsection (2)(a) or (b).

History: 1994, Act 451, Eff. Mar. 30, 1995;—Am. 1995, Act 71, Imd. Eff. June 5, 1995.

324.20134a Repealed. 1995, Act 71, Imd. Eff. June 5, 1995.

Compiler's note: The repealed section pertained to transfer of exempt status by state or local unit of government.

324.20135 Civil action; jurisdiction; conditions; notice; awarding costs and fees; rights not impaired; venue.

Sec. 20135. (1) Except as otherwise provided in this part, a person, including a local unit of government on behalf of its citizens, whose health or enjoyment of the environment is or may be adversely affected by a release from a facility or threat of release from a facility, other than a permitted release or a release in compliance with applicable federal, state, and local air pollution control laws, by a violation of this part or a rule promulgated or order issued under this part, or by the failure of the directors to perform a nondiscretionary act or duty under this part, may commence a civil action against any of the following:

(a) An owner or operator who is liable under section 20126 for injunctive relief necessary to prevent irreparable harm to the public health, safety, or welfare, or the environment from a release or threatened release in relation to that facility.

(b) A person who is liable under section 20126 for a violation of this part or a rule promulgated under this part or an order issued under this part in relation to that facility.

(c) One or more of the directors if it is alleged that 1 or more of the directors failed to perform a nondiscretionary act or duty under this part.

(2) The circuit court has jurisdiction in actions brought under subsection (1)(a) to grant injunctive relief necessary to protect the public health, safety, or welfare, or the environment from a release or threatened release. The circuit court has jurisdiction in actions brought under subsection (1)(b) to enforce this part or a rule promulgated or order issued under this part by ordering such action as may be necessary to correct the violation and to impose any civil fine provided for in this part for the violation. A civil fine recovered under this section shall be deposited in the fund. The circuit court has jurisdiction in actions brought under subsection (1)(c) to order 1 or more of the directors to perform the nondiscretionary act or duty concerned.

(3) An action shall not be filed under subsection (1)(a) or (b) unless all of the following conditions exist:

(a) The plaintiff has given at least 60 days' notice in writing of the plaintiff's intent to sue, the basis for the suit, and the relief to be requested to each of the following:

(*i*) The department.

(*ii*) The attorney general.

(*iii*) The proposed defendants.

(b) The state has not commenced and is not diligently prosecuting an action under this part or under other appropriate legal authority to obtain injunctive relief concerning the facility or to require compliance with this part or a rule or an order under this part.

(4) An action shall not be filed under subsection (1)(c) until the plaintiff has given in writing at least 60 days' notice to the directors of the plaintiff's intent to sue, the basis for the suit, and the relief to be requested.

(5) In issuing a final order in an action brought pursuant to this section, the court may award costs of litigation, including reasonable attorney and expert witness fees to the prevailing or substantially prevailing party if the court determines that an award is appropriate.

(6) This section does not affect or otherwise impair the rights of any person under federal, state, or common law.

(7) An action under subsection (1)(a) or (b) shall be brought in the circuit court for the circuit in which the alleged release, threatened release, or other violation occurred. An action under subsection (1)(c) shall be brought in the circuit court for Ingham county.

History: 1994, Act 451, Eff. Mar. 30, 1995;—Am. 1995, Act 71, Imd. Eff. June 5, 1995.

324.20135a Access to property; action by court.

Sec. 20135a. (1) A person who is liable under section 20126 or a lender that has a security interest in all or a portion of a facility may file a petition in the circuit court of the county in which the facility is located seeking access to the facility in order to conduct response activities approved by the department. If the court grants access to property under this section, the court may do any of the following:

(a) Provide compensation to the property owner or operator for damages related to the granting of access to the property, including compensation for loss of use of the property.

(b) Enjoin interference with the response activities.

(c) Grant any other appropriate relief as determined by the court.

(2) If a court grants access to property under this section, the owner or operator of the property to which access is granted is not liable for either of the following:

(a) A release caused by the response activities for which access is granted unless the owner or operator is otherwise liable under section 20126.

(b) For conditions associated with the response activity that may present a threat to public health or safety.

History: Add. 1995, Act 71, Imd. Eff. June 5, 1995.

324.20136 Repealed. 1995, Act 71, Imd. Eff. June 5, 1995.

Compiler's note: The repealed section pertained to grant programs.

324.20137 Additional relief; providing copy of complaint to attorney general; jurisdiction; judicial review; intervenor.

Sec. 20137. (1) In addition to other relief authorized by law, the attorney general may, on behalf of the state, commence a civil action seeking 1 or more of the following:

(a) Temporary or permanent injunctive relief necessary to protect the public health, safety, or welfare, or the environment from the release or threat of release.

(b) Recovery of state response activity costs pursuant to section 20126a.

(c) Damages for the full value of injury to, destruction of, or loss of natural resources resulting from the release or threat of release, including the reasonable costs of assessing the injury, destruction, or loss resulting from the release or threat of release.

(d) A declaratory judgment on liability for future response costs and damages.

(e) A civil fine of not more than $1,000.00 for each day of noncompliance without sufficient cause with a written request of the department pursuant to section 20114(1)(h). A fine imposed under this subdivision shall be based on the seriousness of the violation and any good faith efforts of the person to comply with the request of the department.

(f) A civil fine of not more than $10,000.00 for each day of violation of this part or a rule promulgated under this part. A fine imposed under this subdivision shall be based upon the seriousness of the violation and any good faith efforts of the person to comply with this part or a rule promulgated under this part.

(g) A civil fine of not more than $25,000.00 for each day of violation of a judicial order or an administrative order issued pursuant to section 20119, including exemplary damages pursuant to section 20119.

(h) Enforcement of an administrative order issued pursuant to section 20119.

(i) Enforcement of information gathering and entry authority pursuant to section 20117.

(j) Enforcement of the reporting requirements under section 20114(1), (3), and (6).

(k) Any other relief necessary for the enforcement of this part.

(2) If an action is brought under this part by a plaintiff other than the attorney general, the plaintiff shall, at the time of filing, provide a copy of the complaint to the attorney general.

(3) Except as otherwise provided in this part, an action brought under this part may be brought in the circuit court for the county of Ingham, in the county in which the defendant resides, has a place of business, or in which the registered office of a defendant corporation is located, or in the county where the release occurred.

(4) A state court does not have jurisdiction to review challenges to a response activity selected or approved by the department under this part or to review an administrative order issued under this part in any action except an action that is 1 of the following:

(a) An action to recover response costs, damages, or for contribution.

(b) An action by the state to enforce an administrative order under this part or by any other person under section 20135(1)(b) to enforce an administrative order or to recover a fine for violation of an order.

(c) An action pursuant to section 20119(5) for review of a decision by the department denying or limiting reimbursement.

(d) An action pursuant to section 20135 challenging a response activity selected or approved by the department, if the action is filed after the completion of the response activity.

(e) An action by the state pursuant to section 20126a(6) to compel response activity.

(5) In any judicial action under this part, judicial review of any issues concerning the selection or adequacy of a response activity taken, ordered, or agreed to by the state are limited to the administrative record. If the court finds that the record is incomplete or inadequate, the court may consider supplemental material in the action. In considering objections raised in a judicial action under this part, the court shall uphold the state's decision in selecting a response activity unless the objecting party can demonstrate based on the administrative record that the decision was arbitrary and capricious or otherwise not in accordance with law. In reviewing alleged procedural errors, the court may disallow costs or damages only to the extent the errors were so serious and related to matters of such central importance that the activity would have been significantly changed had the errors not been made.

(6) In an action commenced under this part, any person may intervene as a matter of right if that person claims an interest relating to the subject matter of the action and is situated so that the disposition of the action may, as a practical matter, impair or impede the person's ability to protect that interest, unless the court finds the person's interest is adequately represented by an existing party.

History: 1994, Act 451, Eff. Mar. 30, 1995;—Am. 1995, Act 71, Imd. Eff. June 5, 1995.

324.20138 Unpaid costs and damages as lien on facility; priority; commencement and sufficiency of lien; petition; notice of hearing; increased value as lien; perfection, duration, and release of lien; document stating completion of response activities.

Sec. 20138. (1) All unpaid costs and damages for which a person is liable under section 20126 constitute a lien in favor of the state upon a facility that has been the subject of response activity by the state and is owned by that person. A lien under this subsection has priority over all other liens and encumbrances except liens and encumbrances recorded before the date the lien under this subsection is recorded. A lien under this subsection arises when the state first incurs costs for response activity at the facility for which the person is responsible.

(2) If the attorney general determines that the lien provided in subsection (1) is insufficient to protect the interest of the state in recovering response costs at a facility, the attorney general may file a petition in the circuit court of the county in which the facility is located seeking either or both of the following:

(a) A lien upon the facility subject to response activity that takes priority over all other liens and encumbrances that are or have been recorded on the facility.

(b) A lien upon real or personal property or rights to real or personal property, other than the facility, owned by the person described in subsection (1), having priority over all other liens and encumbrances except liens and encumbrances recorded prior to the date the lien under this subsection is recorded. However, the following are not subject to the lien provided for in this subdivision:

(*i*) Assets of a qualified pension plan or individual retirement account under the internal revenue code.

(*ii*) Assets held expressly for the purpose of financing a dependent's college education.

(*iii*) Up to $500,000.00 in nonbusiness real or personal property or rights to nonbusiness real or personal property, except that not more than $25,000.00 of this amount may be cash or securities.

(3) A petition submitted pursuant to subsection (2) shall set forth with as much specificity as possible the type of lien sought, the property that would be affected, and the reasons the attorney general believes the lien is necessary. Upon receipt of a petition under subsection (2), the court shall promptly schedule a hearing to determine whether the petition should be granted. Notice of the hearing shall be provided to the attorney general, the property owner, and any persons holding liens or perfected security interests in the real property subject to response activity. A lien shall not be granted under subsection (2) against the owner of the facility if the owner is not liable under section 20126.

(4) In addition to the lien provided in subsections (1) and (2), if the state incurs costs for response activity that increases the market value of real property that is the location of a release or threatened release, the increase in value caused by the state funded response activity, to the extent the state incurred unpaid costs and damages, constitutes a lien in favor of the state upon the real property. This lien has priority over all other liens or encumbrances that are or have been recorded upon the property.

(5) A lien provided in subsection (1), (2), or (4) is perfected against real property when a notice of lien is filed by the department with the register of deeds in the county in which the real property is located. A lien upon personal property provided in subsection (2) is perfected when a notice of lien is filed by the department in accordance with applicable law and regulation for the perfection of a lien on that type of personal property. In addition, the department shall, at the time of the filing of the notice of lien, provide a copy of the notice of lien to the owner of that property by certified mail.

(6) A lien under this section continues until the liability for the costs and damages is satisfied or resolved or becomes unenforceable through the operation of the statute of limitations provided in section 20140.

(7) Upon satisfaction of the liability secured by the lien, the department shall file a notice of release of lien in the same manner as provided in subsection (5).

(8) If the department, at the time or prior to the time of filing the notice of release of lien pursuant to subsection (7), has made a determination that the person liable under section 20126 has completed all of the response activity at the real property pursuant to the approved remedial action plan, the department shall execute and file with the notice of release of lien a document stating that all response activities required in the approved remedial action plan have been completed.

History: 1994, Act 451, Eff. Mar. 30, 1995;—Am. 1995, Act 71, Imd. Eff. June 5, 1995.

324.20139 Applicability of penalties; conduct constituting felony; penalties; jurisdiction; criminal liability for substantial endangerment to public health, safety, or welfare; determination; knowledge attributable to defendant; award; rules; definition.

Sec. 20139. (1) The penalties provided in this section only apply to a release that occurs after July 1, 1991.

(2) A person who does any of the following is guilty of a felony and shall be fined not less than $2,500.00 or more than $25,000.00 for each violation:

(a) Knowingly releases or causes a release contrary to applicable federal, state, or local requirements or contrary to any permit or license held by that person, if that person knew or should have known that the release could cause personal injury or property damage.

(b) Intentionally makes a false statement, representation, or certification in any application, record, report, plan, or other document filed or required to be maintained under this part and rules promulgated under this part.

(c) Intentionally renders inaccurate any monitoring device or record required to be maintained under this part or a rule promulgated under this part.

(d) Misrepresents his or her qualifications in a document prepared pursuant to section 20129a.

(3) In addition to a fine imposed under subsection (2), the court may impose an additional fine of not more than $25,000.00 for each day during which the release occurred. If the conviction is for a violation committed after a first conviction of the person under this subsection, the court shall impose a fine of not less than $25,000.00 and not more than $50,000.00 per day of violation. Upon conviction, in addition to a fine, the court in its discretion may sentence the defendant to imprisonment for not more than 2 years or impose probation upon a person for a violation of this part. With the exception of the issuance of criminal complaints, issuance of warrants, and the holding of an arraignment, the circuit court for the county in which the violation occurred has exclusive jurisdiction.

(4) Upon a finding by the court that the action of a criminal defendant prosecuted under this section poses or posed a substantial endangerment to public health, safety, or welfare, the court shall impose, in addition to the penalties set forth in subsections (2) and (3), a fine of not less than $1,000,000.00 and, in addition to a fine, a sentence of 5 years' imprisonment.

(5) To find a defendant criminally liable for substantial endangerment under subsection (4), the court shall determine that the defendant knowingly or recklessly acted in such a manner as to cause a danger of death or serious bodily injury and that either of the following has occurred:

(a) The defendant had an actual awareness, belief, or understanding that his or her conduct would cause a substantial danger of death or serious bodily injury.

(b) The defendant acted in gross disregard of the standard of care that any reasonable person would observe in similar circumstances.

(6) Knowledge possessed by a person other than the defendant under subsection (5) may be attributable to the defendant if the defendant took affirmative steps to shield himself or herself from the relevant information.

(7) The department may pay an award of up to $10,000.00 to an individual that provides information leading to the arrest and conviction of a person for a violation of this section. The department shall promulgate rules that prescribe criteria for granting awards under this section. An award shall not be made under this section until rules are promulgated prescribing the criteria for making awards. Awards under this subsection may be paid from the Michigan environmental assurance fund, if enabling legislation creating the fund is enacted into law.

(8) As used in this section, "serious bodily injury" means bodily injury that involves a substantial risk of death, unconsciousness, extreme physical pain, protracted and obvious disfigurement, or protracted loss or impairment of the function of a bodily member, organ, or mental faculty.

History: 1994, Act 451, Eff. Mar. 30, 1995;—Am. 1995, Act 71, Imd. Eff. June 5, 1995.

324.20140 Limitation periods.

Sec. 20140. (1) Except as provided in subsection (2), the limitation period for filing actions under this part is as follows:

(a) For the recovery of response activity costs and natural resources damages pursuant to section 20126a(1)(a), (b), or (c), within 6 years of initiation of physical on-site construction activities for the remedial action selected or approved by the department at a facility, except as provided in subdivision (b).

(b) For 1 or more subsequent actions for recovery of response activity costs pursuant to section 20126, at any time during the response activity, if commenced not later than 3 years after the date of completion of all response activity at the facility.

(c) For civil fines under this part, within 3 years after discovery of the violation for which the civil fines are assessed.

(2) For recovery of response activity costs and natural resources damages that accrued prior to July 1, 1991, the limitation period for filing actions under this part is July 1, 1994.

History: 1994, Act 451, Eff. Mar. 30, 1995;—Am. 1995, Act 71, Imd. Eff. June 5, 1995.

324.20141 Repealed. 1995, Act 71, Imd. Eff. June 5, 1995.

Compiler's note: The repealed section pertained to citizens review board.

324.20142 Compliance as bar to certain claims; exceptions.

Sec. 20142. (1) Except as provided in section 20126a(5), a person who has complied with the requirements of this part or is exempt from liability under this part is not subject to a claim in law or equity for performance of response activities under part 17, part 31, or common law.

(2) This section does not bar any of the following:

(a) Tort claims unrelated to performance of response activities.

(b) Tort claims for damages which result from response activities.

(c) Tort claims related to the exercise or failure to exercise responsibilities under section 20107a.

History: Add. 1995, Act 71, Imd. Eff. June 5, 1995.

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY

DRAF

INTEROFFICE COMMUNICATION

May 14, 1996 *REVISED DRAFT*

MEMORANDUM #8

TO: Environmental Response Division (ERD) Staff

FROM: Alan J. Howard, Chief, Environmental Response Division

SUBJECT: Interim Generic Utility Worker Groundwater Contact Criteria: Addendum to Interim Operational Memoranda #8, Revision 4 (June 5, 1995) and #14, Revision 2 (June 6, 1995)

The attached document describes the application and technical basis for Part 201 generic groundwater contact criteria (GCC). These criteria should be reviewed for their applicability in all land use categories. The criteria described in the attached document are relevant in determining the adequacy of a remedial action and for making a determination about whether property is a facility. These criteria will be controlling factors in facility determinations only when more restrictive exposure pathways for groundwater are not pertinent (e.g., the groundwater is not in an aquifer, so application of the drinking water-based criteria are not appropriate).

Exposure to contaminants via direct contact with groundwater may be the controlling factor for the cleanup of groundwater in some cases. This is fully discussed in the attached materials. Note carefully that the new generic criteria are likely to be controlling factors in two situations:

- where ingestion of contaminants in groundwater is not relevant because land use restrictions prevent the use of groundwater for drinking water, or
- where the groundwater is not in an aquifer.

Groundwater contaminant migration off-property and/or to nearby surface waters must also be considered before deciding whether the generic GCC will control the need for groundwater remediation.

These generic GCC address only the dermal route of exposure to groundwater contaminants. Similar to other generic criteria, the generic utility worker GCC are only protective of systemic (i.e., within the body) health effects. For some contaminants and exposure settings, the inhalation route may be the more significant route of exposure when use of groundwater has been reliably restricted or the groundwater is not in an aquifer. Potential inhalation concerns must be addressed as outlined in my November 14, 1995 memorandum to staff.

Generic GCC for application in settings where additional groundwater contact exposures must be accounted for (e.g., in ponds) are still under development and will be provided as soon as they are available.

Staff of the ERD must obtain approval of the use of these criteria before the remedial action plan or closure report is approved. Questions or further information can be directed to Christine Flaga, 517-373-0160; Jeffrey Crum, 335-3092, or Linda Larsen, 335-3161.

Attachments

cc: Mr. Jim Sygo, DEQ
Mr. Arthur Nash, DEQ
Mr. Paul Zugger, DEQ
Mr. Robert Miller, DEQ
Mr. Dennis Drake, DEQ
Ms. Lynn Boyd, DEQ

APPLICATION OF UTILITY WORKER GCC

The generic utility worker GCC criteria are appropriate and relevant to facilities where it can be demonstrated that:

1. there is no migration of groundwater contaminants to an aquifer at concentrations above the residential drinking water values, or drinking water use of the aquifer is reliably restricted, and

2. contaminant migration to an existing nearby surface water body at concentrations above applicable generic or mixing zone-based groundwater surface water interface (GSI) criteria is not a relevant pathway, and

3. the facility is located where underground utilities exist in saturated soils, or may be constructed in saturated soils.

Facility information must be adequately characterized to assure proper application of the generic utility worker GCC. If non-drinking water uses of the groundwater are not institutionally controlled, consideration must be given to whether the generic utility worker GCC are adequately protective. The extent of groundwater contaminant migration must also be adequately characterized to assure that appropriate criteria are applied in accordance with current and future uses of the groundwater on- and off-property. The GCC criteria are applicable to all land use categories. Note, though, that if the groundwater cleanup criteria are based on a pathway other than the GCC (e.g., drinking water or inhalation), Section 20120a(16) requires that residential-based criteria be met at the property boundary unless adequate land use restrictions are in place to make consideration of residential exposures unnecessary. Attention should be given to the hydrogeology, contaminant concentrations, exposure setting, land use and receptor activities for all properties that are impacted by the contamination. Consideration should also be given to groundwater contaminant migration in utility corridors, such as storm and sewer water collection and drainage systems which often discharge to surface water bodies.

UTILITY WORKER SCENARIO

Subsurface utility repair, maintenance and installation are common activities that may result in periodic contact with groundwater contaminants by utility workers under any land use. Therefore, generic utility worker GCC have been developed for application to all land use categories. Utility worker exposure to groundwater contaminants is likely to occur throughout the duration of their employment, resulting in a higher frequency of contact with contaminants relative to a construction worker. However, consideration should be given to known or planned long-term construction projects which could result in greater overall exposure of a construction worker.

Application of the utility worker GCC is required at all facilities where soil excavations to conduct utility work will result in groundwater seepage and collection in the excavation. As a general rule, GCC are not applicable unless groundwater samples can be obtained from saturated zones; seasonal variations must be considered. These criteria are applicable at both facilities that have existing utilities and facilities where utilities could be placed in the future. The depth of the existing utilities, if any, and reasonable expectations about the depth of future utilities need to be considered in determining the depth at which the GCC would apply. While many utilities are present near the ground surface, be aware that some utilities such as sewers may be at considerably greater depths. Remedial action plans must identify existing utility corridors and their depth in relation to the saturated soils, and describe the basis for conclusions regarding the potential depth of future utilities.

DRAFT

PART 201 INTERIM GENERIC GROUNDWATER CONTACT CRITERIA FOR UTILITY WORKERS

May 14, 1996

Jeffrey A. Crum

This memorandum provides interim generic groundwater contact criteria (GCC) that may be used to address utility worker dermal contact with groundwater contaminants. These criteria have been developed in response to the increasing number of facilities where groundwater is reliably restricted from drinking water use, or is hydrogeologically classified as "not in an aquifer." Application of the Part 201 health-based drinking water values are not applicable to these situations, and past use of the residential soil "20x drinking water" or soil direct contact values are not consistent with Part 201 Section 20120a(3) because contaminant absorption from groundwater and soil are different. Section 20120a(3) requires the department to appropriately characterize human exposures associated with land uses and to use reasonable and relevant exposure pathways in establishing the human health risk assessment assumptions used for developing cleanup criteria. To facilitate remedial action at facilities where groundwater use for drinking water is not applicable, utility worker GCC were developed to characterize the risks associated with dermal contact with groundwater contaminants to assure human health protection.

The generic utility worker GCC presented in the attached table address only the dermal route of exposure to groundwater contaminants. For some contaminants and exposure settings, the inhalation route may be the more significant route of exposure when drinking water use of the groundwater has been reliably restricted, or groundwater is not in an aquifer. Inhalation of emissions from volatile groundwater contaminants is applicable to utility workers since excavations more than 4 feet below ground surface are considered confined spaces under occupational safety regulations (MIOSHA Administrative Rule 6402, promulgated pursuant to 1974 PA 154, as amended). Further, the GCC may not be protective for generic closures where indoor or ambient air inhalation exposures, or future pond construction (swimmer exposures), may result in the application of more restrictive criteria. Additional guidance for evaluating inhalation exposure to groundwater contaminants is provided in attachment A. ***In all cases, the exposure pathway with the most restrictive criteria will apply, unless land use restrictions preclude exposure to the groundwater for that pathway.***

Similar to other generic criteria, utility worker GCC are only protective of systemic human health effects--those which occur as a result of absorption and distribution of the chemical to an organ/tissue ***within*** the body. Assessment of the potential for non-systemic or acute effects must be conducted to determine if more restrictive criteria, than determined from the above exposure pathway evaluation, are necessary to protect for these endpoints. ***It is also important that groundwater contaminant concentrations be evaluated for potential physical hazards, such as corrosivity and flammability.*** Further guidance for addressing these concerns is provided in attachment B.

This document only addresses utility worker exposures. Separate criteria will be developed in the future to consider the potential for pond development and subsequent exposure of swimmers to groundwater contaminants venting to these surface waters. When reviewing remedial actions proposed for facilities in rural areas, the pond swimmer exposure scenario may be the controlling factor. If you believe the pond scenario is relevant for a facility you are evaluating, consult your supervisor for direction.

Exposure Assumptions

Consistent with the development of other generic criteria, the exposure assumptions for utility workers were developed to characterize a reasonable maximum exposure (RME). Dermal contact with groundwater by a utility worker is not likely to be continuous over the 8-hour work day. It is reasonably assumed that a utility worker will be in contact with groundwater for 25% of the 8 hour work day (i.e., ET=2 hours/day). An EF of 20 days/year was selected to account for the presence of multiple utilities and the fact that the number of days required for repair or installation varies for different utility types. An ED default value of 21 years is used for the utility worker since they are considered to spend as many years on the job as an industrial worker characterized in the generic soil direct contact criteria calculations. The skin SA is not considered to be equivalent to the skin SA of the industrial worker. It is more probable that half the lower legs, forearms and hands (i.e., SA=3,000 cm^2; EPA, 1992) will be the areas of the body routinely in contact with groundwater contaminants for this scenario. The conventional adult body weight of 70 kg is used for the utility line worker.

Please see attachment C for an explanation of the calculations that were performed in the development of the utility worker GCC, and the generic utility worker GCC equations.

DETERMINING SOIL CLEANUP CRITERIA

When the utility worker GCC are the controlling criteria for groundwater cleanup, corresponding soil cleanup criteria may be developed using options provided in Rule 299.5711(2). In this case, the acceptable methods for establishing soil concentrations protective of groundwater are:

- Comparison of leachate test results to the GCC or to background groundwater concentrations,
- Use of 20 times the GCC concentration as an acceptable soil concentration, or
- Concentrations derived through ERD-approved fate and transport modeling.

Remember that other pathways, such as direct contact with soil or inhalation of emissions from volatile contaminants in soil, may be more restrictive and control the overall soil cleanup criteria.

GENERAL PROVISIONS

The generic utility worker GCC generated from the equations in attachment C should be considered draft, as the equations and other matters addressed pertaining to their use are subject to revision. Final cleanup standards must be confirmed by Environmental Response Division toxicologists and approved as part of a specific remedial action plan (RAP).

This document is intended to provide guidance to ERD staff to foster consistent application of Part 201 of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended, and associated Administrative Rules. This document is not intended to convey any rights to any parties nor create any duties or responsibilities under law. This document and matters addressed herein are subject to revision.

Questions related to the generic utility worker GCC can be directed to Christine Flaga (517-373-0160), Jeffrey Crum (517-335-3092), or Linda Larsen (517-335-3161).

REFERENCES

EPA (U.S. Environmental Protection Agency). 1992. Dermal Exposure Assessment: Principles and Applications. Interim Report. Office of Research and Development. EPA/600/R-93/089.

Attachment A

DRA

INHALATION EXPOSURE TO GROUNDWATER CONTAMINANTS

The potential for emissions from volatile contaminants in groundwater to indoor air and confined spaces must be evaluated to determine if the utility worker GCC are protective of inhalation exposures. Inhalation of emissions from volatile groundwater contaminants must be considered for utility workers since excavations more than 4 feet below ground surface are considered confined spaces under occupational safety regulations (MIOSHA Administrative Rule 6402, promulgated pursuant to 1974 PA 154, as amended). Consideration of inhalation exposures is also appropriate to assure protection of current and/or future human receptors living or working indoors at the facility.

Assessment of groundwater contaminant volatile emissions is only required for chemicals with a Henry's Law constant greater than 1×10^{-5} atm-m^3/mole *and* a molecular weight of less than 200 g/mole (EPA, 1991). If the chemical has these characteristics, contact an ERD toxicologist for assistance in calculating appropriate criteria.

Until the Department identifies and establishes quantitative methods for developing generic groundwater inhalation criteria for volatile emissions to indoor air and confined spaces, the ASTM (1996) Risk-Based Screening Levels (RBSLs) for "groundwater volatile emission to indoor air" can be used to identify groundwater contaminant concentrations that do not need further evaluation. Environmental Response Division is currently using a software package, which applies the ASTM equations to derive generic (Tier 1) land use-based RBSLs for volatile groundwater contaminants emitted to indoor air. ***Although the RBSLs are not regulatory compliance criteria, they are acceptable for generic land use closures.*** Parties may propose other quantitative approaches, or conduct a site-specific assessment to support the application of alternative criteria protective of inhalation of groundwater volatile emissions to indoor air and confined spaces. Development of Part 201 generic groundwater inhalation criteria for volatile emissions to indoor air and confined spaces will be pursued at a later date. We expect that those generic criteria will be less restrictive than the RBSLs.

Although inhalation exposure to groundwater contaminants volatilizing to *ambient air* above ground surface may be a relevant pathway at some facilities, criteria for this exposure route are not expected to be less than the future Part 201 indoor air and confined space groundwater inhalation criteria.

REFERENCES

EPA (Environmental Protection Agency). 1991. Risk Assessment Guidance for Superfund. Development of Preliminary Remediation Goals. Interim. (Part B)

ASTM (American Society For Testing and Materials). 1996. Standard Guide for Risk-Based Corrective Action Applied at Petroleum Sites. ES-1739.

Attachment B

DRAF

ISSUES NOT ADDRESSED BY THE GROUNDWATER CONTACT CRITERIA

Several chemicals have generic utility worker GCC that exceed their water solubility concentration. This is most likely due to development of generic GCC that only address protection of *systemic* (i.e., toxic effects which occur as a result of absorption and distribution of the chemical to a site/organ *within* the body) health effects. Use of oral toxicity values based on administered doses in conjunction with dermal absorbed estimates of dose may also contribute to elevated criteria. For chemicals which have water solubility values that are less than the utility worker GCC, the solubility value will become the default GCC. In addition, where data are insufficient to develop GCC and inhalation screening criteria, the water solubility values become the default GCC. Groundwater contaminant concentrations above their water solubilities may result in free product formation, which may cause non-systemic or acute health effects, as well as other physical hazards, which may need to be addressed.

Chemical-specific evaluation of the potential for non-systemic effects and/or acute health effects, as required under Section 20120a(4) and administrative rule 299.5711(6), which may be significant to dermal exposures, has not been completed. ERD toxicologists are in the process of identifying contaminants that may cause point-of-entry (e.g., contact dermatitis) and reproductive/developmental effects to assure that the most sensitive toxic endpoint is represented in the development of Part 201 criteria. In all cases, it is important that groundwater contaminant concentrations be evaluated for potential physical hazards, such as corrosivity and flammability. Until these concerns can be incorporated into the criteria development process, ERD toxicologists will use professional judgment on a facility-by-facility basis to prevent delays in remedial decisions.

It is not appropriate to use the oral slope factors for the carcinogenic polycyclic aromatic hydrocarbons (PAHs) to develop dermal exposure-based GCC since they cause skin cancer at the point of application. Therefore, criteria are not provided for the carcinogenic PAHs. Their presence in groundwater, however, will likely be limited since they are relatively immobile in soil. Professional judgment will be used to address situations where these contaminants are present in the groundwater.

REFERENCES

EPA (U.S. Environmental Protection Agency). 1989. Risk Assessment Guidance for Superfund. Volume I. Human Health Evaluation Manual. (Part A). Interim Final. Office of Emergency and Remedial Response. EPA/540/1-89/002.

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CALCULATION OF GENERIC GROUNDWATER CONTACT CRITERIA

Once the appropriate generic exposure scenario has been identified for the facility, or the party chooses to perform a facility-specific criteria calculation, the first step for generic GCC calculations is to estimate the dermal absorbed dose (DA) over the specified exposure period (time in hours). Derivation of the DA is performed differently for inorganic and organic compounds. In addition, the equations presented in EPA's (1992) dermal exposure assessment guidance for estimating chemical-specific dermal absorption have been rearranged to back-calculate the chemical concentration in water (C_w in EPA) consistent with all Part 201 generic risk-based equations; EPA determines the risk associated with exposure to a chemical-specific water concentration, whereas Part 201 derives the chemical-specific concentration in water associated with the target risk. The DA_{event} term in EPA (1992) is replaced by DA_i and DA_o to designate the chemical-specific dermal absorbed dose for inorganic and organic compounds, respectively. It also assumed for these generic calculations that only one exposure "event" occurs per day, thereby eliminating the need to consider event frequency as incorporated into the EPA (1992) method.

Current EPA (1992) guidance recommends using the steady-state approach for estimating the dermal absorbed dose for inorganic substances (DA_i), shown in the following equation:

$$DA_i = K_p * ET$$

where,

DA_i = dermal absorbed dose (cm chemical-specific)
K_p = permeability coefficient - skin penetration rate (cm/hr, chemical specific)
ET = exposure time (hr)

Permeability coefficients (K_p) for some inorganics are provided in Table 5-3 of EPA (1992). If a K_p is not listed for a particular inorganic, a default value of 0.001 cm/hour was used (EPA, 1992).

Determination of the dermal absorbed dose for organic compounds (DA_o) is more complex, because a nonsteady-state method is recommended to account for contaminant absorption that occurs after the actual exposure event due to storage of contaminant within skin lipids (fat) (EPA, 1992). Factors such as the contaminants tendency to partition between lipid and water phases influence the amount of contaminant absorbed after exposure has ceased. Table 5-7 of EPA (1992) provides estimated K_p values for several chemicals using the Potts and Guy (1992) correlation equation shown below.

$$Log\ K_p = -2.72 + 0.71 * (\log K_{ow}) - (0.0061 * MW)$$

where,

K_{ow} = octanol-water partition coefficient (L/L, chemical-specific)
MW = molecular weight (g/mole, chemical-specific)

Octanol/water partition coefficients (K_{ow}) and the molecular weights (MW) for several organics chemicals are presented in Table 5-7 of EPA (1992) along with the calculated K_p value. These estimated K_p values are then used in one of the equations presented below, depending on the ET value of the generic exposure scenario relative to the chemical-specific t^* value listed in Table 5-8. As described earlier, it is necessary to delete the concentration in water term (C_w) from EPA (1992) equations 5.20 and 5.21. The equations used to estimate organic contaminant absorption (DA_o) through the skin are as follows:

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If ET > t^*, then : $DA_o = 2 * K_p * [(6 * T * ET)/\pi]^{1/2}$

If ET < t^*, then : $DA_o = K_p * [(ET/1 + B) + 2 * T * (1 + 3*B)/(1 + B)]$

where,

DA_o = dermal absorbed dose (cm, chemical-specific)
K_p = permeability coefficient (cm/hr, chemical-specific)
ET = exposure time (hr)
t^* = time required to reach steady state (hr)
T = lag time (hr)
B = dimensionless constant representing the octanol-water partitioning properties of a chemical

Chemical-specific values for t^*, T and B are presented in Table 5-8 of EPA (1992). For chemicals which do not have listed K_{ow} values in Table 5-7, but are regulated under Part 201, peer-reviewed literature values were used to develop K_p values for these chemicals. EPA (1992) guidance was followed for conducting the necessary successive steps to derive chemical-specific values for t^*, T and B to complete the appropriate calculation of the DA_o.

The DA_i or DA_o are then incorporated into the appropriate generic groundwater contact equation shown below for calculation of the criteria.

Generic Groundwater Contact Equations

UTILITY WORKER

CARCINOGENS:

$$C_{gw/dc} = \frac{BW * AT * TR * 1000\ ug/mg}{SF * SA * DA * EF * ED * CF}$$

where,

$C_{gw/dc}$	risk-based groundwater concentration for dermal contact	= ug/l, or ppb
BW	body weight	= 70 kg
AT	averaging time	= 25,550 days (70 * 365)
TR	acceptable risk level	= 10^{-5}
SF	cancer slope factor	= chemical-specific $(mg/kg/day)^{-1}$
SA	skin surface area (adult)	= 3,000 cm^2/day
DA	dose absorbed (see text above for calculation)	= chemical-specific, cm
EF	exposure frequency	= 20 days/year
ED	exposure duration	= 21 years
CF	conversion factor	= 1E-3 L/cm^3

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NONCARCINOGENS:

$$C_{gw/dc} = \frac{HQ * RfD * BW * AT * 1000\ ug/mg}{SA * DA * EF * ED * CF}$$

where,

$C_{gw/dc}$	risk-based groundwater concentration for dermal contact	= ug/l, or ppb
HQ	hazard quotient	= 1
RfD	oral reference dose	= mg/kg/day
AT	averaging time	= 10,950 days (30 * 365)
SA	skin surface area (adult)	= 3,000 cm^2/day
DA	dose absorbed (see text above for calculation)	= chemical-specific, cm
EF	exposure frequency	= 20 days/year
ED	exposure duration	= 21 years
CF	conversion factor	= 1E-3 L/cm^3

REFERENCES

EPA (U.S. Environmental Protection Agency) 1992. Dermal Exposure Assessment: Principles and Applications. Interim Report. Office of Research and Development. EPA/600/R-93/089.

Potts, R.O. and Guy, R.H. 1992. Predicting skin permeability. Pharmacol. Res., accepted for publication.

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Part 201 Interim Groundwater Contact Criteria

All values below are expressed in ug/L (ppb).

Chemical	Utility Worker	Water Solubility (ug/L)
Acenaphthene	*1.7E+5	4,200
Acenaphthylene	ID	3,900
Acetaldehyde	3.3E+7	NA
Acetic acid	ID	6.0E+9
Acetone	3.1E+7	1.0E+9
Acetonitrile	5.7E+6	2.0E+8
Acrolein	3.9E+6	2.1E+8
Acrylamide	5,300	2.2E+9
Acrylic acid	ID	NA
Acrylonitrile	8,000	7.5E+7
Alachlor	ID	NA
Aldicarb	ID	6.0E+6
Aldicarb sulfoxide	ID	NA
Aldicarb sulfone	ID	NA
Aldrin	34	180
Aluminum	ID	NA
Ammonia	ID	NA
Aniline	4.3E+5	3.6E+7
Anthracene	*4.0E+5	43
Antimony	1.5E+5	NA
Arsenic	9,500	NA
Atrazine	ID	7.0E+4
Azobenzene	ID	NA
Barium	3.0E+7	NA
Benzene	9,300	1.8E+6
Benzidine	11	5.2E+5
Benzo(a)anthracene	DC	9.4
Benzo(b)fluoranthene	DC	1.5
Benzo(k)fluoranthene	DC	0.8
Benzo(g,h,i)perylene	ID	NA
Benzo(a)pyrene	DC	1.6
Benzoic acid	*8.6E+7	3.5E+6
Benzyl alcohol	*8.3E+7	4.4E+7
Benzyl chloride	2,000	4.9E+5
Beryllium	3,300	NA
bis(2-chloroethoxy)ethane	ID	NA
bis(2-Chloroethyl)ether	1,900	1.7E+7
bis(2-Ethylhexyl)phthalate	47	340
Boron	2.6E+7	NA
Bromobenzene	ID	NA
Bromodichloromethane	11,000	6.7E+6
Bromoform	1.0E+5	3.1E+6
Bromomethane	64,000	1.5E+7
n-Butanol	1.2E+7	7.4E+7
2-Butanone (MEK)	6.2E+7	2.4E+8
n-Butyl acetate	ID	6.7E+6
t-Butyl alcohol	ID	NA

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Part 201 Interim Groundwater Contact Criteria

All values below are expressed in ug/L (ppb).

Chemical	Utility Worker	Water Solubility (ug/L)
Butyl benzyl phthalate	*1.0E+5	2,900
Cadmium	2.1E+5	NA
Camphene	ID	33,000
Caprolactam	ID	5.3E+9
Carbaryl	ID	1.3E+5
Carbofuran	ID	7.0E+5
Carbon disulfide	7.7E+5	1.2E+6
Carbon tetrachloride	1,400	7.9E+5
Chlordane	10	56
Chloride	ID	NA
Chlorobenzene	69,000	4.7E+5
Chloroethane	1.9E+5	5.7E+6
2-Chloroethyl vinyl ether	ID	1.5E+7
Chloroform	89,000	7.9E+6
Chloromethane	1.1E+5	6.3E+6
4-Chloro-3-methylphenol	51,000	3.9E+6
beta-Chloronaphthalene	ID	6,700
2-Chlorophenol	78,000	2.2E+7
o-Chlorotoluene	ID	NA
Chlorpyrifos	ID	1,100
Chromium (III)	6.4E+8	NA
Chromium (VI)	2.0E+6	NA
Chrysene	DC	1.6
Cobalt	5.3E+6	NA
Copper	1.6E+7	NA
Cyanazine	ID	NA
Cyanide	ID	NA
Cyclohexanone	ID	2.3E+7
Dacthal	ID	NA
Dalapon	ID	5.0E+8
4-4'-DDD	19	90
4-4'-DDE	16	120
4-4'-DDT	6.9	25
Decabromodiphenyl ether	ID	30
Di-n-butyl phthalate	*87,000	11,000
Di(2-ethylhexyl) adipate	ID	NA
Di-n-octyl phthalate	250	3,000
Diacetone alcohol	ID	NA
Diazinon	ID	69,000
Dibenzo(a,h)anthracene	ID*	0.67
Dibenzofuran	ID	NA
Dibromochloromethane	9,500	2.6E+6
Dibromomethane	1.7E+5	1.1E+7
1,2-Dichlorobenzene	*1.8E+5	1.6E+5
1,3-Dichlorobenzene	*1.3E+5	1.1E+5
1,4-Dichlorobenzene	2,900	74,000
3,3'-Dichlorobenzidine	270	3,100

(16)

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Part 201 Interim Groundwater Contact Criteria

All values below are expressed in ug/L (ppb).

Chemical	Utility Worker	Water Solubility (ug/L)
Dichlorodifluoromethane	*2.8E+6	3.0E+5
1,1-Dichloroethane	2.1E+6	5.1E+6
1,2-Dichloroethane	11,000	8.5E+6
1,1-Dichloroethylene	1,000	2.3E+6
cis-1,2-Dichloroethylene	1.7E+5	3.5E+6
trans-1,2-Dichloroethylene	1.9E+5	6.3E+6
2,6-Dichloro-4-nitroaniline	ID	NA
2,4-Dichlorophenol	51,000	4.5E+6
2,4-Dichlorophenoxyacetic acid	ID	NA
1,2-Dichloropropane	8,100	2.8E+6
1,3-Dichloropropene	5,100	2.8E+6
Dichlorovos	9,600	1.6E+7
Dicyclohexyl phthalate	ID	NA
Dieldrin	3.3	200
Diethoxymethane	ID	NA
Diethyl ether	4.3E+6	6.1E+7
Diethyl phthalate	*1.2E+7	1.1E+6
Diethylene glycol monobutyl ether	ID	NA
Diisopropylamine	ID	NA
Dimethyl phthalate	*6.0E+8	4.2E+6
N,N-Dimethylacetamide	ID	NA
N,N-Dimethylaniline	ID	NA
Dimethylformamide	ID	NA
2,4-Dimethylphenol	4.8E+5	7.9E+6
2,6-Dimethylphenol	ID	NA
3,4-Dimethylphenol	15,000	NA
Dimethylsulfoxide	ID	NA
2,4-Dinitrotoluene	1,300	2.7E+5
Dinoseb	6,100	52,000
1,4-Dioxane	1.4E+6	9.0E+8
Diquat	ID	7.0E+5
Diuron	*46,000	37,000
Endosulfan	*950	510
Endothall	ID	1.0E+8
Endrin	*270	250
Epichlorohydrin	1.5E+6	6.6E+7
Ethanol	1.0E+9	NA
Ethyl acetate	*8.1E+7	6.4E+7
1-Ethyl-2-methylbenzene	ID	NA
Ethylbenzene	*2.0E+5	1.7E+5
Ethylene dibromide	16	4.2E+6
Ethylene glycol	ID	NA
Ethylene glycol acetate	ID	NA
Ethylene glycol monobutyl ether	1.6E+5	NA
Fluoranthene	*30,000	210
Fluorene	*76,000	2,000
Fluorine (solulble fluoride)	2.6E+7	NA

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Part 201 Interim Groundwater Contact Criteria

All values below are expressed in ug/L (ppb).

Chemical	Utility Worker	Water Solubility (ug/L)
Formaldehyde	1.5E+7	5.5E+8
Formic acid	6.2E+8	1.0E+9
1-Formylpiperidine	ID	NA
Gentian violet	ID	NA
Glyphosate	ID	1.2E+7
Heptachlor	18	180
Heptachlor epoxide	3.1	200
n-Heptane	ID	NA
Hexabromobenzene	ID	NA
Hexachlorobenzene (C-66)	4.9	6,200
Hexachlorobutadiene (C-46)	210	2,500
alpha-Hexachlorocyclohexane	16	2,000
beta-Hexachlorocyclohexane	54	240
Hexachlorocyclopentadiene (C-56)	1,400	1,800
Hexachloroethane	4,000	50,000
n-Hexane	ID	NA
2-Hexanone	ID	1.6E+7
Indeno(1,2,3-cd)pyrene	DC	0.022
Iron	ID	NA
Isobutyl alcohol	2.3E+7	7.6E+7
Isophorone	1.1E+6	1.2E+7
Isopropyl alcohol	ID	NA
Lead	ID	NA
Lindane	87	6,800
Magnesium	1.0E+9	NA
Manganese	2.0E+6	NA
Mercury (Inorganic)	*1.3E+5	56
Methanol	*2.7E+8	2.9E+7
Methoxychlor	*2,700	45
2-Methoxyethanol	3.6E+6	NA
2-Methyl-4-chlorophenoxyacetic acid	ID	NA
2-Methyl-4,6-dinitrophenol	ID	NA
4-Methyl-2-pentanone (MIBK)	2.5E+6	2.0E+7
Methyl-tert-butyl ether (MTBE)	ID	NA
N-Methyl-morpholine	ID	NA
Methylcyclopentane	ID	NA
4,4'-Methylene-bis-2-chloroaniline	70	NA
Methylene chloride	1.6E+5	1.3E+7
2-Methylnaphthalene	ID	25,000
2-Methylphenol	3.8E+5	2.6E+7
3-Methylphenol	7.6E+5	2.3E+7
4-Methylphenol	38,000	2.3E+7
Metolachlor	ID	NA
Molybdenum	2.1E+6	NA
Naphthalene	*78,000	31,000
Nickel	3.2E+8	NA
Nitrate	6.8E+8	NA

(18)

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Part 201 Interim Groundwater Contact Criteria

All values below are expressed in ug/L (ppb).

Chemical	Utility Worker	Water Solubility (ug/L)
Nitrite	4.3E+7	NA
Nitrobenzene	9,600	2.1E+6
2-Nitrophenol	74,000	2.5E+6
n-Nitroso-di-n-propylamine	220	9.9E+6
N-Nitrosodiphenylamine	30,000	35,000
Oxamyl	ID	NA
Oxo-hexyl acetate	ID	NA
Pendimethalin	ID	NA
Pentachlorobenzene	230	650
Pentachloronitrobenzene	*5,900	32
Pentachlorophenol	24	2.0E+6
Pentane	ID	NA
2-Pentene	ID	NA
Phenanthrene	*1,600	1,000
Phenol	1.7E+7	8.3E+7
Picloram	ID	4.3E+5
Piperidine	ID	NA
Polybrominated biphenyls	ID	0
Polychlorinated biphenyls (PCBs)	0.71	45
Prometon	ID	NA
Propachlor	ID	NA
Propazine	ID	NA
Propionic acid	ID	NA
Propyl alcohol	2.0E+7	NA
Propylene glycol	ID	NA
Pyrene	*14,000	140
Pyridine	92,000	3.0E+5
Selenium	2.1E+6	NA
Silver	3.3E.+6	NA
Simazine	ID	NA
Sodium	1.0E+9	NA
Styrene	3,200	3.1E+5
Sulfate	ID	NA
Tebuthiuron	ID	NA
2,3,7,8-Tetrabromodibenzo-p-dioxin	ID	NA
1,2,4,5-Tetrachlorobenzene	*1.4E+5	1,300
2,3,7,8-Tetrachlorodibenzo-p-dioxin	8.3E-6	0.019
1,1,1,2-Tetrachloroethane	5,600	1.1E+6
1,1,2,2-Tetrachloroethane	2,100	3.0E+6
Tetrachloroethylene	1,600	2.0E+5
Tetrahydrofuran	ID	NA
Thallium	29,000	NA
Toluene	8.0E+5	5.3E+5
p-Toluidine	ID	NA
Toxaphene	41	740
Triallate	ID	NA
Tributylamine	ID	NA

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Part 201 Interim Groundwater Contact Criteria

All values below are expressed in ug/L (ppb).

Chemical	Utility Worker	Water Solubility (ug/L)
1,2,4-Trichlorobenzene	16,000	3.0E+5
1,1,1-Trichloroethane	2.2E+5	1.3E+6
1,1,2-Trichloroethane	9,400	4.4E+6
Trichloroethylene	18,000	1.1E+6
Trichlorofluoromethane	*2.7E+6	1.1E+6
2,4,5-Trichlorophenol	1.3E+5	1.2E+6
2,4,6-Trichlorophenol	5,600	8.0E+5
2(2,4,5-Trichlorophenoxy)propionic acid	36,000	1.4E+5
1,2,3-Trichloropropane	42,000	1.9E+6
1,1,2-Trichloro-1,2,2-trifluoroethane	*1.1E+8	1.7E+5
Triethanolamine	ID	NA
3-Trifluoromethyl-4-nitrophenol	ID	NA
Trifluralin	ID	NA
2,2,4-Trimethyl pentane	ID	NA
2,2,4-Trimethyl-2-pentene	ID	NA
1,2,4-Trimethylbenzene	ID	NA
1,3,5-Trimethylbenzene	ID	NA
tris(2,3-Dibromopropyl)phosphate	140	NA
Urea	ID	NA
Vanadium	3.7E+6	NA
Vinyl acetate	7.7E+6	2.0E+7
Vinyl chloride	370	2.8E+6
White phosphorus	6,400	NA
Xylenes	*3.5E+6	1.9E+5
Zinc	2.3E+8	NA

* Chemicals for which water solubilities are more restrictive; water solubility becomes the criteria.

DC = Chemical is a dermal carcinogen, therefore GCC are not appropriate. Contact an ERD toxicologist.

ID = Insufficient data

NA = Not Available

(20)

ENVIRONMENTAL RESPONSE DIVISION

OPERATIONAL MEMORANDUM #8, REVISION 4

ERRATA SHEET
JUNE 8, 1995

Page 1, Disclosure statement prior to paragraph 1
~~THIS OPERATIONAL MEMORANDUM WILL TAKE EFFECT ONLY WHEN HOUSE BILL 4596 IS SIGNED INTO LAW.~~ *HOUSE BILL 4596, AS AMENDED BY THE SENATE, WAS SIGNED INTO LAW AND BECAME EFFECTIVE ON JUNE 5, 1995.*

Page 1, Paragraph 1
Revision 4 of this Operational Memorandum reflects changes made as a result of two major legislative actions: (1) the incorporation of the Michigan Environmental Response Act (MERA), 1982 PA 307, as amended, ~~(2)~~ into the Natural Resources and Environmental Protection Code, 1994 PA 451; and *(2)* the 1995 amendments to Part 201 contained in House Bill 4596, ***as amended by the Senate (1995 PA 71).***

Page 6, Residential Direct Contact Soil Criterion Algorithm
Insert the RSC into the equation for the direct contact soil criterion algorithm for noncarcinogens.

NONCARCINOGENS:

$$\frac{HQ \times RfD \times AT \times CF \times RSC}{FC \times [(EF_i \times IF \times AE_i) + (EF_d \times DF \times AE_d)]}$$

Insert the following in the list of default values for the direct contact soil criterion algorithm for noncarcinogens.

RSC (relative source contribution) = *1*

Page 7, Paragraph 2
The approach for carcinogens is based on the assumption that a high dose of a carcinogen received over a short period of ~~tome~~ *time* is equivalent to a corresponding low dose spread over a lifetime.

Page 7, Paragraph 4
~~The relative source contribution factor (RSC) of 20% remains a parameter within the equations for groundwater criteria for noncarcinogens to maintain consistency with the EPA and State of Michigan in their development of drinking water standards. The 20% RSC represents a default value to be replaced with a chemical-specific value when data are available. The RSC has been eliminated from the equations for the direct contact soil criteria. (For additional discussion on the RSC, see Operational Memo #14.)~~

The relative source contribution factor (RSC) in the groundwater criteria equations for noncarcinogens is 20%. This is consistent with the EPA and the State of Michigan in the development of drinking water standards. The RSC for the direct contact soil criteria equations for noncarcinogens is 100%. These RSC values represent default values to be used unless compound and site-specific data are available to demonstrate that a different source contribution is appropriate. (For additional discussion on the RSC, see Operational Memo #14.)

Page 9, Paragraph 1

When chemical-specific data are not available, the absorption efficiency applicable to dermal contact (AE_d) shall be either 10% for a volatile organic chemical or 1% ~~for other organic chemicals, polychlorinated biphenyls, pesticides, or inorganic parameters.~~ ***for non-volatile organic chemicals or inorganic parameters.***

(2

MICHIGAN DEPARTMENT OF NATURAL RESOURCES

INTEROFFICE COMMUNICATION

June 5, 1995

TO: Environmental Response Division Staff

FROM: Alan J. Howard, Chief, Environmental Response Division

SUBJECT: Interim Environmental Response Division Operational Memorandum #8, Revision 4: Generic Residential Cleanup Criteria

THIS DRAFT, INTERIM OPERATIONAL MEMORANDUM HAS BEEN PREPARED TO FACILITATE IMPLEMENTATION OF THE 1995 AMENDMENTS TO PART 201 OF THE NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION ACT, 1994 PA 451 (FORMERLY THE MICHIGAN ENVIRONMENTAL RESPONSE ACT). THIS OPERATIONAL MEMORANDUM WILL TAKE EFFECT *ONLY* WHEN HOUSE BILL 4596 IS SIGNED INTO LAW. INTERNAL REVIEW OF THIS MEMORANDUM IS ON-GOING, AND NO OUTSIDE REVIEW HAS BEEN COMPLETED. THE CONTENT OF THE MEMORANDUM, AND THE ATTACHED CRITERIA, ARE SUBJECT TO CHANGE AND SHOULD BE RELIED UPON ONLY AFTER CONFIRMATION WITH APPROPRIATE ERD STAFF.

Revision 4 of this Operational Memorandum reflects changes made as a result of two major legislative actions: (1) the incorporation of the Michigan Environmental Response Act (MERA), 1982 PA 307, as amended, (2) into the Natural Resources and Environmental Protection Code, 1994 PA 451; and the 1995 amendments to Part 201 contained in [House Bill 4596]. Enactment of the Natural Resources and Environmental Protection Act resulted in new section numbers for all of the former MERA, but did not make any substantive changes in the law. [House Bill 4596] substantially amends Part 201. Those amendments, particularly the changes in cleanup standards, are reflected in this revision of Operational Memorandum #8. Unless otherwise noted, Section references in this memorandum are to Part 201 of Act 451.

The attached table lists generic residential cleanup criteria which have been developed pursuant to Sections 20120A(1)(A) and (3), according to the updated algorithms presented in this memo. This table replaces the previously issued list of Type B criteria dated February 4, 1994. The label of "Type B" has been eliminated and the criteria are now referred to as generic residential criteria. The algorithms as presented in the administrative rules of the Michigan Environmental Response Act, 1982 Public Act 307, as amended, have been replaced by updated algorithms which represent current U.S. Environmental Protection Agency (EPA) guidance and a format consistent with the industrial/commercial equations and those used by the Underground Storage Tank Division (USTD).

The criteria were developed using currently available toxicological data, exposure data, and other data and are subject to change as new data become

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available. These criteria are presented in two significant figures; reference doses and slope factors used to generate the criteria were also reported in two significant figures. Cleanup criteria from the attached table should be compared to analytical data presented in two significant figures, as well.

This list presents noncarcinogens and carcinogens together; carcinogens are presented in bold and italics. Chemicals beginning with numbers (such as 1,1,2-trichloroethane) are incorporated alphabetically within the list. Criteria on these lists should be considered draft; final cleanup criteria will be confirmed by Environmental Response Division (ERD) toxicologists and approved as part of a specific remedial action plan (RAP). Staff are reminded that generic residential RAPs must address all elements required by Part 201 and the administrative rules, including those for which specific criteria have not been developed. Additional guidance follows.

Note that in cases where generic residential criteria are less than target method detection limits (MDLs) or background, target MDLs or background levels become the cleanup goal. Generic residential criteria are not relevant in these cases.

The table presents values for the subrules that are most often expected to be the controlling factor in determining soil cleanup criteria. However, a generic residential RAP must include rationale that supports the conclusions drawn from the assessment of pertinent pathways (i.e., some discussion of each pertinent pathway must be included which assesses whether more restrictive criteria are required; See R 299.5711(1) and R 299.5711(6).

HEALTH-BASED AND AESTHETIC DRINKING WATER VALUES

The values in the first column of the table were developed using the residential groundwater algorithms presented later in this memo for carcinogens and noncarcinogens. The values in the second column of the table were established, where sufficient data are available, to protect against adverse aesthetic impacts of hazardous substances on groundwater.

The most restrictive of the values in the first two columns of the table is the cleanup criterion required to satisfy Section 20120A(4) of Part 201. However, where a State Drinking Water Standard has been established, that standard will override the health-based drinking water criteria, as indicated in Sec. 20120A(5) of Part 201. A more restrictive aesthetic criterion will take precedence over the State Drinking Water Standard. Note that Rule 299.5709, referenced in Section 20120A(5), requires that aquifer cleanup criteria take into account adverse aesthetic impacts resulting from one or a combination of hazardous substances. If adverse aesthetic impacts remain when health-based criteria have been achieved, further remedial measures may be required. Consult your Supervisor if you encounter such a case.

IMPACTS OF GROUNDWATER CONTAMINANTS ON SURFACE WATER

The third column in the table lists values based on calculations done by Surface Water Quality Division (SWQD) in accordance with Rule 323.1057 of Part 4 of Part 31 of the Natural Resources and Environmental Protection Act, 1994 PA 451 (formerly known as the Water Resources Commission Act, 1929, PA 245, as amended) or on the National Toxics Rule (NTR; Federal Register, December 22, 1992. Vol. 57(246):60848-60923). For use in ERD programs, the criterion which protects surface water has been termed the groundwater surface water interface (GSI) value. The final GSI value is the more restrictive of the Rule 57 value and the NTR value, where both are available (with the exception of arsenic whose GSI value is the Rule 57 value even though it is greater than the NTR value). Where only one of the two values is available, that number becomes the GSI value.

The GSI values are the criteria used to judge compliance with Rule 299.5713. GSI values are developed for surface water which is not used as a drinking water source and also for surface water which serves as a source of drinking water. GSI values presented in the list are for surface waters not protected as a drinking water source. If the surface water at a site serves as a drinking water source, contact an ERD toxicologist to obtain the correct GSI value. In cases where data are inadequate to calculate a GSI value, the party proposing the remedial action may generate the minimum data necessary to propose a value for Department review and approval.

Prior to passage of the 1995 amendments, a mixing zone was not allowed when assessing the impact of groundwater venting to a surface water. A mixing zone is now allowed for venting groundwater at those sites where an additional load to the receiving stream of site-specific contaminants is allowable and where a mixing zone is appropriate for the receiving stream. If a RAP allows for venting groundwater, the discharge must comply with requirements of Part 31 of Act 451 and the relevant rules promulgated under that Part.

Demonstration of compliance with surface water requirements may be made by assessing groundwater concentrations at the groundwater-surface water interface or through evaluation of mixing zone, whichever is appropriate for a particular site. Predictive modeling and direct monitoring are options to establish compliance with the GSI value at the groundwater-surface water interface. If the groundwater-surface water interface is the compliance point for a particular site, it is not necessary that the GSI value be achieved throughout the aquifer. However, a remedial action plan which proposes to meet the GSI value throughout the aquifer in lieu of monitoring at the interface or modeling will be acceptable.

Note that the sixth column on the table will show 20 times the GSI values. This value is shown for ease of reference in cases where soil is to be remediated to that level as a source control measure. Rule 299.5711 does not require that soil meet the "20 times GSI values", as long as the GSI value is not exceeded at the appropriate compliance point.

SOIL CRITERIA PROTECTIVE OF GROUNDWATER

The "20X" values in the table are provided for convenience and are not mandatory if leachate tests or other methods which better represent in situ conditions support the use of a higher value (refer to Operational Memo #12 for guidance on appropriate leachate methods). For certain chemicals which strongly adsorb to soil and are known not to leach at significant concentrations (i.e., PCBs, carcinogenic polynuclear aromatic hydrocarbons and some chlorinated pesticides), the direct contact value is accepted as the soil cleanup criterion to protect groundwater in addition to the protection against long-term, systemic direct contact hazards. However, there are certain situations (i.e., presence of solvents or collection of unfiltered groundwater samples) which could result in the presence of these types of materials in groundwater. These other conditions should be evaluated before a chemical is considered nonmobile in soil. Consult an ERD toxicologist if you think direct contact values for other contaminants would be protective of groundwater or if you have questions about conditions that could cause the transport of a nonmobile contaminant through soil.

SOIL DIRECT CONTACT CRITERIA

Direct contact criteria only consider long-term, systemic exposure from ingestion of and dermal contact with contaminated soil. Consequently, there

(3)

are other potential concerns that may need to be addressed (see discussion of issues not addressed by the direct contact criteria presented below).

Compliance with direct contact criteria are required throughout the affected media in the unlimited residential land use category, but exposure controls and land use restrictions may be employed to prevent exposures to more highly contaminated soils at depth under the limited residential land use category.

Average on-site soil concentrations, represented as a 95% upper confidence level (UCL) on the arithmetic mean, may be used to determine compliance with the soil direct contact value. On-site 95% UCLs should, however, reasonably represent the areas over which exposures are expected to occur. Typically, the exposure area for a residential property is approximately one-quarter acre in size. Refer to EPA guidance on how to appropriately calculate the 95% UCL (EPA, 1992a).

Issues Not Addressed by the Direct Contact Criteria

Inhalation: All RAPs must document that they are protective of the public health, safety and welfare and the environment. As a result, they must contain some discussion of potential inhalation risks, and whether inhalation (i.e. exposure through volatile or particulate contaminant emissions) is a pertinent pathway for human exposure at the site in question. The direct contact criteria do not address and are not applicable for the inhalation pathway because they do not incorporate potential inhalation effects, long-term or acute, of hazardous substances in soil.

Chemical characteristics which are pertinent to this discussion include vapor pressure and/or Henry's Law constant, the potential to cause cancer via the inhalation route, the potential to cause irritation of respiratory tissue and special characteristics which may make a contaminant an inhalation hazard (e.g., friable asbestos). The RAP should indicate whether any materials with these characteristics are present. If such materials are present, it may be necessary to conduct a risk assessment of the inhalation pathway to determine if lower cleanup criteria are required for protection of human health. Consult an ERD toxicologist for guidance. If no significant inhalation risk exists, criteria and/or exposure control measures which are protective for other routes of exposure will be deemed protective for the inhalation pathway and a narrative assessment for the inhalation pathway will be sufficient.

Dermal Toxicity: The direct contact soil equation does not address acute skin toxicity or skin sensitization. These concerns may have to be addressed before chemicals with skin toxicity or sensitization characteristics can be left in place at the direct contact value. Contact an ERD toxicologist for guidance.

Ecological Concerns: RAPs must also address ecological concerns. The RAP should include a description of the physical setting of the site, including any natural resources which could be affected by the release(s) addressed in the plan. In general, potential ecological impacts are defined as adverse impacts on a community or a population of organisms rather than on an individual who is the focus of a human health risk assessment. An ecological risk assessment will be required only if there is a "sensitive environmental resource" present at or near the site, or if there are other special circumstances such as concern for persistent or bioaccumulative hazardous substances, which may adversely effect the food chain, or a physical feature that would attract wildlife to the site (e.g., migratory waterfowl habitat).

Professional judgment must be used to determine whether it is likely that criteria more restrictive than those required to protect public health, or those required pursuant to other applicable regulations (e.g., groundwater/surface water interface criteria), are necessary to protect natural resources at or near the site. If ERD staff believe that there is a need for an ecological assessment, this should be reviewed with your supervisor and other technical experts as appropriate. Ecological risk assessments will be the exception rather than the rule.

TARGET METHOD DETECTION LIMITS

The table also includes the target method detection limits (MDLs) for each hazardous substance, where one has been determined. These target MDLs are taken from Operational Memorandum #6, revision 4 and are provided to allow for convenient comparison between generic residential criteria and target MDLs. Consult Operational Memorandum #6 for a full description of the use of target MDLs and proper methods for analysis.

The use of particular methods and detection limits listed in Operational Memorandum #6 are not mandatory. Other methods or detection limits may be approved as part of a site-specific RAP.

These target MDLs are applicable to environmental investigations and monitoring performed pursuant to Part 201 response activities. These detection limits may not be applicable to environmental monitoring activities performed pursuant to other Parts of Act 451 or environmental statutes. Facilities subject to regulation under other environmental statutes should consult with the appropriate DNR Division for further information regarding appropriate analytical detection limits.

GENERIC RESIDENTIAL ALGORITHMS

RESIDENTIAL GROUNDWATER ALGORITHMS:

CARCINOGENS:

$$C_{dw} = \frac{10^{-5} \times BW \times AT \times CF}{SF \times EF \times ED \times IR_{dw}}$$

where,

C_{dw} (risk-based drinking water concentration)	= in ug/l (ppb)
10^{-5} cancer risk	= acceptable risk
BW (body weight)	= 70 kg
AT (averaging time in days)	= 25,550 days (70 x 365)
CF (conversion factor)	= 1000 ug/mg
SF (cancer slope factor, mg/kg-d^{-1})	= chemical-specific
EF (exposure frequency)	= 350 d/yr
ED (exposure duration)	= 30 yr
IR_{dw} (drinking water ingestion rate)	= 2 liter/day

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NONCARCINOGENS:

$$C_{dw} = \frac{HQ \times RfD \times BW \times AT \times RSC \times CF}{EF \times ED \times IR_{dw}}$$

where,

C_{dw} (risk-based drinking water concentration)	= in ug/l (ppb)
HQ (hazard quotient)	= 1
RfD (oral reference dose, mg/kg/d)	= chemical-specific
BW (body weight)	= 70 kg
AT (averaging time)	= 10,950 days (30 x 365)
RSC (relative source contribution)	= 0.2
CF (conversion factor)	= 1000 ug/mg
EF (exposure frequency)	= 350 d/yr
ED (exposure duration)	= 30 yr
IR_{dw} (drinking water ingestion rate)	= 2 liter/day

RESIDENTIAL DIRECT CONTACT SOIL CRITERION ALGORITHMS:

CARCINOGENS:

$$C_s = \frac{10^{-5} \times AT \times CF}{SF \times FC \times [(EF_i \times IF \times AE_i) + (EF_d \times DF \times AE_d)]}$$

where,

C_s (risk-based soil concentration)	= ug/kg (ppb)
10^{-5} cancer risk	= acceptable risk
AT (averaging time)	= 25,550 days (70 x 365)
CF (conversion factor)	= 1E+9 ug/kg
SF (cancer slope factor, mg/kg-d^{-1})	= chemical-specific
FC (fraction of soil contaminated)	= 1
EF_i (ingestion exposure frequency)	= 350 d/yr
EF_d (dermal exposure frequency)	= 245 d/yr
IF (age-adjusted soil ingestion factor)	= 114 mg-yr/kg-d*
AE_i (ingestion absorption efficiency)	= (see text)
DF (age-adjusted soil dermal factor)	= 2442 mg-yr/kg-d**
AE_d (dermal absorption efficiency)	= (see text)

NONCARCINOGENS:

$$\frac{HQ \times RfD \times AT \times CF}{FC \times [(EF_i \times IF \times AE_i) + (EF_d \times DF \times AE_d)]}$$

where,

C_s (risk-based soil concentration)	= ug/kg (ppb)
HQ (hazard quotient)	= 1
RfD (oral reference dose, mg/kg/d)	= chemical-specific
AT (averaging time)	= 10,950 days (30 x 365)
CF (conversion factor)	= 1E+9 ug/kg
FC (fraction soil contaminated)	= 1
EF_i (ingestion exposure frequency)	= 350 d/yr
EF_d (dermal exposure frequency)	= 245 d/yr
IF (age-adjusted soil ingestion factor)	= 114 mg-yr/kg-d*
AE_i (ingestion absorption efficiency)	= (see text)
DF (age-adjusted soil dermal factor)	= 2442 mg-yr/kg-d**
AE_d (dermal absorption efficiency)	= (see text)

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$$^{*}IF_{soil/age\text{-}adj.} = \frac{IR_{soil/age\ 1\text{-}6} \times ED_{age\ 1\text{-}6}}{BW_{age\ 1\text{-}6}} + \frac{IR_{soil/age\ 7\text{-}31} \times ED_{age\ 7\text{-}31}}{BW_{age\ 7\text{-}31}}$$

where,

$IR_{soil/age\ 1\text{-}6}$	(soil ingestion rate)	= 200 mg/day
$ED_{age\ 1\text{-}6}$	(exposure duration)	= 6 years
$BW_{age\ 1\text{-}6}$	(body weight)	= 15 kg
$IR_{soil/age\ 7\text{-}31}$	(soil ingestion rate)	= 100 mg/d
$ED_{age\ 7\text{-}31}$	(exposure duration)	= 24 yr
$BW_{age\ 7\text{-}31}$	(body weight)	= 70 kg

$$^{**}DF_{soil/age\text{-}adj.} = \frac{SA_{age\ 1\text{-}6} \times AF \times ED_{age\ 1\text{-}6}}{BW_{age\ 1\text{-}6}} + \frac{SA_{age\ 7\text{-}31} \times AF \times ED_{age\ 7\text{-}31}}{BW_{age\ 7\text{-}31}}$$

where,

$SA_{age\ 1\text{-}6}$	(skin surface area)	= 1820 cm^2/day
AF	(soil adherence factor)	= 1.0 mg/cm^2
$ED_{age\ 1\text{-}6}$	(exposure duration)	= 6 years
$BW_{age\ 1\text{-}6}$	(body weight)	= 15 kg
$SA_{age\ 7\text{-}31}$	(skin surface area)	= 5000 cm^2/day
AF	(soil adherence factor)	= 1.0 mg/cm^2
$ED_{age\ 7\text{-}31}$	(exposure duration)	= 24 yr
$BW_{age\ 7\text{-}31}$	(body weight)	= 70 kg

The residential equations yield values which represent concentrations of contaminants in water in units of micrograms per liter (ug/l) and in soil in units of micrograms per kilogram (ug/kg), or parts per billion (ppb). To convert to units of parts per million or milligrams per liter (mg/l) in water and milligrams per kilogram (mg/kg) in soil, divide by 1,000.

All exposure assumptions represent current EPA guidance. The selection of an appropriate averaging time (AT) is dependent upon the type of toxic effect being evaluated. AT represents the number of days over which the exposure is averaged. When evaluating long-term exposure to noncarcinogenic compounds, exposures are calculated by averaging over the period of exposure (i.e., subchronic or chronic exposures). For carcinogenic compounds, exposures are calculated by prorating the total cumulative dose over a lifetime (also called lifetime average daily dose). The approach for carcinogens is based on the assumption that a high dose of a carcinogen received over a short period of tome is equivalent to a corresponding low dose spread over a lifetime. The averaging time for carcinogens is 25,550 days (70 years x 365 days) and 10,950 days (30 years x 365 days) for noncarcinogens.

The acceptable level of risk for carcinogens has been changed from one in one million (10^{-6}) to one in one hundred thousand (10^{-5}). All criteria for carcinogens have been changed appropriately. The acceptable hazard quotient (HQ) for noncarcinogens has always been 1, although this parameter was not explicitly presented in the previous MERA equations. The HQ is the ratio of a single substance's exposure level over a specified time period to a reference dose for that substance derived from a similar exposure period. An HQ of 1 indicates that an exposure level greater than the reference dose is unacceptable.

The relative source contribution factor (RSC) of 20% remains a parameter within the equations for groundwater criteria for noncarcinogens to maintain consistency with the EPA and State of Michigan in their development of

drinking water standards. The 20% RSC represents a default value to be replaced with a chemical-specific value when data are available. The RSC has been eliminated from the equations for the direct contact soil criteria. (For additional discussion on the RSC, see Operational Memo #14.)

The exposure duration of 30 years represents a national upper-bound time (90th percentile) at one residence (EPA, 1989). The exposure frequency (EF) of 350 represents the number of days per year that a resident is exposed to drinking water at their home; it assumes that people spend approximately 15 days per year away from their homes for vacations or other reasons. Two separate EF values are used for exposure to soil, each specific to the ingestion and dermal routes of exposure.

For ingestion of soil, EPA guidance ("Standard Default Exposure Factors" OSWER Directive: 9285.6-03, March 25, 1991) recommends a daily intake rate of 200 mg/day for children aged 1-6 years and 100 mg/day for all others. These intake values are believed to represent upper-bound estimates of average soil ingestion rates.

The EPA-recommended soil ingestion rates account for ingestion of both outdoor soils and indoor dust. The values are derived primarily from fecal tracer studies which estimate the amount of soil ingested throughout a day's activities. As such, the intake rates are not event-specific (i.e. the rates do not represent the amount of soil ingested during outdoor activities). Data suggest that up to 80% of indoor dust consists of outdoor soils which have been brought into a residence by air deposition and foot traffic. Therefore, it may not be assumed that ingestion of contaminated soil is entirely precluded by climatic conditions such as snow cover.

There is no currently available method for determining the relative contribution of soil vs. dust to the daily total, or the effect of climatic conditions on the rate of soil ingestion. Therefore, a constant year round exposure is assumed and the appropriate EF value for ingestion of soil/dust for the residential soil direct contact criterion is 350 days per year.

The EPA recommends that local weather conditions such as snow cover be considered in determining the appropriate EF for dermal contact with soil. It is assumed that Michigan winters last for 4 months (120 days) making soil unavailable for contact. Therefore, the EF for dermal contact with soil for the residential soil direct contact criterion is 245 days per year (365-120).

Ingestion and dermal contact rates within the direct contact soil criterion equation are adjusted to account for both children and adults. It is assumed that during the 30 year exposure period, 6 years is spent as a child who ingests more soil/day and the remaining 24 years is spent as a child/adult ingesting less soil/day. The age-adjusted approach was previously used in the development of the Type B soil direct contact criteria (although the data and calculations were different) and is recommended by EPA (EPA, 1991).

The skin surface area for child and adult receptors in the age-adjusted dermal factor is equal to 25 percent of the 50th percentile of total skin surface area for the respective age group (EPA, 1992b). Dermal exposure to soil is expected to occur on the hands, arms, legs, neck and head, accounting for approximately 25% of the total skin surface area.

The absorption efficiencies are the same as those used previously. When chemical-specific data are not available, the absorption efficiency applicable

to ingestion (AE_i) shall be either 100% for volatile organic chemicals or 50% for other organic chemicals, polychlorinated biphenyls, pesticides, or inorganic parameters. When chemical-specific data are not available, the absorption efficiency applicable to dermal contact (AE_d) shall be either 10% for a volatile organic chemical or 1% for other organic chemicals, polychlorinated biphenyls, pesticides, or inorganic parameters.

This memo is intended to provide guidance to Division staff to foster consistent application of Part 201 of the Natural Resources and Environmental Protection Act, 1994 PA 451 and associated Administrative Rules. This document is not intended to convey any rights to any parties nor create any duties or responsibilities under law. This document and matters addressed herein are subject to revision.

Questions about values in the attached table should be directed to one of the ERD toxicologists: Christine Flaga, telephone 517-373-0160, Jeffrey Crum, telephone 517-335-3092, or Linda Larsen, telephone 517-335-3161. Other questions about this memorandum should be directed to District Supervisors.

Attachment
rev. 4

REFERENCES

EPA, 1992a. Supplemental Guidance to RAGS: Calculating the Concentration Term. OSWER Publication 9285.7-081. May, 1992.

EPA, 1992b. Dermal Exposure Assessment: Principles and Applications. Interim Report. EPA/600/8-91/011B. January, 1992.

PART 201 OF THE NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION ACT, 1994
PA 451
GENERIC RESIDENTIAL CLEANUP CRITERIA FOR GROUNDWATER AND SOIL
(Revision 4)

Residential criteria were calculated using currently available toxicological data. These criteria may change as new toxicity data become available. They are not necessarily final cleanup standards. Please read the attached introduction for details. Carcinogenic chemicals are shown in bold italics. All values are expressed in units of parts per billion (ppb); ug/l in water and ug/kg in soil. Scientific notation is represented by E+ or E- a value, for example 2×10^6 is reported as 2E+6. Please refer to Operational Memorandum #6 for additional information concerning analytical methods and method detection limits.

	GROUNDWATER (ppb:ug/l)				SOIL (ppb:ug/kg)			
Chemical	Health-Based Drinking Water Value	Aesthetic Drinking Water Value	GSI Value	Target Method Detection Limit in Water	20X Drinking Water Value	20X GSI Value	Direct Contact Value	Target Method Detection Limit in Soil
Acenaphthene	1,300	NA	3.8	5	26,000	76	7.6E+7	330
Acenaphthylene	26	NA	{B}	5	520	{B}	1.5E+6	330
Acetaldehyde	950	NA	{B}	500	19,000	{B}	1.4E+7	2,500
Acetic acid	4,200	NA	{B}	16,000	84,000	{B}	6.3E+7	9.0E+5
Acetone	730	NA	25,000	100	15,000	5.0E+5	1.1E+7	100
Acetonitrile	140	NA	810	50	2,800	16,000	2.1E+6	100
Acrolein	120	NA	2.5	5	2,400	50	1.8E+6	10
Acrylamide	0.19	NA	9.1	0.5	3.8	180	2,200	5
Acrylic acid	3,900	NA	{B}	NA	78,000	{B}	5.8E+7	NA
Acrylonitrile	1.6	NA	2.2	1	32	44	4,700	10
Alachlor	2 {C}	NA	48	1	40	960	1.2E+5	20
Aldicarb	3 {C}	NA	{B}	2	60	{B}	4.2E+5	50
Aldicarb sulfoxide	4 {C}	NA	{B}	2	80	{B}	5.5E+5	50
Aldicarb sulfone	2 {C}	NA	{B}	2	40	{B}	4.6E+5	50
Aldrin	0.05	NA	0.0014	0.01	{E}	{E}	580	20
Aluminum	ID	50 {A,F}	{B}	100	1,000	{B}	ID	700
Ammonia	ID {P}	NA	20 {D}	50	ID {P}	400	ID {P}	1,000
Aniline	150	NA	4	20	3,000	80	1.7E+6	1,700
Anthracene	7,300	NA	1.1E+5	5	1.5E+5	2.2E+6	4.2E+8	330
Antimony	6 {A,C}	NA	50 {A}	5	120 {A}	1,000	1.5E+5	500
Arsenic	50 {A,C}	NA	11 {A}	5	1,000 {A}	220 {A}	5,500 {A}	100
Atrazine	3 {C}	NA	7.8	1	60	160	45,000	50
Azobenzene	7.7	NA	{B}	NA	150	{B}	90,000	NA
Barium	2,000 {A,C}	NA	630 {A,D}	200	40,000 {A}	13,000 {A}	3.0E+7	1,000
Benzene	5 {C}	NA	53	5	100	1,100	88,000	10
Benzidine	0.0037	NA	0.0054	50	0.074	0.11	43	1,000
Benzo(a)anthracene {Q}	1.2	NA	0.31	5	{E}	{E}	14,000	330
Benzo(b)fluoranthene {Q}	1.2	NA	0.31	5	{E}	{E}	14,000	330
Benzo(k)fluoranthene {Q}	12	NA	0.31	5	{E}	{E}	1.4E+5	330
Benzo(g,h,i)perylene	26	NA	{B}	5	{E}	{E}	1.5E+6	330

(33)

	GROUNDWATER (ppb:ug/l)				SOIL (ppb:ug/kg)			
Chemical	Health-Based Drinking Water Value	Aesthetic Drinking Water Value	GSI Value	Target Method Detection Limit in Water	20X Drinking Water Value	20X GSI Value	Direct Contact Value	Target Method Detection Limit in Soil
Benzo(a)pyrene (Q)	0.2 {C}	NA	0.31	5	{E}	{E}	1,400	330
Benzoic acid	32,000	NA	{B}	50	6.4E+5	{B}	1E+9 {G}	3,300
Benzyl alcohol	10,000	NA	22	50	2.0E+5	440	1.6E+8	1,300
Benzyl chloride	5	NA	{B}	0.5	100	{B}	15,000	200
Beryllium	4 {C}	NA	{B}	1	80	{B}	2,300	200
Bis(2-chloroethoxy)ethane	ID	NA	{B}	5	ID	{B}	ID	330
bis(2-Chloroethyl)ether	0.77	NA	4.2	5	15	84	2,300	330
bis(2-Ethylhexyl)phthalate	6 {C}	NA	59	5	{E}	{E}	7.0E+5	330
Boron	440 {A}	NA	{B}	300	8,800 {A}	{B}	2.5E+7	8,000
Bromobenzene	ID	NA	{B}	1	ID	{B}	ID	10
Bromodichloromethane	100 {C,S}	NA	24	1	2,000 {S}	480	41,000	10
Bromoform	100 {C,S}	NA	65	1	2,000 {S}	1,300	3.2E+5	10
Bromomethane	10	NA	11	1	200	220	1.5E+5	10
n-Butanol	950	NA	{B}	800	19,000	{B}	1.4E+7	4,400
2-Butanone (MEK)	13,000	NA	7,200	50	2.6E+5	1.4E+5	2.0E+8	100
n-Butyl acetate	550	NA	40	10	11,000	800	8.3E+6	20
t-Butyl alcohol	3,900	NA	8,300	1,000	78,000	1.7E+5	5.9E+7	4,400
Butyl benzyl phthalate	1,200	NA	{B}	5	24,000	{B}	6.8E+7	330
Cadmium	5 {A,C}	NA	0.64 {A,D}	0.5	100 {A}	13 {A}	2.1E+5	50
Camphene	ID	NA	{B}	NA	ID	{B}	ID	NA
Caprolactam	5,800	NA	{B}	NA	1.2E+5	{B}	3.4E+8	NA
Carbaryl	700	NA	{B}	20	14,000	{B}	4.1E+7	1,000
Carbofuran	40 {C}	NA	1.6	20	800	32	5.5E+5	200
Carbon disulfide {R}	800	NA	{B}	50	16,000	{B}	1.2E+7	100
Carbon tetrachloride	5 {C}	NA	21	1	100	420	20,000	10
Chlordane	2 {C}	NA	0.00053	0.02	{E}	{E}	7,600	10
Chloride	ID	2.5E+5	{B}	10,000	5.0E+5	{B}	ID	2.0E+5
Chlorobenzene	100 {C}	NA	71	1	2,000	1,400	2.1E+6	10
Chloroethane	220	NA	{B}	1	4,400	{B}	6.7E+5	10
2-Chloroethyl vinyl ether	ID	NA	{B}	10	ID	{B}	ID	100
Chloroform	100 {C,S}	NA	80	1	2,000 {S}	1,600	4.2E+5	10
Chloromethane	66	NA	{B}	1	1,300	{B}	2.0E+5	10
4-Chloro-3-methylphenol	150	NA	4.4	5	3,000	88	2.2E+6	330
beta-Chloronaphthalene	1,800	NA	{B}	5	36,000	{B}	2.7E+7	330
2-Chlorophenol	45	NA	10	5	900	200	6.8E+5	330
o-Chlorotoluene	150	NA	{B}	1	3,000	{B}	2.2E+6	10
Chlorpyrifos	22	NA	0.002	0.2	440	0.04	1.3E+6	10
Chromium (III) {I}	100 {A,C,J}	NA	77 {A,D}	50	2,000 {A}	1,500 {A}	6.3E+8	2,500
Chromium (VI) {I}	100 {A,C,J}	NA	7.3 {A}	5	2,000 {A}	150 {A}	2.0E+6	200

Chemical	GROUNDWATER (ppb:ug/l)				SOIL (ppb:ug/kg)			
	Health-Based Drinking Water Value	Aesthetic Drinking Water Value	GSI Value	Target Method Detection Limit in Water	20X Drinking Water Value	20X GSI Value	Direct Contact Value	Target Method Detectic Limit in Soil
Chrysene {Q}	120	NA	0.31	5	{E}	{E}	1.4E+6	330
Cobalt	37	NA	{B}	10	740	{B}	2.1E+6	500
Copper	1,400 {A}	1,000	18 {A,D}	25	20,000	360 {A}	1.6E+7	1,000
Cyanazine	1.5	NA	4.7	10	30	94	17,000	500
Cyanide {R}	200 {C}	NA	5.2	20	4,000	100	9.3E+6	500
Cyclohexanone	33,000	NA	{B}	50	6.6E+5	{B}	5.0E+8	100
Dacthal	73	NA	{B}	1	1,500	{B}	4.2E+6	20
Dalapon	200 {C}	NA	{B}	10	4,000	{B}	9.3E+6	100
4-4'-DDD	3.5	NA	0.0084	0.02	{E}	{E}	41,000	20
4-4'-DDE	2.5	NA	0.0059	0.02	{E}	{E}	29,000	20
4-4'-DDT	2.5	NA	0.00023	0.02	{E}	{E}	29,000	20
Decabromodiphenyl ether	73	NA	{B}	10	1,500	{B}	4.2E+6	100
Di-n-butyl phthalate	880	NA	12,000	5	18,000	2.4E+5	5.1E+7	330
Di(2-ethylhexyl) adipate	400 {C}	NA	{B}	5	8,000	{B}	2.1E+6	330
Di-n-octyl phthalate	130	NA	{B}	5	2,600	{B}	7.6E+6	330
Diacetone alcohol	ID	NA	{B}	NA	ID	{B}	ID	NA
Diazinon	1.3	NA	0.002	0.5	26	0.04	76,000	10
Dibenzo(a,h)anthracene {Q}	0.12	NA	0.31	5	{E}	{E}	1,400	330
Dibenzofuran	ID	NA	{B}	5	ID	{B}	ID	330
Dibromochloromethane	100 {C,S}	NA	29	1	2,000	580	31,000	10
Dibromomethane	80	NA	{B}	5	1,600	{B}	4.6E+6	10
1,2-Dichlorobenzene	600 {C}	NA	7	1	12,000	140	9.4E+6	10
1,3-Dichlorobenzene	600 {C}	NA	180	1	12,000	3,600	9.4E+6	10
1,4-Dichlorobenzene	75 {C}	NA	15	1	1,500	300	1.1E+5	10
3,3'-Dichlorobenzidine	1.9	NA	0.063	20	38	1.3	5,700	2,000
Dichlorodifluoromethane	1,700	NA	{B}	1	34,000	{B}	2.5E+7	10
1,1-Dichloroethane	880	NA	{B}	1	18,000	{B}	1.3E+7	10
1,2-Dichloroethane	5 {C}	NA	560	1	100	11,000	28,000	10
1,1-Dichloroethylene	7 {C}	NA	32	1	140	640	1.1E+5	10
cis-1,2-Dichloroethylene	70 {C}	NA	{B}	1	1,400	{B}	1.2E+6	10
trans-1,2-Dichloroethylene	100 {C}	NA	300	1	2,000	6,000	1.9E+6	10
2,6-Dichloro-4-nitroaniline	2,200	NA	{B}	0.01	44,000	{B}	1.3E+8	0.1
2,4-Dichlorophenol	73	NA	34 {D}	5	1,500	680	4.2E+6	330
2,4-Dichlorophenoxyacetic acid	70 {C}	NA	47	10	1,400	940	4.2E+6	200
1,2-Dichloropropane	5 {C}	NA	64	1	100	1,300	38,000	10
1,3-Dichloropropene {J}	4.7	NA	3	1	96	60	14,000	10
Dichlorovos	2.9	NA	{B}	0.1	58	{B}	34,000	50
Dicyclohexyl phthalate	ID	NA	{B}	5	ID	{B}	ID	330
Dieldrin	0.053	NA	3.2E-5	0.02	{E}	{E}	620	20

Chemical	GROUNDWATER (ppb:ug/l)				SOIL (ppb:ug/kg)			
	Health-Based Drinking Water Value	Aesthetic Drinking Water Value	GSI Value	Target Method Detection Limit in Water	20X Drinking Water Value	20X GSI Value	Direct Contact Value	Target Method Detection Limit in Soil
Diethoxymethane	ID	NA	{B}	10	ID	{B}	ID	100
Diethyl ether	3,700	NA	{B}	50	74,000	{B}	5.5E+7	100
Diethyl phthalate	5,500	NA	1.2E+5	5	1.1E+5	2.4E+6	3.2E+8	330
Diethylene glycol monobutyl ether	88	NA	{B}	NA	1,800	{B}	5.1E+6	NA
Diisopropylamine	5.6	NA	{B}	NA	110	{B}	85,000	NA
Dimethyl phthalate	73,000	NA	2.9E+6	5	1.5E+6	5.8E+7	1E+9 {G}	330
N,N-Dimethylacetamide	180	NA	{B}	NA	3,600	{B}	2.7E+6	NA
N,N-Dimethylaniline	16	NA	{B}	NA	320	{B}	2.4E+5	NA
Dimethylformamide	700	NA	3,800	NA	14,000	76,000	1.1E+7	NA
2,4-Dimethylphenol	370	NA	31	5	7,400	620	2.1E+7	330
2,6-Dimethylphenol	4.4	NA	{B}	5	88	{B}	2.5E+5	330
3,4-Dimethylphenol	10	NA	{B}	5	200	{B}	5.9E+5	330
Dimethylsulfoxide	2.2E+5	NA	{B}	NA	4.4E+6	{B}	1.0E+9 {G}	NA
2,4-Dinitrotoluene	1.3	NA	91	5	26	1,800	15,000	330
Dinoseb	7 {C}	NA	0.5 {D}	1	140	10	4.2E+5	20
1,4-Dioxane	77	NA	2,000	1	1,500	40,000	2.3E+5	10
Diquat	20 {C}	NA	{B}	1	400	{B}	9.3E+5	NA
Endosulfan {J}	1.7	NA	{B}	0.01	{E}	{E}	97,000	3.3
Endothall	100 {C}	NA	{B}	20	2,000	{B}	7.2E+6	NA
Endrin	2 {C}	NA	0.0023	0.02	{E}	{E}	72,000	20
Epichlorohydrin	86	NA	{B}	5	1,700	{B}	2.6E+5	10
Ethanol	2.0E+6	NA	41,000	1,000	4.0E+7	8.2E+5	1.0E+9 {G}	4,400
Ethyl acetate	6,600	NA	1,000	NA	1.3E+5	20,000	9.9E+7	NA
1-Ethyl-2-methylbenzene	ID	NA	{B}	NA	ID	{B}	ID	NA
Ethylbenzene	700 {C}	74	31	1	1,500	620	1.1E+7	10
Ethylene dibromide	0.05 {C}	NA	1.1	1	1	22	30	10
Ethylene glycol	15,000	NA	68,000	5,000	3.0E+5	1.4E+6	8.4E+8	5,000
Ethylene glycol acetate	ID	NA	{B}	NA	ID	{B}	ID	NA
Ethylene glycol monobutyl ether	95	NA	{B}	NA	1,900	{B}	1.4E+6	NA
Fluoranthene	880	NA	370	5	18,000	7,400	5.1E+7	330
Fluorene	880	NA	14,000	5	18,000	2.8E+5	5.1E+7	330
Fluorine	400 {C}	2,000	1,900	NA	8,000	38,000	2.5E+7	NA
Formaldehyde	1,300	NA	170	100	26,000	3,400	2.0E+7	500
Formic acid	10,000	NA	{B}	18,000	2.0E+5	{B}	1.5E+8	9.0E+5
1-Formylpiperidine	80	NA	{B}	NA	1,600	{B}	1.2E+6	NA
Gentian violet	8.5	NA	{B}	NA	170	{B}	99,000	NA
Glyphosate	700 {C}	NA	{B}	100	14,000	{B}	4.2E+7	NA
Heptachlor	0.4 {C}	NA	0.0016	0.01	{E}	{E}	2,200	20
Heptachlor epoxide	0.2 {C}	NA	0.0011	0.01	{E}	{E}	1,100	20

(14)

(36)

Chemical	GROUNDWATER (ppb:ug/l)				SOIL (ppb:ug/kg)			
	Health-Based Drinking Water Value	Aesthetic Drinking Water Value	GSI Value	Target Method Detection Limit in Water	20X Drinking Water Value	20X GSI Value	Direct Contact Value	Target Method Detect Limit in Soil
n-Heptane	32,000	NA	4	NA	6.4E+5	80	4.8E+8	NA
Hexabromobenzene	20	NA	{B}	{K}	400	{B}	1.2E+6	{K}
Hexachlorobenzene (C-66)	1 {C}	NA	0.0019	{K}	20	0.038	6,200	{K}
Hexachlorobutadiene (C-46)	11	NA	500	{K}	220	10,000	1.3E+5	{K}
alpha-Hexachlorocyclohexane	0.14	NA	0.13	0.01	2.8	2.6	1,600	20
beta-Hexachlorocyclohexane	0.47	NA	0.46	0.01	9.6	9.2	5,500	20
Hexachlorocyclopentadiene (C-56)	50 {C}	NA	0.54	{K}	1,000	11	3.0E+6	{K}
Hexachloroethane	61	NA	13	2	1,200	260	1.8E+5	50
n-Hexane	3,000	NA	{B}	NA	60,000	{B}	4.5E+7	NA
2-Hexanone	1,000	NA	{B}	50	20,000	{B}	1.5E+7	100
Indeno(1,2,3-cd)pyrene (Q)	1.2	NA	0.31	5	{E}	{E}	14,000	330
Iron	ID	300 {A}	{B}	100	6,000 {A}	{B}	ID	2,000
Isobutyl alcohol	2,300	NA	{B}	1,000	48,000	{B}	3.5E+7	4,400
Isophorone	900	NA	860	5	18,000	17,000	2.7E+6	330
Isopropyl alcohol	470	NA	21,000	400	9,400	4.2E+5	7.0E+6	4,400
Lead	4 {A,L}	NA	6.6 {A,D}	3	80 {A}	130 {A}	4.0E+5	1,000
Lindane	0.2 {C}	NA	0.08	0.01	4	1.6	7,600	20
Magnesium	4.2E+5	NA	{B}	30	8.4E+6	1.0E+9	1.0E+9 {G}	3,000
Manganese	180 {A}	50 {A}	{B}	20	1,000 {A}	{B}	2.0E+6	2,000
Mercury (Inorganic)	2 {A,C}	NA	0.0013 {A}	0.2	40 {A}	0.026 {A}	1.3E+5	100
Methanol	3,700	NA	41,000	1,000	74,000	8.2E+5	5.5E+7	4,400
Methoxychlor	40 {C}	NA	{B}	0.5	80	{B}	2.1E+6	50
2-Methoxyethanol	29	NA	{B}	NA	580	{B}	4.4E+5	NA
2-Methyl-4-chlorophenoxyacetic acid	7.3	NA	{B}	0.5	150	{B}	4.2E+5	100
2-Methyl-4,6-dinitrophenol	2.6	NA	0.59	20	52	12	1.5E+5	1,700
4-Methyl-2-pentanone (MIBK)	370	NA	{B}	50	7,400	{B}	5.5E+6	100
Methyl-tert-butyl ether (MTBE)	240	NA	380	50	4,800	7,600	3.6E+6	100
N-Methyl-morpholine	20	NA	{B}	NA	400	{B}	3.0E+5	NA
Methylcyclopentane	ID	NA	{B}	50	ID	{B}	ID	500
4,4'-Methylene-bis-2-chloroaniline (M)	0.88	NA	{B}	1	{E}	{E}	10,000	50
Methylene chloride	5 {C}	NA	59	5	100	1,200	3.4E+5	10
2-Methylnaphthalene	ID	NA	{B}	5	ID	{B}	ID	330
2-Methylphenol	370	NA	38	5	7,400	760	5.5E+6	330
3-Methylphenol	370	NA	{B}	5	7,400	{B}	2.1E+7	330
4-Methylphenol	37	NA	6.2	5	740	120	2.1E+6	330
Metolachlor	160	NA	150	10	3,200	3,000	1.9E+6	50
Molybdenum	37 {A}	NA	800 {A}	10	740	16,000 {A}	2.1E+6	100
Naphthalene	260	NA	29	5	5,200	580	1.5E+7	330
Nickel	100 {A,C}	NA	57 {A,D}	50	2,000 {A}	1,100 {A}	3.2E+7	1,000

Chemical	GROUNDWATER (ppb:ug/l)				SOIL (ppb:ug/kg)			
	Health-Based Drinking Water Value	Aesthetic Drinking Water Value	GSI Value	Target Method Detection Limit in Water	20X Drinking Water Value	20X GSI Value	Direct Contact Value	Target Method Detection Limit in Soil
Nitrate {P}	10,000 {C,P}	NA	{B}	100	2.0E+5 {P}	{B}	ID	NA
Nitrite {P}	1,000 {C,P}	NA	{B}	100	20,000 {P}	{B}	ID	NA
Nitrobenzene	3.4	NA	1,900	5	68	38,000	51,000	330
2-Nitrophenol	20	NA	{B}	5	400	{B}	1.2E+6	330
n-Nitroso-di-n-propylamine	0.12	NA	{B}	5	2.4	{B}	370	330
N-Nitrosodiphenylamine	170	NA	160	5	3,400	3,200	5.2E+5	330
Oxamyl	200 {C}	NA	{B}	NA	4,000	{B}	1.6E+7	NA
Oxo-hexyl acetate	73	NA	{B}	NA	1,500	{B}	1.1E+6	NA
Pendimethalin	880	NA	0.62	0.1	18,000	12	5.1E+7	20
Pentachlorobenzene	6.1	NA	{B}	2	120	{B}	3.5E+5	50
Pentachloronitrobenzene	55	NA	{B}	2	1,100	{B}	3.2E+6	50
Pentachlorophenol	1 {C}	NA	0.8 {D}	20	20	16	82,000	3,400
Pentane	ID	NA	{B}	100	ID	{B}	ID	1,000
2-Pentene	ID	NA	{B}	NA	ID	{B}	ID	NA
Phenanthrene	26	NA	{B}	5	520	{B}	1.5E+6	330
Phenol	4,400	NA	1,100	5	88,000	22,000	6.6E+7	330
Picloram	500 {C}	NA	{B}	10	10,000	{B}	3.0E+7	100
Piperidine	3.2	NA	{B}	NA	64	{B}	48,000	NA
Polybrominated biphenyls {J}	0.096	NA	{B}	NA	{E}	{E}	1,100	NA
Polychlorinated biphenyls (PCBs) {J,T}	0.5 {C}	NA	2.0E-5	0.2	{E}	{E}	2,300	330
Prometon	160	NA	{B}	0.5	3,200	{B}	9.3E+6	20
Propachlor	95	NA	{B}	1	1,900	{B}	5.5E+6	20
Propazine	200	NA	{B}	0.5	4,000	{B}	1.1E+7	20
Propionic acid	12,000	NA	{B}	100	2.4E+5	{B}	1.9E+8	6,700
Propyl alcohol	1,400	NA	15,000	NA	28,000	3.0E+5	2.1E+7	NA
Propylene glycol	1.5E+5	NA	1.9E+5	5,000	3.0E+6	3.8E+6	1.0E+9 {G}	5,000
Pyrene	550	NA	11,000	5	11,000	2.2E+5	3.2E+7	330
Pyridine	7.3	NA	20	20	150	400	1.1E+5	330
Selenium	50 {A,C}	NA	5 {A}	5	1,000 {A}	100 {A}	2.1E+6	500
Silver	34 {A}	100	0.1 {A}	0.5	680 {A}	2 {A}	2.0E+6	500
Simazine	4 {C}	NA	3.4	10	80	68	2.2E+6	40
Sodium	1.6E+5	NA	{B}	NA	3.2E+6	{B}	1.0E+9 {G}	NA
Styrene	100 {C}	NA	19	1	2,000	380	85,000	10
Sulfate	ID	2.5E+5	{B}	NA	5.0E+6	{B}	ID	NA
Tebuthiuron	510	NA	{B}	NA	10,000	{B}	3.0E+7	NA
2,3,7,8-Tetrabromodibenzo-p-dioxin {O}	{O}	NA	{O}	0.0001	{E}	{E}	{O}	0.01
1,2,4,5-Tetrachlorobenzene	2,500	NA	0.4	0.1	50,000	8	1.4E+8	20
2,3,7,8-Tetrachlorodibenzo-p-dioxin {O}	3E-5 {C}	NA	1.4E-8	1.0E-5	{E}	{E}	0.09	0.001
1,1,1,2-Tetrachloroethane	33	NA	{B}	1	660	{B}	99,000	10

Chemical	GROUNDWATER (ppb:ug/l)				SOIL (ppb:ug/kg)			
	Health-Based Drinking Water Value	Aesthetic Drinking Water Value	GSI Value	Target Method Detection Limit in Water	20X Drinking Water Value	20X GSI Value	Direct Contact Value	Target Method Detectic Limit in Soil
1,1,2,2-Tetrachloroethane	4.3	NA	32	1	86	640	13,000	10
Tetrachloroethylene	5 {C}	NA	22	1	100	440	50,000	10
Tetrahydrofuran	240	NA	3,300	1,000	4,800	66,000	3.6E+6	10,000
Thallium	2 {A,C}	NA	5.4 {A}	2	40 {A}	110 {A}	28,000	500
Toluene	1,000 {C}	790	110	1	16,000	2,200	2.4E+7	10
p-Toluidine	4.5	NA	{B}	NA	90	{B}	52,000	NA
Toxaphene	3 {C}	NA	0.0002	1	60	0.004	2,300	170
Triallate	95	NA	{B}	1	1,900	{B}	5.5E+6	20
Tributylamine	10	NA	{B}	NA	200	{B}	1.5E+5	NA
1,2,4-Trichlorobenzene	70 {C}	NA	22	5	1,400	440	6.3E+6	330
1,1,1-Trichloroethane	200 {C}	NA	120	1	4,000	2,400	3.1E+6	10
1,1,2-Trichloroethane	5 {C}	NA	65	1	100	1,300	45,000	10
Trichloroethylene	5 {C}	NA	94	1	100	1,900	1.6E+5	10
Trichlorofluoromethane	2,600	NA	580	1	52,000	12,000	3.8E+7	10
2,4,5-Trichlorophenol	730	NA	25	50	15,000	500	4.2E+7	1,700
2,4,6-Trichlorophenol	77	NA	27 {D}	5	1,500	540	9.0E+5	330
2(2,4,5-Trichlorophenoxy)propionic acid {N}	50 {C}	NA	21	1	1,000	420	3.2E+6	50
1,2,3-Trichloropropane	42	NA	{B}	1	840	{B}	2.4E+6	10
1,1,2-Trichloro-1,2,2-trifluoroethane	2.0E+5	NA	33	NA	4.0E+6	660	1.0E+9 {G}	NA
Triethanolamine	3,700	NA	{B}	NA	74,000	{B}	5.5E+7	NA
3-Trifluoromethyl-4-nitrophenol	4,500	NA	32 {D}	NA	90,000	640	2.6E+8	NA
Trifluralin	110	NA	{B}	1	2,200	{B}	1.3E+6	50
2,2,4-Trimethyl pentane	ID	NA	{B}	50	ID	{B}	ID	500
2,2,4-Trimethyl-2-pentene	ID	NA	{B}	NA	ID	{B}	ID	NA
1,2,4-Trimethylbenzene	30	NA	22	1	600	440	4.5E+5	10
1,3,5-Trimethylbenzene	23	NA	26	1	460	520	3.4E+5	10
tris(2,3-Dibromopropyl)phosphate	0.47	NA	{B}	NA	9.4	{B}	5,500	NA
Urea	ID {P}	NA	{B}	400	ID {P}	{B}	ID {P}	20,000
Vanadium	64 {A}	NA	8 {A}	20	1,300 {A}	160 {A}	3.7E+6	1,000
Vinyl acetate	640	NA	{B}	50	13,000	{B}	9.7E+6	100
Vinyl chloride	2 {C}	NA	3.1	1	40	62	1,200	10
White phosphorus {R}	0.11	NA	{B}	NA	2.2	{B}	6,300	NA
Xylenes	10,000 {C}	280	59	3	5,600	1,200	2.0E+8	30
Zinc	2,400 {A}	5,000 {A}	81 {A,D}	20	48,000 {A}	1,600 {A}	1.4E+8	1,000

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(17)

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es

Background, as defined in Rule 701(c), may be substituted if higher than the cleanup criteria.

Chemical has either not been evaluated or an inadequate data base precludes the development of a GSI value. Contact an ERD toxicologist for assistance.

{C} State of Michigan Drinking Water Standard established pursuant to Section 5 of the Safe Drinking Water Act, Act No. 399 of the Public Acts of 1976 used as the default.

{D} GSI value is pH, temperature, or water hardness dependent. Contact an ERD toxicologist for details.

{E} Chemical, due to its physicochemical properties, is not expected to leach through soils to groundwater under most conditions.

(F) Professional judgment used to determine that 50 ppb of aluminum in drinking water is protective of human health.

{G} Criteria exceeds 100% in soil, hence it is reduced to 100%.

{H} Criteria is based on agricultural impacts (phytotoxicity), not 20X groundwater criterion.

{I} Valence-specific chromium data (Cr III and Cr VI) must be compared to the same valence-specific cleanup criteria. If analytical data are provided for "total" chromium only, then values for chromium VI must be applied as the cleanup criteria. Chromium III cleanup criteria can only be used at sites where groundwater is prevented from being used as a public water supply, currently or in the future.

{J} Chemical may be present in several isomer forms. Isomer specific concentrations must be combined for comparison to criteria. Contact an ERD toxicologist for further explanation.

{K} Two different analytical methods and target method detection limits are available for this chemical. Refer to Operational Memorandum #6 for details.

{L} Criteria developed using the U.S. EPA Integrated Uptake Biokinetic Model for children. No risk assessment method(s) is currently available to evaluate lead toxicity in adults. Higher level may be acceptable if soil concentration is less than 400 ppm and groundwater migrating off-site will not impact adjacent properties. Contact an ERD toxicologist for further explanation.

{M} Also known as MBOCA.

{N} Also known as Silvex.

{O} Use 2,3,7,8-TCDD "toxicity equivalence factors" (TEFs) for other chlorinated and /or brominated dibenzo-p-dioxins and chlorinated and/or brominated dibenzofurans for comparison to cleanup criteria. Contact an ERD toxicologist for details.

{P} All potential sources of nitrogen-nitrate must be combined and compared to nitrate criteria. Contact an ERD toxicologist for details.

{Q} Criteria for carcinogenic polynuclear aromatic hydrocarbons (PAHs) were developed using "relative potential potencies" (RPPs) to benzo(a)pyrene.

{R} Chemical may be reactive in soil.

{S} Concentrations of trihalomethanes in groundwater must be combined to determine compliance with the health-based drinking water value of 100 ppb.

{T} Toxic Substances Control Act, Subpart G - PCB Spill Cleanup Policy standards may be more restrictive.

ID = Inadequate data to develop criterion; NA = Not available.

(18)

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REVISIONS FOR OPERATIONAL MEMORANDA #8 (Revision #4) AND #14 (Revision #2)
January 25, 1996

For an explanation of the footnotes, please refer to the Operational Memos.

CHEMICAL	CHANGE	DATE	REASON FOR CHANGE
Aluminum	(A) footnote added to 20X Drinking Water Value and Direct Contact Values (DCVs). DCVs pending	10/3/95	Omission
Arsenic	Residential DCV changed to 6,600 ppb Ind DCV changed to 1.0E+5 ppb Comm III DCV changed to 1.4 E+5 Comm IV DCV changed to 3.3 E+5	6/23/95	Based on U.S. Environmental Protection Agency (EPA) Integrated Risk Information System (IRIS) addition of oral slope factor.
Arsenic	Groundwater surface water interface (GSI) value changed to 50 ppb	11/14/95	Revision of Rule 57 value per Surface Water Quality Division (SWQD).
bis(2-Chloroethyl)ether	GSI value changed to 5.9 ppb	11/14/95	Revision of Rule 57 value per SWQD.
Boron	GSI value changed to 1,400 ppb	11/14/95	Revision of Rule 57 value per SWQD.
Chlorobenzene	GSI value changed to 26 ppb	11/14/95	Revision of Rule 57 value per SWQD.
Copper	Health-based drinking water (HBDW) value changed to 1,300 ppb	9/20/95	Change reflects action level for copper under MI Safe Drinking Water Act (SDWA)
4,4'-DDD	GSI value changed to 9.0E-5 ppb	11/14/95	Revision of Rule 57 value per SWQD.
Dibromochloromethane	(S) footnote added to the 20X Drinking Water Value	9/12/95	Change reflects requirement under the MI SDWA.
2,4-Dimethylphenol	GSI value changed to 30 ppb	11/14/95	Revision of Rule 57 value per SWQD.
Diuron	Residential criteria are as follows: HBDW value is 31 ppb, GSI value is not available, 20X DW value is 620 ppb, DCV is 1.8E+6 ppb. The Ind/Comm HBDW value is 90 ppb, the Ind, Comm III, and Comm IV DCVs are 1.9E+7, 2.7E+7 and 6.4E+7 ppb, respectively. The Method Detection Levels (MDLs) are 0.02 and 2 ppb for water and soil, respectively, using method 632	10/2/95	Addition–new chemical.
Fluorine	Name should be "Fluorine (soluble fluoride)"	9/12/95	Clarification
Fluorine (soluble fluoride)	HBDW value should be 4,000 with a (C) footnote and the 20X value should be 80,000 ppb.	9/12/95.	Correction of typo.
Fluorine (soluble fluoride)	MDLs changed to 100 ppb in water and 5,000 ppb in soil	9/13/95	Per Operational Memorandum #6, Revision #4.
Hexabromobenzene	MDLs changed to 10 ppb in water and 330 ppb in soil	9/13/95	Per Operational Memorandum #6, Revision #4.
Hexachlorobenzene (C-66)	MDLs changed to 0.1 ppb in water and 20 ppb in soil with (K) footnote on both	9/13/95	Per Operational Memorandum #6, Revision #4.
Hexachlorobutadiene (C-46)	MDLs changed to 5 ppb in water and 330 ppb in soil	9/13/95	Per Operational Memorandum #6, Revision #4.
Hexachlorocyclopentadiene (C-56)	MDLs changed to 2 ppb in water and 200 ppb in soil with (K) footnote on each	9/13/95	Per Operational Memorandum #6, Revision #4.
Magnesium	20X GSI should have (B) footnote	9/12/95	Correction of typo.

CHEMICAL	CHANGE	DATE	REASON FOR CHANGE
Methoxychlor	20X Residential Drinking Water Value should be 800 ppb	9/12/95	Correction of typo.
2-Methylnaphthalene	Criteria added to list. (Use naphthalene criteria.)	9/8/95	EPA Office of Research and Development (ORD) justification for proposed provisional reference dose (RfD) for 2-methylnaphthalene using "Naphthalene" oral RfD as a surrogate (EPA/ORD 7/11/95).
2-Methylnaphthalene	GSI value changed to 34 ppb	11/14/95	Per SWQD Rule 57 (value for Naphthalene).
Naphthalene	GSI value changed to 34 ppb	11/14/95	Revision of Rule 57 value per SWQD.
Nitrate	MDL in soil changed to 1,000 ppb	9/13/95	Per Operational Memorandum #6, Revision #4.
Nitrite	MDL in soil changed to 1,000 ppb	9/13/95	Per Operational Memorandum #6, Revision #4.
Pentachlorobenzene	GSI value changed to 0.44 ppb	11/14/95	Revision of Rule 57 value per SWQD.
Pentachlorophenol	MDLs changed to 1 ppb in water and 1,700 ppb in soil	9/13/95	Reevaluation of MDLs.
Pentachlorophenol	DCVs changed to 8,100 ppb for residential, 63,000 for Ind., 89,000 for Comm III, and 1.7E+5 for Comm IV	9/20/95	Changes based on chemical-specific absorption efficiencies of 100% for the oral and 37% for the dermal route of exposure
Polychlorinated Biphenyls	Compliance with the Toxic Substance Control Act (TSCA) may be required; decision pending. Contact Toxicology Unit.	6/28/95	
Simazine	MDL in water changed to 1 ppb	9/13/95	Per Operational Memorandum #6, Revision #4.
Sodium	MDLs changed to 1,000 ppb in water and 10,000 in soil	9/13/95	Per Operational Memorandum #6, Revision #4.
Sulfate	MDL in water changed to 1,000 ppb in water	9/13/95	Per Operational Memorandum #6, Revision #4.
p-Toluidine	MDLs changed to 10 ppb in water and 660 ppb in soil	9/13/95	Per Operational Memorandum #6, Revision #4.
3-Trifluoromethyl-4-nitrophenol	MDLs changed to 0.2 ppb in water and 20 ppb in soil	9/13/95	Per Operational Memorandum #6, Revision #4.
White phosphorus	MDLs changed to 0.005 ppb in water and 100 ppb in soil	9/13/95	Per Operational Memorandum #6, Revision #4.

(F2)

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY

INTEROFFICE COMMUNICATION

April 29, 1997

RECEIVED

MAY 14 1997

TO: Environmental Response Division Staff

FROM: Alan J. Howard, Chief
Environmental Response Division

SUBJECT: Part 201 Generic Soil Inhalation Criteria for Ambient Air: Addendum to Interim Operational Memoranda #8, Revision 4 (June 5, 1995) and #14, Revision 2 (June 6, 1995)

Attached is the technical support document (TSD) for the generic Part 201 Soil Inhalation Criteria for Ambient Air (SIC) which includes a list of the criteria. The generic SIC have been developed to assess the potential for human health effects from long-term exposure to airborne soil contaminants in ambient air. The TSD describes the development and application of the criteria which are applicable in determining the adequacy of a remedial action plan and whether a property is a facility. This version replaces all previously distributed versions of the SIC.

Any questions related to the cleanup criteria can be directed to the toxicologists Christine Flaga, 517-373-0160; Jeffrey Crum, 517-335-3092; or Linda Larsen, 517-335-3161.

Attachments

cc: Mr. Arthur Nash, USTD
Mr. James Sygo, WMD
Mr. Harold Fitch, GSD

A Howard

(1)

Generic Soil Inhalation Criteria For Ambient Air: Technical Support Document

Environmental Response Division
Michigan Department of Environmental Quality

(3)

The Michigan Department of Environmental Quality (MDEQ) will not discriminate against any individual or group on the basis of race, sex, religion, age, national origin, color, marital status, disability, or political beliefs. Questions or concerns should be directed to the Office of Personnel Services, PO Box 30473, Lansing, MI 48909.

For information or assistance on this publication, contact MDEQ, Environmental Response Division, PO Box 30426, Lansing, MI 48909-7926; 517-241-7651.

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DEQ Michigan Department of Environmental Quality

PART 201
GENERIC SOIL INHALATION CRITERIA FOR AMBIENT AIR: TECHNICAL SUPPORT DOCUMENT

Environmental Response Division
Michigan Department of Environmental Quality
April 23, 1997

This memorandum provides draft interim generic soil inhalation criteria (SIC) for ambient air that may be used to address inhalation exposures to soil contaminants under residential, industrial and commercial land use scenarios. These criteria have been developed pursuant to sections 20120a(1)(a) through (d) and 20120(a)(3) of Part 201 of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended. Section 20120a(3) requires the department to develop cleanup criteria based on human health risk assessment assumptions utilizing reasonable and relevant exposure pathways. Current soil direct contact values presented in Interim Operational Memorandum #8, Revision #4 (June 5, 1995) and #14, Revision #2 (June 6, 1995) are only protective of chronic, systemic health effects which may result from incidental ingestion of soil or direct dermal contact with soil. For some chemicals, the inhalation route of exposure may present a greater risk of harm. Therefore, the generic SIC have been developed to assess the potential for human health effects from exposure to airborne soil contaminants in ambient air.

Part 201 administrative rule 299.5711(4) provides that contaminant concentrations in soil "shall not result in an air emission that causes an increased cancer risk of 1 in 1,000,000 or a concentration that causes, alone or through reaction with other air contaminants, injurious effects to human health, safety, or welfare; animal life; plant life of significant value; or to property." (The target cancer risk for Part 201 facilities was changed by the 1995 amendments to 1 in 100,000.) In addition, rule 299.5715(2) states, "Hazardous substance concentrations shall not produce any emission which results in a violation of the provisions of Act No. 348 of the Public Acts of 1965, as amended," (now known as Part 55 of Act 451). Emissions from Part 201 facilities are not subject to the permit requirements of the Air Toxics Rules, however, Part 55 administrative rule 336.1901(a) and (b) contains general provisions similar to those in Part 201 rule 299.5711(4). Compliance with ambient air screening levels developed under the authority of the Air Toxics Rules has been determined to be one way of demonstrating compliance with rule 901. Therefore, the methods used to develop Air Quality Division (AQD) screening values and the regulations governing application of those values have been considered and employed in the development of SIC for ambient air where appropriate. Some modifications in AQD methods and applications were made in consideration of the use of these screening values for SIC development.

The criteria presented in the attached tables are not protective of indoor air contamination which may result from vapor intrusion from soil into buildings. A generic approach under Part 201 to address the potential for indoor air risks which may result from soil contaminants is not available but is under development. At sites where vapor intrusion may occur, including all sites in the unlimited residential category, a site-specific evaluation must be performed to determine if this pathway poses a human health concern. Site-specific evaluations of the indoor air pathway should be submitted to the ERD Toxicology Unit for review.

The generic SIC are intended to be protective of chronic human health effects which may result from exposure to ambient airborne contaminants. The allowable levels in soil developed under this scenario do not completely account for and may not be protective of other endpoints such as acute human health effects, ocular irritation, dermal irritation or sensitization, physical hazards such as reactivity, corrosivity, or ignitability, and/or ecological impacts. The potential for these effects to occur must be considered to determine if more restrictive criteria are needed to ensure protection for these endpoints.

TECHNICAL DEVELOPMENT OF SIC

GENERIC ALGORITHMS

The generic residential SIC algorithms presented below are consistent with the revised Environmental Protection Agency (EPA) Soil Screening Guidance: Technical Background Document (EPA, 1996). These algorithms yield values which represent concentrations of contaminants in soil in units of micrograms per kilogram (ug/kg or ppb). All exposure assumptions represent current EPA guidance. A discussion of the default exposure assumptions for residential land use may be found in Operational Memorandum #8 (Revision 4). Discussion of parameters which are specific to the inhalation pathway is presented below.

Please note that the reference concentration (RfC) is presented in units of milligrams per cubic meter of air (mg/m^3) and the inhalation unit risk (IURF) for carcinogens is presented in micrograms per cubic meter of air $(ug/m^3)^{-1}$. The RfC and the IURF differ from oral toxicity values in that they represent a concentration in the media of concern (i.e., air) rather than a dose to the receptor in units of mg/kg-day. These values are presumed to be protective of most human receptors, therefore, it is not necessary to include either body weight or inhalation rate (intake) in the generic equation. Air Quality Division (AQD) screening values developed under the authority of Part 55 of Act 451 were used in lieu of EPA developed RfC's where those values are not available. Please consult the Part 55 Air Toxics Rules for information regarding development of screening values.

Generic Residential SIC Algorithms Protective of Ambient Air Exposures

Carcinogens:

$$\text{Volatile Soil Inhalation Criteria} = \frac{10^{-5} \times AT}{IURF \times EF \times ED \times (1/VF)}$$

where,

10^{-5} cancer risk	= target risk
AT (averaging time)	= 25,550 days (70 x 365)
IURF (inhalation unit risk factor)	= chemical-specific $(ug/m^3)^{-1}$
EF (exposure frequency)	= 350 days/year
ED (exposure duration)	= 30 years
VF (volatilization factor)	= chemical-specific in m^3/kg

$$\text{Particulate Soil Inhalation Criteria} = \frac{10^{-5} \times AT}{IURF \times EF \times ED \times (1/PEF)}$$

where,

10^{-5} cancer risk	= target risk
AT (averaging time)	= 25,550 days (70 x 365)
IURF (inhalation unit risk factor)	= chemical-specific $(ug/m^3)^{-1}$
EF (exposure frequency)	= 350 days/year
ED (exposure duration)	= 30 years
PEF (particulate emission factor)	= chemical-specific in m^3/kg

Noncarcinogens:

$$\text{Volatile Soil Inhalation Criteria} = \frac{THQ \times AT \times CF}{EF \times ED \times (1/RfC \times 1/VF)}$$

where,

THQ (target hazard quotient)	= 1
AT (averaging time)	= 10,950 days (30 x 365)
CF (conversion factor)	= 1000 ug/mg
EF (exposure frequency)	= 350 days/year
ED (exposure duration)	= 30 years
RfC (reference concentration)	= chemical-specific in mg/m^3
VF (volatilization factor)	= chemical-specific in m^3/kg

$$\text{Particulate Soil Inhalation Criteria} = \frac{THQ \times AT \times CF}{EF \times ED \times (1/RfC \times 1/PEF)}$$

where,

THQ (target hazard quotient)	= 1
AT (averaging time)	= 10,950 days (30 x 365)
CF (conversion factor)	= 1000 ug/mg
EF (exposure frequency)	= 350 days/year
ED (exposure duration)	= 30 years
RfC (reference concentration)	= chemical-specific in mg/m^3
PEF (particulate emission factor)	= chemical-specific in m^3/kg

The volatilization factor (VF) and the particulate emission factor (PEF) in the equations above are used to define the relationship of the acceptable level of contaminant in air to a corresponding concentration of contaminant in soil. This relationship is dependent upon the emission of contaminant from soil and the subsequent dispersion of the airborne contaminant. Emission of volatile contaminants from soil will be discussed under the Soil to Air Volatilization Factor section below. Emission of particulates from soil will be discussed under the Particulate Emission Factor section, also below. Since the dispersion of airborne contaminants affects both the VF and the PEF, this parameter will be discussed separately under the heading of Q/C: Air Dispersion Factor.

SOIL TO AIR VOLATILIZATION FACTOR

The soil to air volatilization factor (VF) relates the concentration of a contaminant in the soil to the concentration of volatilized contaminant in the ambient air. VF is calculated from the equation below using chemical-specific properties and default values for soil properties that are representative of generic conditions for Michigan.

$$VF = (Q / C) \times (1 / J_s^{ave})$$

J_s^{ave}, using the Jury infinite source model is calculated as:

$$J_s^{ave} = \rho_b \, (4 \, D_A / \pi \, t)^{1/2} \times 10^4 \, cm^2/m^2$$

and D_A is calculated as:

$$D_A = \frac{[(\Theta_a^{10/3} D_i H' + \Theta_w^{10/3} D_w) / n^2]}{\rho_b K_d + \Theta_w + \Theta_a H'}$$

where,

VF	Volatilization Factor	= chemical-specific in m^3/kg
J_s^{ave}	Normalized Average Flux from Soil	= chemical-specific in g/m^2-s
D_A	Apparent Diffusivity	= chemical-specific in cm^2/s
Q/C	Dispersion Factor	= source size-specific in g/m^2-s per kg/m^3
t	Exposure Time	= scenario specific in s (ED x 3.1536E+7 sec/yr)
Θ_a	Air-filled Soil Porosity	= 0.28 L_{air}/L_{soil}
n	Total Soil Porosity	= 0.43 L_{pore}/L_{soil}
Θ_w	Water-filled Soil Porosity	= 0.15 L_{water}/L_{soil}
ρ_b	Dry Soil Bulk Density	= 1.5 g/cm^3
ρ_s	Soil Particle Density	= 2.65 g/cm^3
D_i	Diffusivity in Air	= chemical-specific in cm^2/s
D_w	Diffusivity in Water	= chemical-specific in cm^2/s
H'	Henry's Law Constant x 41	= chemical-specific (unitless)
K_{oc}	Soil Organic Partition Coefficient	= chemical-specific in cm^3/g
f_{oc}	Organic Carbon Content of Soil	= 0.006 g/g (0.6%)
K_d	Soil-water Partition Coefficient	= chemical-specific (cm^3/g)
	Organic Compounds	= K_{oc} (cm^3/g) x f_{oc} (g/g)
	Inorganic Compounds	= calculated value (EPA, 1996)

The VF equation above is based on the assumption of an infinite source of contamination. In effect, this assumes that the concentration of contaminant in the soil remains constant throughout the entire exposure duration. The contaminant flux from soil predicted by this model is, therefore, unchanging and air concentrations would remain constant throughout the exposure duration. Under these assumptions, exposure to airborne contaminants on the last day of the exposure duration is the same as on the first.

The VF may also be calculated based on a known mass of contaminant using a finite source model. Both the infinite and finite source models assume that the contamination exists from ground surface to a subsurface depth. However, the vertical extent of the contaminant source (i.e., the source thickness or depth) must be adequately characterized throughout the facility to use the finite source model.

Finite Source VF

The finite source model for calculation of the VF incorporates two concepts which are not included in the infinite source model. First, that the vertical extent of the contamination is of a discreet thickness. Second, that as volatile contaminants are emitted from soil to air, an ever larger zone of depletion is created at the soil surface. This zone (as its name implies) is depleted of contaminants over a period of time and serves to retard volatilization of contaminants present at lower depths.

The simplified finite source model equation for VF is

$$VF = (Q/C) \times (C_0/\rho_b) \times (1/J_s^{ave})$$

and

$$J_s = C_0(D_A/\pi t))^{1/2}[1-e^{(-ds2/4DAt)}] \times 1E\text{-}4\ m^2/cm^2$$

where,

VF	Volatilization Factor	= chemical-specific in m^3/kg
Q/C	Dispersion Factor	= source size-specific in g/m^2-s per kg/m^3
C_0	Uniform Contaminant Concentration at t=0	= 1.5 E-6 g/cm^3
ρ_b	Dry Soil Bulk Density	= 1.5 g/cm^3
J_s^{ave}	Normalized Average Flux from Soil	= chemical-specific in g/m^2-s
J_s	Instantaneous Flux from Soil at time t	= chemical-specific in g/m^2-s
D_A	Apparent Diffusivity (see equation above)	= chemical-specific in cm^2/s
t	Time	= seconds (s)
d_s	Thickness of Source	= site-specific in meters

The finite equation is solved iteratively for time dependent volatile emissions and emissions are averaged over 30 years for residential exposures and 21 years for industrial/commercial exposures. The numerical integration of these calculations may be performed using a spreadsheet program. However, it is important that a minimum of 1 day intervals between time steps be used to calculate the average emission rate (EPA, 1996). Use of larger time intervals may result in mass balance violations and overestimation of volatile flux and the resultant finite VSIC (see mass balance discussion below).

The US EPA has funded the development of the Exposure Model for Soil Organic Fate and Transport (EMSOFT) which provides an integral solution for these calculations which eliminates the problems associated with time intervals and mass balance violations. The EMSOFT model was used to predict average flux rates for the finite source VSIC in the attached tables. The EMSOFT program also permits calculation of emission rates from contaminant sources where an overlying layer of clean soil is present or where several soil layers of differing levels of contamination are present at a facility. It is not feasible to provide generic criteria for all possible scenarios, however, the EMSOFT model may be used to support facility-specific assessment of the soil to ambient air pathway. The EMSOFT computer model and user manual may be obtained from the EPA Office of Research and Development.

In order to back calculate a normalized average flux for finite source VSIC values, a uniform contaminant concentration at time zero must be assumed. This value is set equal to 1 ppm (0.001 mg/g) and adjusted using the default dry soil bulk density of 1.5 g/cm^2. This yields a contaminant concentration at time zero of 1.5E-6 g/cm^2 when converted to the appropriate units (Jury, 1983).

Since the finite VSIC are based upon a limited volume of contaminated soil, these values are generally less restrictive than the infinite source VSIC for the same contaminant (i.e. finite VSIC permit a higher level of contaminant to be left in place). However, for chemicals which exhibit a combination of low volatility, high affinity for soil particles and/or a molecular weight approaching or greater than 200 g/mol, the finite model may produce VSIC which are slightly more restrictive than the infinite model. This difference is a calculation artifact and becomes more probable as the source thickness is increased. Under these circumstances the infinite source VSIC is considered to be protective and is substituted for the finite VSIC where appropriate.

The finite source model averages emissions and accounts for source depletion over extended periods of time. It is important to ensure that contaminants left in place will not present an acute inhalation risk early in the assumed exposure duration. The EMSOFT model provides not only the

average flux over a specified time period, but also the estimated flux rate at discreet intervals of time. These estimates may be used to predict time, duration and magnitude of peak emissions.

Mass Balance VF

The Jury model under both the infinite and finite assumption may result in mass balance violations under some conditions (i.e., the model may predict loss from soil of more contaminant than was initially present). This problem is likely to occur with very volatile chemicals which may be depleted from the soil in a shorter time period than the assumed exposure duration. To prevent mass balance violations, an alternative VF is calculated using the mass balance model equation presented below:

$$VF\,(m^3/kg) = Q/C \times \frac{AT \times (3.15E+1E+7\ s/yr)}{\rho_b \times d_s \times 10^6\ g/Mg}$$

where,

VF	Volatilization Factor	= chemical-specific in m^3/kg
Q/C	Dispersion Factor	= source size-specific in g/m^2-s per kg/m^3
AT	Exposure Period	= scenario specific in years
ρ_b	Dry Soil Bulk Density	= 1.5 Mg/m^3
d_s	Average Source Depth	= site specific in meters

The mass balance model cannot be calculated without knowledge of the depth of the contaminant source (d_s). This check for mass balance violations cannot, therefore, be applied to the infinite source model without facility-specific information regarding the vertical extent of contaminated soils. A mass balance VSIC greater than the infinite source VSIC and/or a finite source VSIC indicates that the Jury model is over predicting volatile flux from soil. When this occurs, the mass balance VSIC may be used in place of either the infinite or finite VSIC. As discussed above, finite VSIC generated using the EMSOFT model are not subject to mass balance violations.

Soil Properties for the VF

The default values for the soil properties in the VF equations above are representative of generic conditions for Michigan. The air-filled soil porosity property has the most significant effect on the emission of contaminants from soil and is dependent upon the assumed moisture content of the soil. The Jury model adjusts the air-filled and soil-filled porosity values to account for the difference between total and effective porosity. Effective porosity is that portion of the total porosity that is actively engaged in transport of contaminants through the soil pore space. The EPA default values given in the SSG will therefore be used for these soil properties without additional adjustment. The EPA default value of 0.006 g/g or 0.6 percent for the fraction of organic content (f_{oc}) in the soil is the mean value for the top 0.3 meters of Class B soils from Carsel et al. (1988) and is consistent with the range of f_{oc} for Michigan.

Decay Constants

Many contaminants will decay or degrade over time through various mechanisms such as hydrolysis, photolysis and microbial degradation. However, environmental degradation is a complex process and is dependent upon several site-specific conditions which are not easily amenable to a generic approach. MDEQ may consider methods to incorporate decay constants into the generic VSIC and this issue may be addressed in future guidance. In the interim, no degradation will be assumed in the calculation of generic VSIC. A responsible party has the option of demonstrating a site-specific rate of decay which can be used to adjust the generic VSIC. Use of site-specific decay rates will not preclude closure under a generic land use category.

(12)

Soil Saturation Limit

The development of chemical-specific soil saturation limits (Csat) is discussed in "Draft Part 201 Generic Soil Saturation Screening Concentrations: Technical Support Document" (October 9, 1996). Csat is defined as the level in soil at which the soil pore water, pore air and surface sorption facilities are saturated with contaminant. At or above this level, free phase contaminant may be present in soil. Under these conditions, the Jury model can no longer predict an accurate VSIC because Henry's law constants which predict partitioning of a chemical between the vapor phase and water are not applicable to free phase contaminants. However, at Csat, the emission of a volatile contaminant from soil to ambient air reaches a plateau and does not increase even when more chemical is added to the soil matrix (EPA, 1996). Target risk levels for ambient air are not exceeded at Csat or greater concentrations for those chemicals with calculated VSIC which exceed Csat. Therefore, the soil to ambient air pathway does not appear to be a human health concern for those chemicals with calculated VSIC greater than Csat. Final cleanup criteria for these chemicals is determined through consideration of other relevant pathways.

Chemical-specific Parameter Values

The EPA SSG Technical Support Document (1996) contains guidance on the collection and handling of chemical-specific values reported in the scientific literature. The values presented in the Technical Support Document were derived for EPA under contract with Research Triangle Institute (RTI). Since reported values for some chemical parameters vary widely, a qualitative review was conducted of the available values and geometric means were calculated as appropriate. Reported organic carbon partition coefficient (Koc) values were found by RTI to vary widely and no values are reported for many chemicals. Therefore, EPA relied upon the relationship of octanol water partition coefficient (Kow) values to Koc values to predict Koc values by employing a regression analysis. This approach has been followed to calculate the Koc values used to develop the Part 201 VSIC. The regression equation is presented below.

$$\log Koc_{(L/kg)} = 0.00028 + (0.983 \times \log Kow)$$

This equation performs well for most chemicals but consistently over predicts Koc values for volatile organic compounds, chlorinated benzenes and some chlorinated pesticides. For these compounds the following equation is used to calculate Koc.

$$\log Koc_{(L/kg)} = 0.0784 + (0.7919 \times \log Kow)$$

If no values were available from the Soil Screening Guidance, the following sources were consulted (in order of preference): the Draft Development of Human Health Based and Ecologically Based Exit Criteria for the Hazardous Waste Identification Project (HWIR), Howard et al. (1989), and the Chemical Evaluation Search and Retrieval System (CESARS) database.

A table containing the chemical-specific values used to develop the generic VSIC will be provided by the ERD Toxicology Unit upon request. VSIC cannot be calculated for all chemicals on the Part 201 list due to the lack of values for one or more chemical parameters. Additional VSIC will be developed as more chemical-specific values are identified.

PARTICULATE EMISSION FACTOR

The particulate emission factor (PEF) relates the concentration of a contaminant in the soil to the concentration of particulates in the air. The PEF equation incorporates factors which account both for

emission of particulates from soil and dispersion after the particulates become airborne. The general equation is presented below. Default values for PEF parameters are identified in Attachment A.

$$PEF = (Q/C) \times 1/[(Ew \times (1-V)) + Ev]$$

where,

PEF	Particulate Emission Factor	= chemical-specific in m^3/kg
Q/C	Dispersion Factor	= source size-specific in g/m^2-s per kg/m^3
Ew	Emission due to wind	= g/m^2 per s
Ev	Emission due to vehicle traffic	= g/m^2 per s
V	Vegetative Cover (unitless)	= 0.5 (50%)

Particulate Emission due to Wind Erosion (Ew)

Ew represents the emission of a chemical from soil due to wind erosion. Parameters which influence this value include meteorological factors such as the mean wind speed and the equivalent threshold value of wind speed at 7 meters. Default values for meteorological factors have been obtained from the data set selected to model the Q/C dispersion factor discussed below. Attachment A, the PEF Worksheet, presents the assumptions and calculations used in developing the generic Ew values.

Ew may be adjusted to account for vegetative cover at a facility. No data are available to estimate the distribution of vegetative cover values for Michigan. In the absence of data, the mid-range value of 0.5 (50%) was chosen as a central tendency value. If vegetative cover at a facility differs significantly from this value, a facility-specific evaluation may be necessary. There is no adjustment for precipitation or snow cover due to the variability statewide of these factors and the inability to correlate them with actual wind erosion events.

Meteorological data characteristic of a specific location may be used to generate alternative cleanup criteria. However, it is not appropriate to combine facility-specific meteorological data with the defaults used to calculate generic criteria. It may not be necessary to generate data for a particular location, rather, data from an existing monitoring location more appropriate for a facility may be used in place of the defaults presented in Attachment A. Please contact an ERD toxicologist for further information concerning location-specific meteorological analysis. Use of location-specific meteorological data does not preclude closure under a generic land use category.

Particulate Emission due to Vehicle Traffic (Ev)

Ev accounts for emission of chemicals from soil due to passenger vehicle traffic. This source of emission was not considered by the EPA in the Soil Screening Guidance, therefore, the vehicle traffic emissions equation in Cowherd (1985) was used to generate default vehicle emission rates. Attachment B contains the default assumptions and equations used to calculate Ev's for residential and industrial/commercial scenarios. Note that the value for Ev is directly proportional to the number of passenger vehicle trips per day assumed for each scenario (e.g. the residential Ev for 10 round trips per day is twice that for 5 round trips per day). A responsible party may use this relationship to adjust the Ev value if it can be demonstrated that vehicle traffic at a facility differs from the default assumptions. The Ev values assume that vehicles at the facility are primarily passenger automobiles. At facilities where trucks and other heavy equipment are expected to be present, a facility-specific assessment of particulate emission due to vehicle traffic may be required.

Q/C: AIR DISPERSION FACTOR

The Q/C factor accounts for dispersion of airborne contaminants. The SSG presents a default value for this parameter which represents the 90th percentile of the distribution of nationally modeled Q/C values from 29 facilities. No Michigan facilities were included in these modeling efforts, therefore, air dispersion modeling was used to develop a Michigan-specific default dispersion factor for Part 201 SIC. A half-acre (0.5) default source size is considered to be representative of a residential property and is consistent with current EPA recommendations for residential facilities. Adaptation of the generic half-acre SIC for other source sizes will be discussed under "Application of SIC" below.

Location Selection of Q/C modeling data.
A half-acre source was modeled with 15 sets of meteorological data routinely used in Michigan air dispersion modeling. The most recent year of available data for each location was chosen (in most cases this was 1991). Maximum, annual average concentrations were obtained using EPA's ISCST3 model assuming a standard emission rate of contaminant from soil of 1 g/m^2-sec.

From these results, three meteorological locations were selected and modeled with the most recent 5 years of data (in all 3 cases this was 1987-1991). These datasets were selected based on location within an area of the state that is both agricultural and industrial, availability of 5 years of recent meteorological data and the conservativeness of the 1991 data. However, the three locations selected do not represent "worst case" meteorological conditions for the State. The 5-year analysis was necessary to ensure that the year of data chosen to calculate the Q/C values was representative of general weather conditions for that area (i.e., the year did not represent unusual weather events). The three meteorological locations selected were Midland-Bay City-Saginaw (MBS), Grand Rapids (GRR) and South Bend (SBN). While South Bend does not lie within the geographical boundaries of the State of Michigan, the dataset from this location is considered representative of southwest Michigan and is routinely used in air modeling by AQD. South Bend was chosen as the default location for conducting the air dispersion modeling for the generic SIC. This location represents roughly the 50th percentile of the 15 Michigan meteorological monitoring locations originally modeled.

Air Dispersion Model
The EPA ISCST3 area source model is used with rural dispersion coefficients and several default assumptions to estimate the dispersion of airborne contaminants. In the SIC scenario, contaminants are emitted directly from the soil, therefore, the emission height was set at zero (0). Additional assumptions are discussed below.

Receptor Height - The Source Receptor Analysis Branch of the EPA Office of Air Quality Planning Standards (OAQPS) has historically recommended a receptor height of zero for air dispersion modeling. MDEQ AQD policy agrees with this position and supports the use of a receptor height of zero to represent a ground level receptor.

The appropriate receptor height for the ISCST3 area source model for ground level receptors and emissions was investigated by Environmental Quality Management (EQM) under contract with EPA. In a technical memorandum dated November 6, 1996, Mr. Craig Mann conveyed EQM's findings to the EPA. The wind tunnel experiments conducted to verify the ISCST3 area source algorithm indicate that the model performs well in the horizontal direction and accurately predicts down-wind concentrations. However, the model algorithm does not account for phenomena such as ground turbulence and temperature cycles which act to mix air concentrations in the first few feet above the ground surface. As a result, the model overpredicts the concentration gradient in the vertical direction resulting in an underestimation of concentrations at elevated heights. Algorithms which account for ground level

phenomena may be available but have not been incorporated into the ISCST3 area source model or any other available program.

In consideration of the above discussion, EPA recommends a zero foot receptor height be used to assess ground level exposures to soil emissions and acknowledges this to be a conservative assumption. Therefore, in keeping with both EPA and MDEQ AQD recommendations, a zero foot receptor height was used to calculate the air dispersion factor for the SIC in the attached tables.

Modeled Air Concentration - Dispersion analysis for SIC development requires modeling of predicted air concentrations based on an assumed uniform emission rate from the source area of 1 g/m^2-sec. A receptor grid is imposed on the half acre source area and average air concentrations are estimated for each discrete receptor location based on annual meteorological data. The Q/C for Part 201 SIC development is the 90th percentile of the distribution of modeled annual average air concentrations for all on-site receptor locations.

Short-term Emission and Dispersion of Volatiles and Particulates

While some variation in the emission of volatile contaminants from soil as a result of changing air temperature and meteorological conditions may occur, these variations are not expected to result in significant fluctuation in ambient air concentrations. Therefore, all VSIC are based on annual average air dispersion modeling. Since both the emission and dispersion of particulates are dependent upon meteorological conditions, day-to-day variations may have significant effects on the resulting ambient air concentration. The PSIC must, therefore, be adjusted to protect against likely short-term peaks in particulate ambient air concentrations.

The formula for PEF presented above represents annual average emission and dispersion of PM-10 particulates. It is not appropriate for evaluating short-term exposures. However, the available models for predicting short-term particulate emission rates are very conservative and not intended for the currently proposed use. Therefore, AQD field monitoring data are used to characterize the likely variation between annual and short term ambient air particulate levels for Michigan.

Data are available for several land use categories at various locations in Michigan for both PM-10 levels and total suspended particulates (TSP). PM-10 is that fraction of the total suspended particulate matter less than or equal to 10 microns in diameter. Particles of this size are considered to be fine enough to enter the respiratory system and to become lodged in the alveoli. PM-10 levels were chosen as the appropriate standard for comparison to the particulate levels predicted by the annual PEF equation. The data indicate that Wayne County has high particulate levels relative to the remainder of the state. However, levels are consistent for the remainder of the state across all land uses and settings. These data, excluding those datasets from Wayne County, are used to establish average annual and 24-hour PM-10 concentrations for Michigan.

The annual average PM-10 level is based on a dataset of 24-hour averages. This allows for the construction of a distribution of 24-hour values and associated percentiles. The average PM-10 level from this distribution (equivalent to an annual average) is 20 ug/m^3 and the 90th percentile is 40 ug/m^3. This suggests that peak particulate levels for a given 24-hour period are likely to be twice as high as an annual average. This assumption is used to adjust the PSIC for the subset of chemicals for which short-term levels may pose a human health risk. PSIC were adjusted by a factor of 2 for all chemicals which are associated with quarterly, 24-hour, 8-hour or 1-hour averaging times under the Air Toxics Rules. No Michigan-specific particulate data are available for less than 24-hour time periods. However, data are available from several other states which indicates that the ratio of annual to 1 hour or 8 hour particulate levels is not greatly different from the annual to 24-hour ratio.

SIC FOR INDUSTRIAL/COMMERCIAL FACILITIES

Two distinct receptor populations must be considered in the development of SIC for industrial and commercial facilities: on-site workers and off-site, near-by residents. Since both Part 201 and Part 55 rules require compliance with residential criteria at the property boundary of a facility, industrial/commercial SIC must consider the need to protect off-site receptors if they represent the more highly impacted receptor group.

Off-site Residential Receptor

In order to assess which of these two receptor populations would control development of industrial/commercial SIC, additional dispersion modeling was conducted to predict air impacts to off-site, near-by receptors. Inputs to the ISCST3 model were identical to those used to predict on-site impacts, however, the Q/C values for off-site impacts are based on the 90th percentile of the concentrations predicted by the model for the perimeter of the source area. This Q/C term was then used to calculate VF and PEF values which were used in the generic SIC equations with residential default exposure values to calculate on-site SIC protective of off-site exposure to ambient air contaminants.

On-site Worker

Calculation of industrial/commercial SIC for on-site workers relied upon the initial modeling efforts for the generic residential SIC to predict the Q/C values. Several parameters were adjusted in the generic equation, however, to characterize the worker population. Consistent with the default exposure values discussed in Operational Memo #14, the exposure duration (ED) was adjusted to 21 years and the exposure frequency (EF) to 245 days.

Intake rate (i.e., inhalation rate) is not explicitly included in the generic residential equations. It is, however, implicit in development of the inhalation toxicity values and the default intake rate for adults is assumed to be 20 m^3/day. In order to adjust this rate to account for the volume of air intake for an on-site worker, an adjusted intake rate (AIR) of 20 m^3/day /10 m^3/day was added to the equation. The 10 m^3/day intake rate for workers is consistent with both EPA and Occupational Safety and Health Administration (OSHA) standard default values and assumes that a worker engaged in moderate activity will respire more heavily while on the job than during light activity and resting portions of a day.

Adjustments to the VF and PEF for on-site workers

The VF for the on-site worker scenario is different than that for the residential scenario since the exposure period used in the calculation for the J_s^{ave} corresponds to the ED of 21 years (see discussion of the J_s^{ave} equation above).

The PEF is adjusted to account for the greater level of vehicular traffic at industrial or commercial facilities (see attachment B). The residential default of 50% vegetative cover was retained for this calculation, however, it is anticipated that some industrial facilities may not be as heavily vegetated. Therefore, this value must be evaluated for its appropriateness to the facility in question.

Results

A comparison of SIC generated under these two scenarios indicates that the on-site worker scenario generates more restrictive industrial/commercial PSIC than the off-site residential scenario. Conversely, the off-site residential scenario produces more restrictive industrial/commercial VSIC. However, the disparity between the on-site worker VSIC and the off-site residential VSIC is minimal. Given the level of uncertainty surrounding the SIC and the conservativeness of perimeter modeling to develop the VF for the off-site scenario, this disparity does not appear to be significant. Therefore, both the VSIC and the PSIC for industrial/commercial sites will be based on protection of the on-site worker.

Generic Industrial/Commercial SIC Algorithms Protective of Ambient Air Exposures

Generic industrial/commercial SIC equations with worker exposure default values are presented below. Default exposure assumptions for industrial and commercial land uses are discussed in Operational Memorandum #14 (Revision 2).

No adjustment for weather conditions has been made to the exposure frequency (EF) for the industrial/commercial scenario. As stated in the discussion of the Q/C dispersion factor, it is not possible to correlate weather conditions and/or temperature with actual wind erosion events. Under some conditions, frozen soil may result in an equal, if not greater, level of particulate emission and exposure.

It is not appropriate to adjust the EF for the VSIC on the assumption that no volatilization occurs during the colder months of the year. While it is true that volatilization rates are correlated with temperatures, some chemicals exhibit high vapor pressures (VP) even at freezing temperatures. Many chemicals are selected for industrial use because they display properties of low freezing points and volatilization for these compounds, while possibly affected, would not be eliminated completely during the colder months of the year. The Henry's Law Constant (HLC) used in the VF equation is typically reported at 20^0 C (68^0 F). The VF equation thus assumes a constant temperature of 68^0 F to predict volatilization without adjustment for either cold temperatures in winter or higher temperatures (and greater volatilization) in summer.

Carcinogens:

$$\text{Volatile Soil Inhalation Criteria} = \frac{10^{-5} \times AT \times AIR}{IURF \times EF \times ED \times (1/VF)}$$

where,

10^{-5} cancer risk	= target risk
AT (averaging time)	= 25,550 days (70 x 365)
AIR (adjusted inhalation rate)	= 20 m^3/d /10 m^3/d
IURF (inhalation unit risk factor)	= chemical-specific $(ug/m^3)^{-1}$
EF (exposure frequency)	= 245 days/year
ED (exposure duration)	= 21 years
VF (volatilization factor)	= chemical-specific in m^3/kg

$$\text{Particulate Soil Inhalation Criteria} = \frac{10^{-5} \times AT \times AIR}{IURF \times EF \times ED \times (1/PEF)}$$

where,

10^{-5} cancer risk	= target risk
AT (averaging time)	= 25,550 days (70 x 365)
AIR (adjusted inhalation rate)	= 20 m^3/d /10 m^3/d
IURF (inhalation unit risk factor)	= chemical-specific $(ug/m^3)^{-1}$
EF (exposure frequency)	= 245 days/year
ED (exposure duration)	= 21 years
PEF (particulate emission factor)	= chemical-specific in m^3/kg

Noncarcinogens:

$$\text{Volatile Soil Inhalation Criteria} = \frac{THQ \times AT \times CF \times AIR}{EF \times ED \times (1/RfC \times 1/VF)}$$

where,

THQ (target hazard quotient)	= 1
AT (averaging time)	= 7,665 days (21 x 365)
CF (conversion factor)	= 1000 ug/mg
AIR (adjusted inhalation rate)	= 20 m^3/d /10 m^3/d
EF (exposure frequency)	= 245 days/year
ED (exposure duration)	= 21 years
RfC (reference concentration)	= chemical-specific in mg/m^3
VF (volatilization factor)	= chemical-specific in m^3/kg

$$\text{Particulate Soil Inhalation Criteria} = \frac{THQ \times AT \times CF \times AIR}{EF \times ED \times (1/RfC \times 1/PEF)}$$

where,

THQ (target hazard quotient)	= 1
AT (averaging time)	= 7,665 days (21 x 365)
CF (conversion factor)	= 1000 ug/mg
AIR (adjusted inhalation rate)	= 20 m^3/d /10 m^3/d
EF (exposure frequency)	= 245 days/year
ED (exposure duration)	= 21 years
RfC (reference concentration)	= chemical-specific in mg/m^3
PEF (particulate emission factor)	= chemical-specific in m^3/kg

APPLICATION OF SIC

The values listed in the attached tables are generated using generic default assumptions concerning meteorological conditions, soil characteristics and human exposure parameters. If default values for either meteorological modeling (i.e., the Q/C dispersion factor) or soil characteristics (e.g. dry soil bulk density, soil porosity) are replaced by facility-specific values, generic closure under sections 20120a(1)(a) through (d) of Part 201 is still likely for the facility. Substitution of facility-specific values for these parameters is acceptable under the generic approach if adequate support for the use of these values is provided. For soil characteristics, facility-specific field evaluation is necessary to support use of values which differ from generic defaults. Use of facility-specific values for exposure parameters (e.g. exposure duration, exposure frequency) will necessitate closure under section 20120a(2).

As indicated by the discussion of the development of SIC values, separate criteria are provided for volatile and particulate emissions. To determine overall compliance with soil cleanup criteria for the soil to ambient air pathway, compliance must be demonstrated for both the VSIC and PSIC values for each chemical of concern.

VSIC

Since the entire column of soil may contribute to volatile emissions, VSIC apply to both surficial and subsurface soil for a generic land use category. Compliance with the VSIC is not required under a limited category, if volatilization of contaminant to the ambient air is determined by the department to be prevented by an engineered exposure barrier.

The soil to ambient air pathway is not a concern for chemicals with calculated VSIC greater than their respective Csat screening value. VSIC which exceed the chemical-specific Csat value are shaded in the attached tables. Please see the Part 201 Generic Soil Saturation Screening Concentrations: Technical Support Document (October 9, 1996) for guidance on how to address soil concentrations which exceed Csat screening values.

Infinite source VSIC are to be used as a "first cut" screening tool. These values may be used as screening values at facilities where the vertical extent of contamination is not well characterized (e.g. Baseline Environmental Assessments, determination of facility status). If contaminant concentrations **do not** exceed these values, the soil to ambient air pathway is not a concern for the facility. If contaminant concentrations **do** exceed infinite source VSIC, the vertical extent of contamination must be characterized before application of the finite source VSIC. Infinite source VSIC are not to be used either to determine the need for a response action to address soil contamination or to verify the adequacy of soil remediation.

Finite source VSIC may be used to determine the need for a response action to address soil contamination or to verify the adequacy of soil remediation when the soil-to-air pathway is the most restrictive and relevant pathway. Since VSIC are protective of long term, systemic health effects only, a responsible party has the responsibility to demonstrate that soil contaminants left in place will not result in unacceptable acute exposures or other health effects such as ocular irritation, dermal irritation or sensitization, physical hazards such as reactivity, corrosivity, or ignitability, and/or ecological impacts.

Finite VSIC are provided for 2 and 5 meter source thickness. These values may be applied where the vertical extent (i.e. thickness) of the contaminant source is no greater than the thickness assumed for these scenarios. The responsible party retains the option of developing finite VSIC based on facility specific characteristics.

Mass balance VSIC are not included in the attached tables since the finite source VSIC generated using the EMSOFT computer model do not result in mass balance violations. Mass balance values may be calculated using the equation discussed above for site-specific reviews.

PSIC

Application of the particulate soil inhalation criteria (PSIC) may differ for the limited and generic land use categories. Under most circumstances, the PSIC will apply to the entire soil column for a generic land use category. For a limited use category, the PSIC will apply only to surficial soils (i.e., the top 6 inches of soil) when excavation of subsurface soils is reliably restricted. In addition, under a limited category, compliance with the PSIC is not required in either surficial or subsurface soils if emission of particulate contaminant to the ambient air is determined by the department to be prevented by an engineered exposure barrier.

Please note: 50% vegetative cover is assumed for all land uses and is used in the PEF equation to adjust the expected emission of particulates from soil due to wind erosion. Professional judgment must be used to determine if the vegetative cover at a facility is consistent with this value, particularly at industrial facilities where activities may prevent vegetative growth. Additionally, professional judgment must be used in situations where vehicle traffic at a facility will be greater than that assumed for the generic scenarios.

APPLICATION OF SIC FOR OTHER SOURCE SIZES

An underlying assumption of the values presented in the attached tables is that the area of soil contamination is equal to 1/2 acre. The source size is defined as the areal extent of contaminated soil and is specified in inputs to the ISCST3 model. In order to adapt the generic SIC for half-acre sources to larger and smaller source sizes, air dispersion modeling was used to provide a set of modifiers to adjust the values presented in the attached tables. The modifier corresponding to a source size which is at least as large as the source size of the facility in question should be chosen. For example if the source size at a facility is 8 acres, the generic SIC for 1/2 acre is multiplied by the modifier for 10 acres to provide generic SIC values for a 10 acre facility. The PRP retains the option to conduct facility-specific meteorological modeling for other source sizes. Values for a 1/2 acres source size in the attached tables which exceed 100% (i.e. 1.0E+9) have been presented as calculated. This was done to ensure that the correct value is used to adapt the 1/2 acre criteria for larger or smaller source sizes. Modifiers are presented below.

Modifiers		
Source Size sq. feet or acres	Q/C g/m^2-s per kg/m^3	Modifier
400 sq feet	261.26	3.17
1000 sq feet	180.76	2.2
2000 sq feet	144.91	1.76
1/2 acre	82.33	1
1 acre	71.74	0.87
5 acre	54.62	0.66
10 acre	49.13	0.6
32 acre	41.55	0.5
100 acre	35.66	0.43

Source Size Characterization

Characterization of the source size need not be precise to determine compliance with screening values. For example, if the source size is estimated to be greater than 1 acre but less than 5 acres, the 5 acre SIC

(31)

may be applied as a conservative screen. The soil to ambient air pathway would not be a concern at this facility if soil concentrations do not exceed the 5 acre SIC. If exceedances are noted, the responsible party may then refine the source size characterization to more accurately define the applicable criteria.

Land Use Categories

Generic exposure assumptions for residential, industrial and commercial land use are discussed in Part 201 Operational Memorandum #8 (Revision 4) and #14 (Revision 2). Consistent with the discussion in Memorandum #14, Commercial Subcategory I land use requires the application of residential criteria. This land use category may include but is not limited to day care centers, any form of educational use, hospitals, elder care centers and nursing homes. Industrial/Commercial SIC are applicable under the Industrial and Commercial II through IV land use categories. Documentation must be provided to ensure that facility activities are consistent with the assumed exposure assumptions used in the development of cleanup criteria.

SIC Application Example

An additional underlying assumption of the generic SIC is that soil contaminants are homogeneous throughout the source area and that this homogeneous source produces a modeled concentration in air. A homogeneous pattern of contamination is unlikely at most Part 201 facilities with the possible exception of uniform fill material. It is not possible to address all possible scenarios under the generic approach, however, consider the following example of a multiacre facility with several small source areas. The entire facility covers 10 acres. There are 5 source areas at the facility which cover 1 acre each and have been impacted with similar contaminants. It is not acceptable to compare the concentration in each source area to the SIC for 1 acre without consideration of the combined effect of all 5 source areas. The contamination emitted from all 5 source areas will commingle in ambient air at the facility to produce an air concentration greater than would be expected from a single 1 acre source. Two questions are foremost: which SIC to apply and to what extent must the source areas be characterized? The answers are interrelated

If the portion of the facility which is outside of the 5 source areas is sampled and demonstrated to be non-detect, the sizes of the source areas can be added together and the detected concentrations within the source areas can be compared to the criteria which best fits the sum of those areas. In this example, the SIC for a 5 acre source size could be used as a first cut screen for ambient air impacts. This is a conservative screen since the airborne contamination emitted from these 5 non-contiguous source areas would be more greatly dispersed over the 10 acre facility than would be the case if all 5 areas of contaminated soil were contiguous. Professional judgment and information concerning site activities should be used to determine the extent of sampling required to characterize the areas between sources. Only samples taken from within the source areas should be included in statistical analysis of the data. Sampling results from the area outside of the source areas cannot be included since this would, in effect, dilute the 95% UCL concentration to be compared to the SIC. The PRP retains the option to conduct a site-specific analysis of the soil to ambient air pathway.

Another possible scenario is that soils outside of and between the 5 source areas are also impacted, but to a lesser extent than the source areas themselves. Since all areas of soil contamination contribute to ambient air levels, the expected air concentration would be somewhat greater than in the example above but not as great as predicted by the generic air dispersion modeling for a 10 acre facility. As a conservative screen for this scenario, facility concentrations are compared to the SIC for 10 acres. Careful professional judgment should be used to determine if the variability in the data indicates that source areas must be considered separately from the remainder of the facility. If variability in the data is reasonable, facility-wide averaging may be acceptable. Consult an ERD toxicologist for further guidance on statistical analysis of source areas. As always, the PRP retains the option to conduct a facility-specific analysis of the soil to ambient air pathway.

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Attachment A

PEF WORKSHEET

Ew - emissions due to wind erosion

$$Ew = (0.036(Um/Ut_{adj})^3 F(x))/3600$$

where:

Um(z) = mean windspeed (m/s) = 4.56 for South Bend (at 6.4m)
Um = Um(z) adjusted to 7 meters (m/s) = $Um(z)(7.0/6.4)^{.15}$ = 4.62
assume: z_0 = 0.005 m
assume: U*t = 0.42 m/s for 0.35 mm aggregate mode
Ut = threshold friction velocity at 7 m (adjust U*t to 7m) = 0.42/0.4*ln(7.0/0.005)) = 7.61 m/s
Ut_{adj} = 7.61 m/s (1.25) = 9.51 m/s
X = 0.886*Ut_{adj}/Um = 1.824 (unitless)
F(x) = 0.48 (unitless)

$Ew = (0.036(4.62/9.51)^3\ 0.48)/3600 = 5.5E\text{-}7\ g/m^2\text{-}s$

Ev- emissions due to vehicle traffic

Ev = 6.90E-7 g/m^2-s (from attachment B)

PEF - particulate emission factor for annual averaging

$$PEF = (Q/C) \times 1/(Ew((1-V)) + Ev)$$

where:

PEF = Particulate Emission Factor	
Residential	= 8.79E+7 m^3/kg
Industrial/Commercial	= 2.32E+7 m^3/kg
Q/C = (Dispersion Factor)	= 82.33 g/m^2-s per kg/m^3
Ew (Emission due to wind erosion)	= 5.5E-7 g/m^2-s
V (Assumed vegetative cover)	= 50% (0.5)
Ev (Emission due to vehicle traffic)	
Residential	= 6.62E-7 g/m^2-s
Industrial/Commercial	= 3.27E-6 g/m^2-s

Attachment B

TO DERIVE A VEHICLE EMISSIONS RATE FOR INCLUSION IN EQN. 7 OF SSG FOR PEF:

Revision Date: 5-May-97

For vehicle emissions, use Eqn. 4-7 in Cowherd, 1985 (EPA/600/8-85/002) :

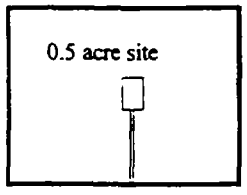
$$E_{10} = 0.85 * (s/10) * (S/24)^{0.8} * (W/7)^{0.3} * (w/6)^{1.2} * ((365-p)/365)$$

Where		Cowherd Residential Default Nos.
E_{10} =	PM_{10} emissions per vehicle-kilometer of travel, (kg/VKT)	
s =	silt content of road surface material, (%)	15
	(Cowherd, 1985 shows a range of 5-68%, with default s = 15%)	
S =	mean vehicle speed, (km/hr)	20
	(Cowherd, 1985 default of S = 48 km/hr. was not used for this driveway scenario)	
W =	mean vehicle weight, (Mg)	2
w =	mean number of wheels	4
p =	number of days with at least 0.254 mm (0.01 inch) of precipitation per year (Figure 4-4 of Cowherd).	135

ASSUMPTIONS: These parameters may be changed if site specific information is available.

Units must be in (grams/m^2-sec) for use in the SSG equation 7.

Size of site	=	0.5	acres
Size of home	=	25	feet per side
Round trips/day	=	10	trips away from home/day
Length of driveway	=	20	metres **(unpaved)**
Time period	=	350	days



CALCULATIONS:

Area of home	=	58.06	square metres
Dimension of site	=	44.98	metres per side
Area of site	=	1965	square metres, excluding area of the house
Dist. travelled/day	=	0.40	Kilometres/day
	=	140.00	Kilometres/year
Vehicle emission	=	0.2931	kg/VKT
	=	0.1172	kg/day
	=	41.034	kg/year at 10 round trips per day

Vehicle emis. at	5 round trips per day	=	20.517	Kg/year
Vehicle emis. at	2 round trips per day	=	8.207	Kg/year

NOTE: The emissions from the vehicle traffic is averaged over the area of the entire site rather than just the area of the driveway (excluding the area of the house).

(I) For ANNUAL averaging time,

Vehicle emissions in grams per square metre per second (10 round trips per day)

$$= 41.034 \frac{Kg}{year} \times \frac{1000\ gm}{Kg} \times \frac{1}{31{,}536{,}000} \frac{year}{sec} \times \frac{1}{1965\ m^2}$$

= **6.62E-07** grams per square metre per second for 0.5 acre site with one home

For comparison:

Vehicle emission rate at	5 round trip per day	=	**3.310E-07**	grams/sq. metre/second for 0.5 acre site with one home
Vehicle emission rate at	2 round trip per day	=	**1.324E-07**	grams/sq. metre/second for 0.5 acre site with one home

Attachment B

VEHICLE EMISSIONS FOR SITE WITH COMMERCIAL ACTIVITIES:

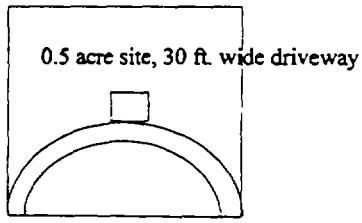
For vehicle emissions, use Eqn. 4-7 in Cowherd, 1985 (EPA/600/8-85/002) :

$$E_{10} = 0.85 * (s/10) * (S/24)^{0.8} * (W/7)^{0.3} * (w/6)^{1.2} * ((365-p)/365)$$

Where		Cowherd Residential Default Nos.
E_{10}	= PM_{10} emissions per vehicle-kilometer of travel, (kg/VKT)	
s	= silt content of road surface material, (%)	15
S	= mean vehicle speed, (km/hr)	20
W	= mean vehicle weight, (Mg)	2
w	= mean number of wheels	4
p	= number of days with at least 0.254 mm (0.01 inch) of precipitation per year (Figure 4-4 of Cowherd).	135

ASSUMPTIONS: These parameters may be changed if site specific information is available.

Size of site	=	0.5	acres
Size of building	=	25	feet per side
Round trips/day	=	50	vehicles/day
Length of driveway	=	45.0	metres **(unpaved)**
Time period	=	307	days (6 days/wk, - 5 holidays)



CALCULATIONS:

Area of building	=	58.06	square metres
Dimension of site	=	44.98	metres per side
Area of site	=	1965	square metres, excluding area of the building
Dist. travelled/day	=	2.25	Kilometres

Vehicle emission = 0.293 kg/VKT * 690.75 Kilometres/year
= 202.484 Kg/year

NOTE: **The emissions from the vehicle traffic is averaged over the area of the entire site rather than just the area of the driveway (excluding the area of the building).**

(I) For ANNUAL averaging time,

Vehicle emissions in grams per square metre per second

$$= 202.484 \frac{Kg}{year} \times \frac{1000\ gm}{Kg} \times \frac{1}{31{,}536{,}000} \frac{year}{sec} \times \frac{1}{1965\ m^2}$$

= **3.27E-06** grams per square metre per second for 0.5 acre "commercial" site with one building

This "commercial" site has 4.93 times the emission rate of a residential scenario of 10 trips per day.

(26)

GENERIC SOIL INHALATION CRITERIA (SIC)
FOR RESIDENTIAL LAND USE
1/2 ACRE SOURCE SIZE

Criteria may change as toxicity and chemical-specific parameter values are updated. The SIC presented are only protective of chronic systemic health effects. Assessment of acute systemic or non-systemic effects must be conducted to determine if more restrictive criteria are necessary.

All values are presented in ug/kg (ppb).

Chemical	RESIDENTIAL SIC				
	Infinite Source VSIC	Finite Source VSIC for 5m source thickness	Finite Source VSIC for 2m source thickness	Csat	PSIC
Acenaphthene	5.7E+7	1.5E+9	1.5E+9	NA	9.6E+9
Acenaphthylene	ID	ID	ID	NA	1.6E+9
Acetaldehyde	ID	ID	ID	1.0E+7	9.7E+8
Acetic acid	ID	ID	ID	1.0E+7	1.1E+10
Acetone	9.2E+7	9.2E+7	1.7E+8	6.4E+7	2.7E+11
Acetonitrile	4.1E+5	4.1E+5	6.8E+5	1.3E+7	9.6E+8
Acrolein	220	270	590	1.4E+7	9.2E+5
Acrylamide	3,300	9,000	9,000	NA	1.6E+6
Acrylic acid	ID	ID	ID	1.0E+7	4.6E+7
Acrylonitrile	3,500	4,600	10,000	5.4E+6	3.1E+7
Alachlor	ID	ID	ID	NA	ID
Aldicarb	ID	ID	ID	NA	ID
Aldicarb sulfoxide	ID	ID	ID	NA	ID
Aldicarb sulfone	ID	ID	ID	NA	ID
Aldrin	41,000	41,000	41,000	NA	4.4E+5
Aluminum	ID	ID	ID	NA	ID
Ammonia	ID	ID	ID	1.0E+7	4.6E+9
Aniline	98,000	98,000	98,000	4.1E+6	4.6E+7
Anthracene	9.8E+8	9.8E+8	9.8E+8	NA	4.E6+10
Antimony	ID	ID	ID	NA	6.4E+7
rsenic	ID	ID	ID	NA	5.0E+5
Atrazine	ID	ID	ID	NA	ID
Azobenzene	ID	ID	ID	NA	6.9E+7
Barium	ID	ID	ID	NA	2.3E+8
Benzene	9,600	33,000	78,000	7.7E+5	2.6E+8
Benzidine	100	4,000	4,000	NA	32,000
Benzo(a)anthracene	ID	ID	ID	NA	ID
Benzo(b)fluoranthene	ID	ID	ID	NA	ID
Benzo(k)fluoranthene	ID	ID	ID	NA	ID
Benzo(g,h,i)perylene	ID	ID	ID	NA	5.5E+8
Benzo(a)pyrene	3.4E+5	4.4E+5	4.4E+5	NA	1.0E+6
Benzoic acid	ID	ID	ID	2.2E+5	ID
Benzyl alcohol	9.5E+8	9.5E+8	9.5E+8	5.9E+6	2.3E+11
Benzyl chloride	10,000	10,000	16,000	5.7E+5	4.3E+7
Beryllium	ID	ID	ID	NA	8.9E+5
bis(2-chloroethoxy)ethane	ID	ID	ID	1.0E+7	ID
bis(2-Chloroethyl)ether	2,700	2,700	2,700	2.2E+6	6.5E+6
bis(2-Ethylhexyl)phthalate	1.4E+9	1.6E+10	1.6E+10	3.1E+7	4.8E+8
Boron	ID	ID	ID	NA	ID
Bromobenzene	ID	ID	ID	1.0E+7	3.7E+8
Bromodichloromethane	6,500	8,700	19,000	2.7E+6	5.8E+7

GENERIC SOIL INHALATION CRITERIA (SIC)
FOR RESIDENTIAL LAND USE
1/2 ACRE SOURCE SIZE

Chemical	RESIDENTIAL SIC				
	Infinite Source VSIC	Finite Source VSIC for 5m source thickness	Finite Source VSIC for 2m source thickness	Csat	PSIC
Bromoform	6.4E+5	6.4E+5	7.7E+5	1.8E+6	1.9E+9
Bromomethane	ID	ID	ID	3.0E+6	2.3E+8
n-Butanol	1.6E+7	1.6E+7	1.6E+7	6.9E+6	1.6E+10
2-Butanone (MEK)	2.1E+7	2.1E+7	3.2E+7	1.7E+7	4.6E+10
n-Butyl acetate	ID	ID	ID	1.0E+7	4.4E+10
t-Butyl alcohol	ID	ID	ID	1.0E+7	1.4E+11
Butyl benzyl phthalate	7.3E+9	7.8E+9	7.8E+9	9.3E+5	3.2E+10
Cadmium	ID	ID	ID	NA	1.2E+6
Camphene	ID	ID	ID	NA	ID
Caprolactam	ID	ID	ID	NA	4.6E+8
Carbaryl	ID	ID	ID	NA	ID
Carbazole	ID	ID	ID	NA	ID
Carbofuran	ID	ID	ID	NA	ID
Carbon disulfide	1.0E+6	7.8E+6	1.9E+7	5.6E+5	3.2E+10
Carbon tetrachloride	2,600	11,000	27,000	9.8E+5	9.1E+7
Chlordane	2.4E+5	2.4E+5	6.4E+5	NA	5.8E+6
Chloride	ID	ID	ID	NA	ID
Chlorobenzene	5.5E+5	9.1E+5	2.0E+6	6.6E+5	3.2E+9
Chloroethane	ID	ID	ID	NA	4.6E+11
2-Chloroethyl vinyl ether	ID	ID	ID	1.0E+7	ID
Chloroform	32,000	1.1E+5	2.7E+5	2.5E+6	8.9E+8
Chloromethane	35,000	4.1E+5	1.0E+6	1.9E+6	3.3E+9
4-Chloro-3-methylphenol	ID	ID	ID	NA	ID
beta-Chloronaphthalene	ID	ID	ID	NA	ID
2-Chlorophenol	ID	ID	ID	1.9E+7	ID
o-Chlorotoluene	ID	ID	ID	1.0E+7	3.2E+9
Chlorpyrifos	ID	ID	ID	NA	9.2E+7
Chromium (III)	ID	ID	ID	NA	2.3E+8
Chromium (VI)	ID	ID	ID	NA	1.8E+5
Chrysene	ID	ID	ID	NA	ID
Cobalt	ID	ID	ID	NA	9.2E+6
Copper	ID	ID	ID	NA	9.2E+7
Cyanazine	ID	ID	ID	NA	ID
Cyanide	ID	ID	ID	NA	2.3E+9
Cyclohexanone	ID	ID	ID	1.0E+7	4.6E+10
Dacthal	ID	ID	ID	NA	ID
Dalapon	ID	ID	ID	1.0E+7	ID
4-4'-DDD	ID	ID	ID	NA	ID
4-4'-DDE	ID	ID	ID	NA	ID
4-4'-DDT	9.1E+6	1.0E+7	1.0E+7	NA	2.2E+7
Decabromodiphenyl ether	ID	ID	ID	NA	5.3E+9
Di-n-butyl phthalate	4.9E+8	2.7E+10	2.7E+10	2.3E+6	2.3E+9
Di(2-ethylhexyl) adipate	ID	ID	ID	1.0E+7	ID
Di-n-octyl phthalate	ID	ID	ID	4.3E+8	ID
Diacetone alcohol	ID	ID	ID	1.0E+7	1.1E+11
Diazinon	ID	ID	ID	1.0E+7	ID

GENERIC SOIL INHALATION CRITERIA (SIC)
FOR RESIDENTIAL LAND USE
1/2 ACRE SOURCE SIZE

Chemical	RESIDENTIAL SIC				
	Infinite Source VSIC	Finite Source VSIC for 5m source thickness	Finite Source VSIC for 2m source thickness	Csat	PSIC
Dibenzo(a,h)anthracene	ID	ID	ID	NA	ID
Dibenzofuran	ID	ID	ID	NA	ID
Dibromochloromethane	17,000	17,000	30,000	1.1E+6	8.7E+7
Dibromomethane	ID	ID	ID	3.3E+6	ID
1,2-Dichlorobenzene	5.5E+6	5.5E+6	9.7E+6	5.9E+5	1.4E+10
1,3-Dichlorobenzene	ID	ID	ID	5.7E+5	ID
1,4-Dichlorobenzene	55,000	55,000	1.1E+5	NA	3.1E+8
3,3'-Dichlorobenzidine	76,000	4.3E+5	4.3E+5	NA	4.5E+6
Dichlorodifluoromethane	7.4E+5	7.8E+6	1.9E+7	3.5E+6	3.2E+10
1,1-Dichloroethane	2.2E+7	9.3E+7	2.2E+8	1.1E+6	3.7E+11
1,2-Dichloroethane	4,400	11,000	25,000	1.4E+6	8.2E+7
1,1-Dichloroethylene	830	5,300	13,000	1.2E+6	4.3E+7
cis-1,2-Dichloroethylene	2.9E+7	9.3E+7	2.2E+8	1.0E+6	3.6E+11
trans-1,2-Dichloroethylene	2.0E+5	8.1E+5	1.9E+6	2.6E+6	3.2E+9
2,6-Dichloro-4-nitroaniline	ID	ID	ID	NA	ID
2,4-Dichlorophenol	2.2E+7	5.7E+7	5.7E+7	2.7E+8	3.5E+9
2,4-Dichlorophenoxyacetic acid	ID	ID	ID	NA	1.6E+9
1,2-Dichloropropane	18,000	48,000	1.1E+5	9.4E+5	1.8E+8
1,3-Dichloropropene	1,000	5,100	12,000	1.2E+6	4.1E+7
Dichlorovos	ID	ID	ID	1.0E+7	2.3E+7
Dicyclohexyl phthalate	ID	ID	ID	NA	ID
Dieldrin	14,000	14,000	14,000	NA	4.6E+5
Diethoxymethane	ID	ID	ID	1.0E+7	ID
Diethyl ether	3.6E+6	8.4E+6	2.0E+7	6.3E+6	3.2E+10
Diethyl phthalate	4.1E+7	4.6E+7	4.6E+7	1.9E+6	2.3E+9
Diethylene glycol monobutyl ether	ID	ID	ID	1.0E+7	9.2E+8
Diisopropylamine	ID	ID	ID	1.0E+7	ID
Dimethyl phthalate	1.3E+7	1.3E+7	1.3E+7	1.3E+6	2.3E+9
N,N-Dimethylacetamide	ID	ID	ID	1.0E+7	ID
N,N-Dimethylaniline	ID	ID	ID	1.0E+7	1.8E+8
Dimethylformamide	ID	ID	ID	1.0E+7	1.4E+9
2,4-Dimethylphenol	2.3E+7	2.3E+7	2.3E+7	NA	3.2E+9
2,6-Dimethylphenol	ID	ID	ID	NA	ID
3,4-Dimethylphenol	ID	ID	ID	NA	ID
Dimethylsulfoxide	ID	ID	ID	1.0E+7	ID
2,4-Dinitrotoluene	1.4E+6	2.4E+6	2.4E+6	NA	1.1E+7
Dinoseb	ID	ID	ID	4.0E+5	ID
1,4-Dioxane	1.4E+5	1.4E+5	2.8E+5	5.7E+7	3.8E+8
Diquat	ID	ID	ID	NA	ID
Diuron	ID	ID	ID	NA	ID
Endosulfan	ID	ID	ID	NA	ID
Endothall	ID	ID	ID	NA	1.6E+9
Endrin	ID	ID	ID	NA	ID
Epichlorohydrin	4.3E+5	4.3E+5	6.3E+5	4.7E+6	1.8E+9
Ethanol	ID	ID	ID	1.0E+7	8.7E+11
Ethyl acetate	3.5E+7	4.4E+7	9.5E+7	5.7E+6	1.5E+11

GENERIC SOIL INHALATION CRITERIA (SIC)
FOR RESIDENTIAL LAND USE
1/2 ACRE SOURCE SIZE

Chemical	RESIDENTIAL SIC				
	Infinite Source VSIC	Finite Source VSIC for 5m source thickness	Finite Source VSIC for 2m source thickness	Csat	PSIC
1-Ethyl-2-methylbenzene	ID	ID	ID	1.0E+7	1.8E+6
Ethylbenzene	6.7E+6	6.7E+6	6.7E+6	3.8E+5	4.6E+10
Ethylene dibromide	1,200	1,500	3,200	1.6E+6	9.7E+6
Ethylene glycol	ID	ID	ID	1.0E+7	5.7E+10
Ethylene glycol acetate	ID	ID	ID	1.0E+7	ID
Ethylene glycol monobutyl ether	ID	ID	ID	1.0E+7	1.1E+10
Fluoranthene	5.3E+8	5.3E+8	5.3E+8	NA	6.4E+9
Fluorene	8.9E+7	8.9E+7	8.9E+7	NA	6.4E+9
Fluorine (soluble fluoride)	ID	ID	ID	NA	ID
Formaldehyde	8,900	22,000	55,000	3.7E+7	1.6E+8
Formic acid	1.5E+5	1.5E+5	1.5E+5	6.3E+7	9.2E+7
1-Formylpiperidine	ID	ID	ID	1.0E+7	ID
Gentian violet	ID	ID	ID	NA	ID
Glyphosate	ID	ID	ID	NA	ID
Heptachlor	43,000	43,000	44,000	NA	1.6E+6
Heptachlor epoxide	58,000	58,000	58,000	NA	8.2E+5
n-Heptane	ID	ID	ID	1.0E+7	1.6E+11
Hexabromobenzene	ID	ID	ID	NA	ID
Hexachlorobenzene (C-66)	12,000	12,000	12,000	NA	4.6E+6
Hexachlorobutadiene (C-46)	95,000	95,000	95,000	1.0E+6	9.7E+7
alpha-Hexachlorocyclohexane	19,000	19,000	19,000	NA	1.2E+6
beta-Hexachlorocyclohexane	1.5E+5	1.9E+5	1.9E+5	NA	4.0E+6
Hexachlorocyclopentadiene (C-56)	ID	ID	ID	2.4E+5	ID
Hexachloroethane	1.4E+6	1.4E+6	1.4E+6	NA	5.3E+8
n-Hexane	ID	ID	ID	1.0E+7	9.2E+9
2-Hexanone	ID	ID	ID	1.0E+7	1.8E+9
Indeno(1,2,3-cd)pyrene	ID	ID	ID	NA	ID
Iron	ID	ID	ID	NA	ID
Isobutyl alcohol	4.0E+7	4.0E+7	4.0E+7	7.1E+6	4.8E+10
Isophorone	2.9E+7	2.9E+7	2.9E+7	4.1E+6	1.3E+10
Isopropyl alcohol	ID	ID	ID	1.0E+7	1.0E+10
Isopropyl benzene	ID	ID	ID	1.2E+6	ID
Lead	ID	ID	ID	NA	6.9E+7
Lindane	ID	ID	ID	NA	ID
Magnesium	ID	ID	ID	NA	4.6E+9
Manganese	ID	ID	ID	NA	2.3E+6
Mercury (Inorganic)	ID	ID	ID	NA	1.4E+7
Methanol	4.9E+6	4.1E+7	9.3E+7	1.8E+6	1.5E+11
Methoxychlor	ID	ID	ID	NA	ID
2-Methoxyethanol	ID	ID	ID	1.0E+7	9.2E+8
2-Methyl-4-chlorophenoxyacetic acid	ID	ID	ID	NA	ID
2-Methyl-4,6-dinitrophenol	ID	ID	ID	NA	ID
Methyl parathion	ID	ID	ID	NA	ID
4-Methyl-2-pentanone (MIBK)	3.2E+7	3.2E+7	6.3E+7	3.0E+6	9.4E+10
Methyl-tert-butyl ether (MTBE)	ID	ID	ID	6.1E+6	1.4E+11
N-Methyl-morpholine	ID	ID	ID	1.0E+7	ID

GENERIC SOIL INHALATION CRITERIA (SIC)
FOR RESIDENTIAL LAND USE
1/2 ACRE SOURCE SIZE

Chemical	RESIDENTIAL SIC				
	Infinite Source VSIC	Finite Source VSIC for 5m source thickness	Finite Source VSIC for 2m source thickness	Csat	PSIC
Methylcyclopentane	ID	ID	ID	1.0E+7	ID
4,4'-Methylene-bis-2-chloroaniline	ID	ID	ID	NA	5.8E+7
Methylene chloride	1.5E+5	5.7E+5	1.4E+6	2.4E+6	4.6E+9
2-Methylnaphthalene	ID	ID	ID	NA	ID
2-Methylphenol	1.7E+7	1.7E+7	1.7E+7	NA	4.6E+9
3-Methylphenol	ID	ID	ID	7.4E+6	ID
4-Methylphenol	ID	ID	ID	NA	ID
Metolachlor	ID	ID	ID	1.0E+7	ID
Molybdenum	ID	ID	ID	NA	ID
Naphthalene	9.8E+6	9.8E+6	9.8E+6	NA	6.4E+9
Nickel	ID	ID	ID	NA	8.9+E6
Nitrate	ID	ID	ID	NA	ID
Nitrite	ID	ID	ID	NA	ID
Nitrobenzene	96,000	96,000	96,000	9.4E+5	8.0E+7
2-Nitrophenol	ID	ID	ID	NA	ID
n-Nitroso-di-n-propylamine	1,600	1,600	1,600	2.4E+6	1.1E+6
N-Nitrosodiphenylamine	ID	ID	ID	NA	ID
Oxo-hexyl acetate	ID	ID	ID	1.0E+7	3.7E+9
Pendimethalin	ID	ID	ID	NA	ID
Pentachlorobenzene	ID	ID	ID	5.8E+5	ID
Pentachloronitrobenzene	1.6E+5	1.6E+5	1.6E+5	NA	2.3E+8
Pentachlorophenol	1.1E+6	4.9E+7	4.9E+7	NA	7.1E+7
Pentane	ID	ID	ID	1.0E+7	8.1E+11
2-Pentene	ID	ID	ID	1.0E+7	ID
Phenanthrene	ID	ID	ID	NA	9.2E+7
Phenol	1.2E+8	1.2E+8	1.2E+8	1.4E+7	2.8E+10
Phosphorus (total)	ID	ID	ID	NA	ID
Phosphorus (total)	ID	ID	ID	NA	ID
Picloram	ID	ID	ID	NA	ID
Piperidine	ID	ID	ID	1.0E+7	6.4E+9
Polybrominated biphenyls	ID	ID	ID	NA	ID
Polychlorinated biphenyls (PCBs)	ID	ID	ID	NA	2.1E+6
Prometon	ID	ID	ID	NA	ID
Propachlor	ID	ID	ID	NA	ID
Propazine	ID	ID	ID	NA	ID
Propionic acid	ID	ID	ID	1.0E+7	1.4E+10
Propyl alcohol	ID	ID	ID	1.0E+7	3.3E+10
Propylene glycol	ID	ID	ID	1.0E+7	2.8E+11
Pyrene	4.7E+8	4.7E+8	4.7E+8	NA	4.6E+9
Pyridine	6,300	39,000	96,000	35,000	1.6E+8
Selenium	ID	ID	ID	NA	9.2E+7
Silver	ID	ID	ID	NA	4.6E+6
Simazine	ID	ID	ID	NA	ID
Sodium	ID	ID	ID	NA	ID
Styrene	6.6E+5	6.6E+5	1.3E+6	1.5E+6	3.6E+9
Sulfate	ID	ID	ID	NA	ID

GENERIC SOIL INHALATION CRITERIA (SIC)
FOR RESIDENTIAL LAND USE
1/2 ACRE SOURCE SIZE

Chemical	RESIDENTIAL SIC				
	Infinite Source VSIC	Finite Source VSIC for 5m source thickness	Finite Source VSIC for 2m source thickness	Csat	PSIC
Tebuthiuron	ID	ID	ID	NA	ID
2,3,7,8-Tetrabromodibenzo-p-dioxin	ID	ID	ID	NA	ID
1,2,4,5-Tetrachlorobenzene	ID	ID	ID	NA	ID
2,3,7,8-Tetrachlorodibenzo-p-dioxin	19	20	20	NA	49
1,1,1,2-Tetrachloroethane	41,000	47,000	96,000	2.6E+6	2.9E+8
1,1,2,2-Tetrachloroethane	7,100	7,100	13,000	1.8E+6	3.7E+7
Tetrachloroethylene	1.3E+5	4.7E+5	1.1E+6	2.1E+5	3.7E+9
Tetrahydrofuran	ID	ID	ID	1.0E+7	2.7E+11
Thallium	ID	ID	ID	NA	ID
Toluene	2.0E+6	4.9E+6	1.1E+7	6.2E+5	1.8E+10
p-Toluidine	ID	ID	ID	1.5E+6	6.9E+7
Toxaphene	3.4E+5	3.4E+5	3.4E+5	NA	6.7E+6
Triallate	ID	ID	ID	1.0E+7	ID
Tributylamine	ID	ID	ID	1.0E+7	3.2E+8
1,2,4-Trichlorobenzene	1.9E+6	1.9E+6	1.9E+6	3.2E+6	1.6E+9
1,1,1-Trichloroethane	5.2E+7	2.2E+8	5.3E+8	1.1E+6	8.7E+11
1,1,2-Trichloroethane	12,000	19,000	42,000	1.6E+6	1.3E+8
Trichloroethylene	56,000	1.6E+5	3.9E+5	1.2E+6	1.3E+9
Trichlorofluoromethane	1.4E+6	1.4E+6	1.4E+6	1.5E+6	4.8E+10
2,4,5-Trichlorophenol	3.0E+8	6.4E+8	6.4E+8	NA	1.6E+10
2,4,6-Trichlorophenol	2.4E+6	8.0E+6	8.0E+6	NA	6.9E+8
2(2,4,5-Trichlorophenoxy)propionic acid	ID	ID	ID	NA	ID
1,2,3-Trichloropropane	ID	ID	ID	2.0E+6	ID
1,1,2-Trichloro-1,2,2-trifluoroethane	1.4E+8	8.7E+8	2.1E+9	1.7E+6	3.5E+12
Triethanolamine	ID	ID	ID	1.0E+7	2.3E+9
3-Trifluoromethyl-4-nitrophenol	ID	ID	ID	NA	ID
Trifluralin	ID	ID	ID	NA	ID
2,2,4-Trimethyl pentane	ID	ID	ID	1.0E+7	ID
2,2,4-Trimethyl-2-pentene	ID	ID	ID	1.0E+7	ID
1,2,4-Trimethylbenzene	ID	ID	ID	1.0E+7	5.6E+10
1,3,5-Trimethylbenzene	ID	ID	ID	1.0E+7	5.6E+10
tris(2,3-Dibromopropyl)phosphate	ID	ID	ID	80,000	4.0E+6
Urea	ID	ID	ID	NA	ID
Vanadium	ID	ID	ID	NA	ID
Vinyl acetate	1.2E+6	2.5E+6	5.7E+6	1.9E+6	9.2E+9
Vinyl chloride	11,000	98,000	2.4E+5	8.0E+5	8.0E+8
White phosphorus	ID	ID	ID	NA	ID
Xylenes	3.2E+7	5.7E+7	1.3E+8	4.0E+5	2.0E+11
Zinc	ID	ID	ID	NA	ID

ID = Insufficient Data
NA = Not Applicable
Shading indicates VSIC values which exceed Csat screening levels.

(32)

GENERIC SOIL INHALATION CRITERIA (SIC) FOR INDUSTRIAL/COMMERCIAL LAND USE 1/2 ACRE SOURCE SIZE

Criteria may change as toxicity and chemical-specific parameter values are updated. The SIC presented are only protective of chronic systemic health effects. Assessment of acute systemic or non-systemic effects must be conducted to determine if more restrictive criteria are necessary.

All values are presented in ug/kg (ppb).

Chemical	INDUSTRIAL/COMMERCIAL SIC				
	Infinite Source VSIC	Finite Source VSIC for 5m source thickness	Finite Source VSIC for 2m source thickness	Csat	PSIC
Acenaphthene	1.4E+8	3.7E+9	4.3E+9	NA	7.3E+9
Acenaphthylene	ID	ID	ID	NA	1.2E+9
Acetaldehyde	ID	ID	ID	1.0E+7	1.0E+9
Acetic acid	ID	ID	ID	1.0E+7	8.6E+9
Acetone	2.2E+8	2.2E+8	3.4E+8	6.4E+7	2.0E+11
Acetonitrile	9.7E+5	9.7E+5	1.4E+6	1.3E+7	7.3E+8
Acrolein	520	570	1,200	1.4E+7	6.9E+5
Acrylamide	11,000	33,000	33,000	NA	1.8E+6
Acrylic acid	ID	ID	ID	1.0E+7	3.5E+7
Acrylonitrile	12,000	14,000	29,000	5.4E+6	3.4E+7
Alachlor	ID	ID	ID	NA	ID
Aldicarb	ID	ID	ID	NA	ID
Aldicarb sulfoxide	ID	ID	ID	NA	ID
Aldicarb sulfone	ID	ID	ID	NA	ID
Aldrin	1.4E+5	1.4E+5	1.4E+5	NA	4.7E+5
Aluminum	ID	ID	ID	NA	ID
Ammonia	ID	ID	ID	1.0E+7	3.5E+9
Aniline	2.3E+5	2.3E+5	2.3E+5	4.1E+6	3.5E+7
Anthracene	2.3E+9	2.3E+9	2.3E+9	NA	3.5E+10
Antimony	ID	ID	ID	NA	4.8E+7
Arsenic	ID	ID	ID	NA	5.4E+5
Atrazine	ID	ID	ID	NA	ID
Azobenzene	ID	ID	ID	NA	7.4E+7
Barium	ID	ID	ID	NA	1.7E+8
Benzene	33,000	95,000	2.3E+5	7.7E+5	2.8E+8
Benzidine	350	16,000	16,000	NA	34,000
Benzo(a)anthracene	ID	ID	ID	NA	ID
Benzo(b)fluoranthene	ID	ID	ID	NA	ID
Benzo(k)fluoranthene	ID	ID	ID	NA	ID
Benzo(g,h,i)perylene	ID	ID	ID	NA	4.1E+8
Benzo(a)pyrene	1.2E+6	1.6E+6	1.6E+6	NA	1.1E+6
Benzoic acid	ID	ID	ID	2.2E+5	ID
Benzyl alcohol	2.3E+9	2.3E+9	2.3E+9	5.9E+6	1.7E+11
Benzyl chloride	34,000	34,000	46,000	5.7E+5	4.6E+7
Beryllium	ID	ID	ID	NA	9.6E+5
bis(2-chloroethoxy)ethane	ID	ID	ID	1.0E+7	ID
bis(2-Chloroethyl)ether	9,300	9,300	9,300	2.2E+6	9.6E+5
bis(2-Ethylhexyl)phthalate	4.8E+9	6.2E+10	6.2E+10	3.1E+7	5.2E+8
Boron	ID	ID	ID	NA	ID
Bromobenzene	ID	ID	ID	1.0E+7	2.8E+8
Bromodichloromethane	22,000	26,000	55,000	2.7E+6	6.2E+7

GENERIC SOIL INHALATION CRITERIA (SIC)
FOR INDUSTRIAL/COMMERCIAL LAND USE
1/2 ACRE SOURCE SIZE

Chemical	INDUSTRIAL/COMMERCIAL SIC				
	Infinite Source VSIC	Finite Source VSIC for 5m source thickness	Finite Source VSIC for 2m source thickness	Csat	PSIC
Bromoform	2.2E+6	2.2E+6	2.3E+6	1.8E+6	2.1E+9
Bromomethane	ID	ID	ID	3.0E+6	1.7E+8
n-Butanol	3.8E+7	3.8E+7	3.8E+7	6.9E+6	1.2E+10
2-Butanone (MEK)	5.0E+7	5.0E+7	6.6E+7	1.7E+7	3.5E+10
n-Butyl acetate	ID	ID	ID	1.0E+7	3.3E+10
t-Butyl alcohol	ID	ID	ID	1.0E+7	1.0E+11
Butyl benzyl phthalate	1.7E+10	1.9E+10	1.9E+10	9.3E+5	2.4E+10
Cadmium	ID	ID	ID	NA	1.3E+6
Camphene	ID	ID	ID	NA	ID
Caprolactam	ID	ID	ID	NA	3.5E+8
Carbaryl	ID	ID	ID	NA	ID
Carbazole	ID	ID	ID	NA	ID
Carbofuran	ID	ID	ID	NA	ID
Carbon disulfide	2.5E+6	1.6E+7	3.9E+7	5.6E+5	2.4E+10
Carbon tetrachloride	8,700	33,000	79,000	9.8E+5	9.8E+7
Chlordane	8.1E+5	8.1E+5	8.1E+5	NA	6.2E+6
Chloride	ID	ID	ID	NA	ID
Chlorobenzene	1.3E+6	1.9E+6	4.1E+6	6.6E+5	2.4E+9
Chloroethane	ID	ID	ID	NA	3.5E+11
2-Chloroethyl vinyl ether	ID	ID	ID	1.0E+7	ID
Chloroform	1.1E+5	3.3E+5	7.8E+5	2.5E+6	9.6E+8
Chloromethane	1.2E+5	1.2E+6	2.9E+6	1.9E+6	3.6E+9
4-Chloro-3-methylphenol	ID	ID	ID	NA	ID
beta-Chloronaphthalene	ID	ID	ID	NA	ID
2-Chlorophenol	ID	ID	ID	1.9E+7	ID
o-Chlorotoluene	ID	ID	ID	1.0E+7	2.4E+9
Chlorpyrifos	ID	ID	ID	NA	6.9E+7
Chromium (III)	ID	ID	ID	NA	6.9E+7
Chromium (VI)	ID	ID	ID	NA	1.9E+5
Chrysene	ID	ID	ID	NA	ID
Cobalt	ID	ID	ID	NA	6.9E+6
Copper	ID	ID	ID	NA	6.9E+7
Cyanazine	ID	ID	ID	NA	ID
Cyanide	ID	ID	ID	NA	1.7E+9
Cyclohexanone	ID	ID	ID	1.0E+7	3.5E+10
Dacthal	ID	ID	ID	NA	ID
Dalapon	ID	ID	ID	1.0E+7	ID
4-4'-DDD	ID	ID	ID	NA	ID
4-4'-DDE	ID	ID	ID	NA	ID
4-4'-DDT	3.1E+7	3.8E+7	3.8E+7	NA	2.4E+7
Decabromodiphenyl ether	ID	ID	ID	NA	5.8E+9
Di-n-butyl phthalate	1.2E+9	7.6E+10	7.6E+10	2.3E+6	1.7E+9
Di(2-ethylhexyl) adipate	ID	ID	ID	1.0E+7	ID
Di-n-octyl phthalate	ID	ID	ID	4.3E+8	ID
Diacetone alcohol	ID	ID	ID	1.0E+7	8.3E+10
Diazinon	ID	ID	ID	1.0E+7	ID

GENERIC SOIL INHALATION CRITERIA (SIC)
FOR INDUSTRIAL/COMMERCIAL LAND USE
1/2 ACRE SOURCE SIZE

Chemical	INDUSTRIAL/COMMERCIAL SIC				
	Infinite Source VSIC	Finite Source VSIC for 5m source thickness	Finite Source VSIC for 2m source thickness	Csat	PSIC
Dibenzo(a,h)anthracene	ID	ID	ID	NA	ID
Dibenzofuran	ID	ID	ID	NA	ID
Dibromochloromethane	57,000	57,000	90,000	1.1E+6	9.4E+7
Dibromomethane	ID	ID	ID	3.3E+6	ID
1,2-Dichlorobenzene	1.3E+7	1.3E+7	2.0E+7	5.9E+5	1.0E+10
1,3-Dichlorobenzene	ID	ID	ID	5.7E+5	ID
1,4-Dichlorobenzene	1.9E+5	1.9E+5	3.2E+5	NA	3.3E+8
3,3'-Dichlorobenzidine	2.6E+5	1.6E+6	1.6E+6	NA	4.8E+6
Dichlorodifluoromethane	1.8E+6	1.6E+7	3.8E+7	3.5E+6	2.4E+10
1,1-Dichloroethane	5.3E+7	1.9E+8	4.5E+8	1.1E+6	2.8E+11
1,2-Dichloroethane	15,000	32,000	73,000	1.4E+6	8.9E+7
1,1-Dichloroethylene	2,800	16,000	37,000	1.2E+6	4.6E+7
cis-1,2-Dichloroethylene	6.9E+7	1.9E+8	4.5E+8	1.0E+6	2.7E+11
trans-1,2-Dichloroethylene	4.8E+5	1.6E+6	3.9E+6	2.6E+6	2.4E+9
2,6-Dichloro-4-nitroaniline	ID	ID	ID	NA	ID
2,4-Dichlorophenol	5.3E+7	1.4E+8	1.4E+8	2.7E+8	2.7E+9
2,4-Dichlorophenoxyacetic acid	ID	ID	ID	NA	1.2E+9
1,2-Dichloropropane	43,000	98,000	2.3E+5	9.4E+5	1.4E+8
1,3-Dichloropropene	3,500	15,000	36,000	1.2E+6	4.4E+7
Dichlorovos	ID	ID	ID	1.0E+7	1.7E+7
Dicyclohexyl phthalate	ID	ID	ID	NA	ID
Dieldrin	47,000	47,000	47,000	NA	5.0E+5
Diethoxymethane	ID	ID	ID	1.0E+7	ID
Diethyl ether	8.5E+6	1.7E+7	4.0E+7	6.3E+6	2.4E+10
Diethyl phthalate	9.8E+7	1.1E+8	1.1E+8	1.9E+6	1.7E+9
Diethylene glycol monobutyl ether	ID	ID	ID	1.0E+7	6.9E+8
Diisopropylamine	ID	ID	ID	1.0E+7	ID
Dimethyl phthalate	3.1E+7	3.1E+7	3.1E+7	1.3E+6	1.7E+9
N,N-Dimethylacetamide	ID	ID	ID	1.0E+7	ID
N,N-Dimethylaniline	ID	ID	ID	1.0E+7	2.0E+8
Dimethylformamide	ID	ID	ID	1.0E+7	1.0E+9
2,4-Dimethylphenol	5.5E+7	5.5E+7	5.5E+7	NA	2.4E+9
2,6-Dimethylphenol	ID	ID	ID	NA	ID
3,4-Dimethylphenol	ID	ID	ID	NA	ID
Dimethylsulfoxide	ID	ID	ID	1.0E+7	ID
2,4-Dinitrotoluene	4.9E+6	8.6E+6	8.6E+6	NA	1.2E+7
Dinoseb	ID	ID	ID	4.0E+5	ID
1,4-Dioxane	4.6E+5	5.2E+5	9.1E+5	5.7E+7	4.2E+8
Diquat	ID	ID	ID	NA	ID
Diuron	ID	ID	ID	NA	ID
Endosulfan	ID	ID	ID	NA	ID
Endothall	ID	ID	ID	NA	1.2E+9
Endrin	ID	ID	ID	NA	ID
Epichlorohydrin	1.5E+6	1.5E+6	1.9E+6	4.7E+6	1.9E+9
Ethanol	ID	ID	ID	1.0E+7	6.6E+11
Ethyl acetate	8.4E+7	9.2E+7	1.9E+8	5.7E+6	1.1E+11

GENERIC SOIL INHALATION CRITERIA (SIC) FOR INDUSTRIAL/COMMERCIAL LAND USE 1/2 ACRE SOURCE SIZE

Chemical	INDUSTRIAL/COMMERCIAL SIC				
	Infinite Source VSIC	Finite Source VSIC for 5m source thickness	Finite Source VSIC for 2m source thickness	Csat	PSIC
1-Ethyl-2-methylbenzene	ID	ID	ID	1.0E+7	1.4E+6
Ethylbenzene	1.6E+7	2.6E+7	5.9E+7	3.8E+5	3.5E+10
Ethylene dibromide	4,100	4,600	9,200	1.6E+6	1.0E+7
Ethylene glycol	ID	ID	ID	1.0E+7	4.3E+10
Ethylene glycol acetate	ID	ID	ID	1.0E+7	ID
Ethylene glycol monobutyl ether	ID	ID	ID	1.0E+7	8.3E+9
Fluoranthene	1.3E+9	1.3E+9	1.3E+9	NA	4.8E+9
Fluorene	2.1E+8	2.1E+8	2.1E+8	NA	4.8E+9
Fluorine (soluble fluoride)	ID	ID	ID	NA	ID
Formaldehyde	3,000	83,000	1.5E+5	3.7E+7	1.8E+8
Formic acid	3.6E+5	3.6E+5	3.6E+5	6.3E+7	6.9E+7
1-Formylpiperidine	ID	ID	ID	1.0E+7	ID
Gentian violet	ID	ID	ID	NA	ID
Glyphosate	ID	ID	ID	NA	ID
Heptachlor	1.5E+5	1.5E+5	1.5E+5	NA	1.8E+6
Heptachlor epoxide	2.0E+5	2.0E+5	2.0E+5	NA	8.9E+5
n-Heptane	ID	ID	ID	1.0E+7	1.2E+11
Hexabromobenzene	ID	ID	ID	NA	ID
Hexachlorobenzene (C-66)	40,000	40,000	40,000	NA	5.0E+6
Hexachlorobutadiene (C-46)	3.2E+5	3.2E+5	3.2E+5	1.0E+6	1.0E+8
alpha-Hexachlorocyclohexane	64,000	64,000	64,000	NA	1.3E+6
beta-Hexachlorocyclohexane	5.1E+5	6.5E+5	6.5E+5	NA	4.3E+6
Hexachlorocyclopentadiene (C-56)	ID	ID	ID	2.4E+5	ID
Hexachloroethane	4.9E+6	4.9E+6	4.9E+6	NA	5.8E+8
n-Hexane	ID	ID	ID	1.0E+7	6.9E+9
2-Hexanone	ID	ID	ID	1.0E+7	1.4E+9
Indeno(1,2,3-cd)pyrene	ID	ID	ID	NA	ID
Iron	ID	ID	ID	NA	ID
Isobutyl alcohol	9.5E+7	9.5E+7	9.5E+7	7.1E+6	3.6E+10
Isophorone	6.9E+7	6.9E+7	6.9E+7	4.1E+6	9.7E+9
Isopropyl alcohol	ID	ID	ID	1.0E+7	7.6E+9
Isopropyl benzene	ID	ID	ID	1.2E+6	ID
Lead	ID	ID	ID	NA	5.2E+7
Lindane	ID	ID	ID	NA	ID
Magnesium	ID	ID	ID	NA	3.5E+9
Manganese	ID	ID	ID	NA	1.7E+6
Mercury (Inorganic)	ID	ID	ID	NA	1.0E+7
Methanol	1.2E+7	8.5E+7	1.9E+8	1.8E+6	1.1E+11
Methoxychlor	ID	ID	ID	NA	ID
2-Methoxyethanol	ID	ID	ID	1.0E+7	6.9E+8
2-Methyl-4-chlorophenoxyacetic acid	ID	ID	ID	NA	ID
2-Methyl-4,6-dinitrophenol	ID	ID	ID	NA	ID
Methyl parathion	ID	ID	ID	NA	ID
4-Methyl-2-pentanone (MIBK)	7.6E+7	7.6E+7	1.3E+8	3.0E+6	7.1E+10
Methyl-tert-butyl ether (MTBE)	ID	ID	ID	6.1E+6	1.0E+11
N-Methyl-morpholine	ID	ID	ID	1.0E+7	ID

GENERIC SOIL INHALATION CRITERIA (SIC)
FOR INDUSTRIAL/COMMERCIAL LAND USE
1/2 ACRE SOURCE SIZE

Chemical	INDUSTRIAL/COMMERCIAL SIC				
	Infinite Source VSIC	Finite Source VSIC for 5m source thickness	Finite Source VSIC for 2m source thickness	Csat	PSIC
Methylcyclopentane	ID	ID	ID	1.0E+7	ID
4,4'-Methylene-bis-2-chloroaniline	ID	ID	ID	NA	6.2E+7
Methylene chloride	5.1E+5	1.7E+6	4.0E+6	2.4E+6	4.9E+9
2-Methylnaphthalene	ID	ID	ID	NA	ID
2-Methylphenol	4.1E+7	4.1E+7	4.1E+7	NA	3.5E+9
3-Methylphenol	ID	ID	ID	7.4E+6	ID
4-Methylphenol	ID	ID	ID	NA	ID
Metolachlor	ID	ID	ID	1.0E+7	ID
Molybdenum	ID	ID	ID	NA	ID
Naphthalene	2.3E+7	2.3E+7	2.3E+7	NA	4.8E+9
Nickel	ID	ID	ID	NA	9.6E+6
Nitrate	ID	ID	ID	NA	ID
Nitrite	ID	ID	ID	NA	ID
Nitrobenzene	2.3E+5	2.3E+5	2.3E+5	9.4E+5	6.0E+7
2-Nitrophenol	ID	ID	ID	NA	ID
n-Nitroso-di-n-propylamine	5,500	5,500	5,500	2.4E+6	1.2E+6
N-Nitrosodiphenylamine	ID	ID	ID	NA	ID
Oxo-hexyl acetate	ID	ID	ID	1.0E+7	2.8E+9
Pendimethalin	ID	ID	ID	NA	ID
Pentachlorobenzene	ID	ID	ID	5.8E+5	ID
Pentachloronitrobenzene	3.9E+5	3.9E+5	4.0E+5	NA	1.7E+8
Pentachlorophenol	3.8E+6	1.9E+8	1.9E+8	NA	7.7E+7
Pentane	ID	ID	ID	1.0E+7	6.1E+11
2-Pentene	ID	ID	ID	1.0E+7	ID
Phenanthrene	ID	ID	ID	NA	6.9E+7
Phenol	2.8E+8	2.8E+8	2.8E+8	1.4E+7	2.1E+10
Phosphorus (total)	ID	ID	ID	NA	ID
Phosphorus (total)	ID	ID	ID	NA	ID
Picloram	ID	ID	ID	NA	ID
Piperidine	ID	ID	ID	1.0E+7	4.8E+9
Polybrominated biphenyls	ID	ID	ID	NA	ID
Polychlorinated biphenyls (PCBs)	ID	ID	ID	NA	2.3E+6
Prometon	ID	ID	ID	NA	ID
Propachlor	ID	ID	ID	NA	ID
Propazine	ID	ID	ID	NA	ID
Propionic acid	ID	ID	ID	1.0E+7	1.0E+10
Propyl alcohol	ID	ID	ID	1.0E+7	2.5E+10
Propylene glycol	ID	ID	ID	1.0E+7	2.1E+11
Pyrene	1.1E+9	1.1E+9	1.1E+9	NA	3.5E+9
Pyridine	15,000	79,000	1.9E+5	35,000	1.2E+8
Selenium	ID	ID	ID	NA	6.9E+7
Silver	ID	ID	ID	NA	3.5E+6
Simazine	ID	ID	ID	NA	ID
Sodium	ID	ID	ID	NA	ID
Styrene	2.3E+6	2.3E+6	3.7E+6	1.5E+6	3.9E+9
Sulfate	ID	ID	ID	NA	ID

GENERIC SOIL INHALATION CRITERIA (SIC) FOR INDUSTRIAL/COMMERCIAL LAND USE 1/2 ACRE SOURCE SIZE

Chemical	INDUSTRIAL/COMMERCIAL SIC				
	Infinite Source VSIC	Finite Source VSIC for 5m source thickness	Finite Source VSIC for 2m source thickness	Csat	PSIC
Tebuthiuron	ID	ID	ID	NA	ID
2,3,7,8-Tetrabromodibenzo-p-dioxin	ID	ID	ID	NA	ID
1,2,4,5-Tetrachlorobenzene	ID	ID	ID	NA	ID
2,3,7,8-Tetrachlorodibenzo-p-dioxin	64	73	73	NA	52
1,1,1,2-Tetrachloroethane	1.4E+5	1.4E+5	2.8E+5	2.6E+6	3.0E+8
1,1,2,2-Tetrachloroethane	24,000	24,000	38,000	1.8E+6	4.0E+7
Tetrachloroethylene	4.4E+5	1.4E+6	3.2E+6	2.1E+5	4.0E+9
Tetrahydrofuran	ID	ID	ID	1.0E+7	2.0E+11
Thallium	ID	ID	ID	NA	ID
Toluene	4.7E+6	1.0E+7	2.3E+7	6.2E+5	1.4E+10
p-Toluidine	ID	ID	ID	1.5E+6	7.4E+7
Toxaphene	1.2E+6	1.2E+6	1.2E+6	NA	7.2E+6
Triallate	ID	ID	ID	1.0E+7	ID
Tributylamine	ID	ID	ID	1.0E+7	2.4E+8
1,2,4-Trichlorobenzene	4.5E+6	4.5E+6	4.5E+6	3.2E+6	1.2E+9
1,1,1-Trichloroethane	1.3E+8	4.4E+8	1.1E+9	1.1E+6	6.6E+11
1,1,2-Trichloroethane	40,000	57,000	1.2E+5	1.6E+6	1.4E+8
Trichloroethylene	1.9E+5	4.8E+5	1.1E+6	1.2E+6	1.4E+9
Trichlorofluoromethane	3.4E+6	2.4E+7	5.8E+7	1.5E+6	3.6E+10
2,4,5-Trichlorophenol	7.2E+8	1.5E+9	1.5E+9	NA	1.2E+10
2,4,6-Trichlorophenol	8.2E+6	2.7E+7	2.7E+7	NA	7.4E+8
2(2,4,5-Trichlorophenoxy)propionic	ID	ID	ID	NA	ID
1,2,3-Trichloropropane	ID	ID	ID	2.0E+6	ID
1,1,2-Trichloro-1,2,2-trifluoroethane	3.3E+8	1.7E+9	4.2E+9	1.7E+6	2.7E+12
Triethanolamine	ID	ID	ID	1.0E+7	1.7E+9
3-Trifluoromethyl-4-nitrophenol	ID	ID	ID	NA	ID
Trifluralin	ID	ID	ID	NA	ID
2,2,4-Trimethyl pentane	ID	ID	ID	1.0E+7	ID
2,2,4-Trimethyl-2-pentene	ID	ID	ID	1.0E+7	ID
1,2,4-Trimethylbenzene	ID	ID	ID	1.0E+7	4.3E+10
1,3,5-Trimethylbenzene	ID	ID	ID	1.0E+7	4.3E+10
tris(2,3-Dibromopropyl)phosphate	ID	ID	ID	80,000	4.3E+6
Urea	ID	ID	ID	NA	ID
Vanadium	ID	ID	ID	NA	ID
Vinyl acetate	2.9E+6	5.0E+6	1.1E+7	1.9E+6	6.9E+9
Vinyl chloride	39,000	2.8E+5	6.9E+5	8.0E+5	8.7E+8
White phosphorus	ID	ID	ID	NA	ID
Xylenes	7.7E+7	1.2E+8	2.6E+8	4.0E+5	1.5E+11
Zinc	ID	ID	ID	NA	ID

ID = Insufficient Data
NA = Not Applicable
Shading indicates VSIC values which exceed Csat screening levels.

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY

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INTEROFFICE COMMUNICATION

May 14, 1996 *REVISED DRAFT*

MEMORANDUM #14

TO: Environmental Response Division (ERD) Staff

FROM: Alan J. Howard, Chief, Environmental Response Division

SUBJECT: Interim Generic Utility Worker Groundwater Contact Criteria: Addendum to Interim Operational Memoranda #8, Revision 4 (June 5, 1995) and #14, Revision 2 (June 6, 1995)

The attached document describes the application and technical basis for Part 201 generic groundwater contact criteria (GCC). These criteria should be reviewed for their applicability in all land use categories. The criteria described in the attached document are relevant in determining the adequacy of a remedial action and for making a determination about whether property is a facility. These criteria will be controlling factors in facility determinations only when more restrictive exposure pathways for groundwater are not pertinent (e.g., the groundwater is not in an aquifer, so application of the drinking water-based criteria are not appropriate).

Exposure to contaminants via direct contact with groundwater may be the controlling factor for the cleanup of groundwater in some cases. This is fully discussed in the attached materials. Note carefully that the new generic criteria are likely to be controlling factors in two situations:

- where ingestion of contaminants in groundwater is not relevant because land use restrictions prevent the use of groundwater for drinking water, or
- where the groundwater is not in an aquifer.

Groundwater contaminant migration off-property and/or to nearby surface waters must also be considered before deciding whether the generic GCC will control the need for groundwater remediation.

These generic GCC address only the dermal route of exposure to groundwater contaminants. Similar to other generic criteria, the generic utility worker GCC are only protective of systemic (i.e., within the body) health effects. For some contaminants and exposure settings, the inhalation route may be the more significant route of exposure when use of groundwater has been reliably restricted or the groundwater is not in an aquifer. Potential inhalation concerns must be addressed as outlined in my November 14, 1995 memorandum to staff.

Generic GCC for application in settings where additional groundwater contact exposures must be accounted for (e.g., in ponds) are still under development and will be provided as soon as they are available.

Staff of the ERD must obtain approval of the use of these criteria before the remedial action plan or closure report is approved. Questions or further information can be directed to Christine Flaga, 517-373-0160; Jeffrey Crum, 335-3092, or Linda Larsen, 335-3161.

Attachments

cc: Mr. Jim Sygo, DEQ
Mr. Arthur Nash, DEQ
Mr. Paul Zugger, DEQ
Mr. Robert Miller, DEQ
Mr. Dennis Drake, DEQ
Ms. Lynn Boyd, DEQ

EQ 0101
(10/95)

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PART 201 INTERIM GENERIC GROUNDWATER CONTACT CRITERIA FOR UTILITY WORKERS

May 14, 1996

Jeffrey A. Crum

This memorandum provides interim generic groundwater contact criteria (GCC) that may be used to address utility worker dermal contact with groundwater contaminants. These criteria have been developed in response to the increasing number of facilities where groundwater is reliably restricted from drinking water use, or is hydrogeologically classified as "not in an aquifer." Application of the Part 201 health-based drinking water values are not applicable to these situations, and past use of the residential soil "20x drinking water" or soil direct contact values are not consistent with Part 201 Section 20120a(3) because contaminant absorption from groundwater and soil are different. Section 20120a(3) requires the department to appropriately characterize human exposures associated with land uses and to use reasonable and relevant exposure pathways in establishing the human health risk assessment assumptions used for developing cleanup criteria. To facilitate remedial action at facilities where groundwater use for drinking water is not applicable, utility worker GCC were developed to characterize the risks associated with dermal contact with groundwater contaminants to assure human health protection.

The generic utility worker GCC presented in the attached table address only the dermal route of exposure to groundwater contaminants. For some contaminants and exposure settings, the inhalation route may be the more significant route of exposure when drinking water use of the groundwater has been reliably restricted, or groundwater is not in an aquifer. Inhalation of emissions from volatile groundwater contaminants is applicable to utility workers since excavations more than 4 feet below ground surface are considered confined spaces under occupational safety regulations (MIOSHA Administrative Rule 6402, promulgated pursuant to 1974 PA 154, as amended). Further, the GCC may not be protective for generic closures where indoor or ambient air inhalation exposures, or future pond construction (swimmer exposures), may result in the application of more restrictive criteria. Additional guidance for evaluating inhalation exposure to groundwater contaminants is provided in attachment A. ***In all cases, the exposure pathway with the most restrictive criteria will apply, unless land use restrictions preclude exposure to the groundwater for that pathway.***

Similar to other generic criteria, utility worker GCC are only protective of systemic human health effects—those which occur as a result of absorption and distribution of the chemical to an organ/tissue ***within*** the body. Assessment of the potential for non-systemic or acute effects must be conducted to determine if more restrictive criteria, than determined from the above exposure pathway evaluation, are necessary to protect for these endpoints. ***It is also important that groundwater contaminant concentrations be evaluated for potential physical hazards, such as corrosivity and flammability.*** Further guidance for addressing these concerns is provided in attachment B.

This document only addresses utility worker exposures. Separate criteria will be developed in the future to consider the potential for pond development and subsequent exposure of swimmers to groundwater contaminants venting to these surface waters. When reviewing remedial actions proposed for facilities in rural areas, the pond swimmer exposure scenario may be the controlling factor. If you believe the pond scenario is relevant for a facility you are evaluating, consult your supervisor for direction.

APPLICATION OF UTILITY WORKER GCC

The generic utility worker GCC criteria are appropriate and relevant to facilities where it can be demonstrated that:

1. there is no migration of groundwater contaminants to an aquifer at concentrations above the residential drinking water values, or drinking water use of the aquifer is reliably restricted, and

2. contaminant migration to an existing nearby surface water body at concentrations above applicable generic or mixing zone-based groundwater surface water interface (GSI) criteria is not a relevant pathway, and

3. the facility is located where underground utilities exist in saturated soils, or may be constructed in saturated soils.

Facility information must be adequately characterized to assure proper application of the generic utility worker GCC. If non-drinking water uses of the groundwater are not institutionally controlled, consideration must be given to whether the generic utility worker GCC are adequately protective. The extent of groundwater contaminant migration must also be adequately characterized to assure that appropriate criteria are applied in accordance with current and future uses of the groundwater on- and off-property. The GCC criteria are applicable to all land use categories. Note, though, that if the groundwater cleanup criteria are based on a pathway other than the GCC (e.g., drinking water or inhalation), Section 20120a(16) requires that residential-based criteria be met at the property boundary unless adequate land use restrictions are in place to make consideration of residential exposures unnecessary. Attention should be given to the hydrogeology, contaminant concentrations, exposure setting, land use and receptor activities for all properties that are impacted by the contamination. Consideration should also be given to groundwater contaminant migration in utility corridors, such as storm and sewer water collection and drainage systems which often discharge to surface water bodies.

UTILITY WORKER SCENARIO

Subsurface utility repair, maintenance and installation are common activities that may result in periodic contact with groundwater contaminants by utility workers under any land use. Therefore, generic utility worker GCC have been developed for application to all land use categories. Utility worker exposure to groundwater contaminants is likely to occur throughout the duration of their employment, resulting in a higher frequency of contact with contaminants relative to a construction worker. However, consideration should be given to known or planned long-term construction projects which could result in greater overall exposure of a construction worker.

Application of the utility worker GCC is required at all facilities where soil excavations to conduct utility work will result in groundwater seepage and collection in the excavation. As a general rule, GCC are not applicable unless groundwater samples can be obtained from saturated zones; seasonal variations must be considered. These criteria are applicable at both facilities that have existing utilities and facilities where utilities could be placed in the future. The depth of the existing utilities, if any, and reasonable expectations about the depth of future utilities need to be considered in determining the depth at which the GCC would apply. While many utilities are present near the ground surface, be aware that some utilities such as sewers may be at considerably greater depths. Remedial action plans must identify existing utility corridors and their depth in relation to the saturated soils, and describe the basis for conclusions regarding the potential depth of future utilities.

Exposure Assumptions

Consistent with the development of other generic criteria, the exposure assumptions for utility workers were developed to characterize a reasonable maximum exposure (RME). Dermal contact with groundwater by a utility worker is not likely to be continuous over the 8-hour work day. It is reasonably assumed that a utility worker will be in contact with groundwater for 25% of the 8 hour work day (i.e., ET=2 hours/day). An EF of 20 days/year was selected to account for the presence of multiple utilities and the fact that the number of days required for repair or installation varies for different utility types. An ED default value of 21 years is used for the utility worker since they are considered to spend as many years on the job as an industrial worker characterized in the generic soil direct contact criteria calculations. The skin SA is not considered to be equivalent to the skin SA of the industrial worker. It is more probable that half the lower legs, forearms and hands (i.e., SA=3,000 cm^2; EPA, 1992) will be the areas of the body routinely in contact with groundwater contaminants for this scenario. The conventional adult body weight of 70 kg is used for the utility line worker.

Please see attachment C for an explanation of the calculations that were performed in the development of the utility worker GCC, and the generic utility worker GCC equations.

DETERMINING SOIL CLEANUP CRITERIA

When the utility worker GCC are the controlling criteria for groundwater cleanup, corresponding soil cleanup criteria may be developed using options provided in Rule 299.5711(2). In this case, the acceptable methods for establishing soil concentrations protective of groundwater are:

- Comparison of leachate test results to the GCC or to background groundwater concentrations,
- Use of 20 times the GCC concentration as an acceptable soil concentration, or
- Concentrations derived through ERD-approved fate and transport modeling.

Remember that other pathways, such as direct contact with soil or inhalation of emissions from volatile contaminants in soil, may be more restrictive and control the overall soil cleanup criteria.

GENERAL PROVISIONS

The generic utility worker GCC generated from the equations in attachment C should be considered draft, as the equations and other matters addressed pertaining to their use are subject to revision. Final cleanup standards must be confirmed by Environmental Response Division toxicologists and approved as part of a specific remedial action plan (RAP).

This document is intended to provide guidance to ERD staff to foster consistent application of Part 201 of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended, and associated Administrative Rules. This document is not intended to convey any rights to any parties nor create any duties or responsibilities under law. This document and matters addressed herein are subject to revision.

Questions related to the generic utility worker GCC can be directed to Christine Flaga (517-373-0160), Jeffrey Crum (517-335-3092), or Linda Larsen (517-335-3161).

REFERENCES

EPA (U.S. Environmental Protection Agency). 1992. Dermal Exposure Assessment: Principles and Applications. Interim Report. Office of Research and Development. EPA/600/R-93/089.

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INHALATION EXPOSURE TO GROUNDWATER CONTAMINANTS

The potential for emissions from volatile contaminants in groundwater to indoor air and confined spaces must be evaluated to determine if the utility worker GCC are protective of inhalation exposures. Inhalation of emissions from volatile groundwater contaminants must be considered for utility workers since excavations more than 4 feet below ground surface are considered confined spaces under occupational safety regulations (MIOSHA Administrative Rule 6402, promulgated pursuant to 1974 PA 154, as amended). Consideration of inhalation exposures is also appropriate to assure protection of current and/or future human receptors living or working indoors at the facility.

Assessment of groundwater contaminant volatile emissions is only required for chemicals with a Henry's Law constant greater than 1×10^{-5} atm-m^3/mole *and* a molecular weight of less than 200 g/mole (EPA, 1991). If the chemical has these characteristics, contact an ERD toxicologist for assistance in calculating appropriate criteria.

Until the Department identifies and establishes quantitative methods for developing generic groundwater inhalation criteria for volatile emissions to indoor air and confined spaces, the ASTM (1996) Risk-Based Screening Levels (RBSLs) for "groundwater volatile emission to indoor air" can be used to identify groundwater contaminant concentrations that do not need further evaluation. Environmental Response Division is currently using a software package, which applies the ASTM equations to derive generic (Tier 1) land use-based RBSLs for volatile groundwater contaminants emitted to indoor air. ***Although the RBSLs are not regulatory compliance criteria, they are acceptable for generic land use closures.*** Parties may propose other quantitative approaches, or conduct a site-specific assessment to support the application of alternative criteria protective of inhalation of groundwater volatile emissions to indoor air and confined spaces. Development of Part 201 generic groundwater inhalation criteria for volatile emissions to indoor air and confined spaces will be pursued at a later date. We expect that those generic criteria will be less restrictive than the RBSLs.

Although inhalation exposure to groundwater contaminants volatilizing to *ambient air* above ground surface may be a relevant pathway at some facilities, criteria for this exposure route are not expected to be less than the future Part 201 indoor air and confined space groundwater inhalation criteria.

REFERENCES

EPA (Environmental Protection Agency). 1991. Risk Assessment Guidance for Superfund. Development of Preliminary Remediation Goals. Interim. (Part B)

ASTM (American Society For Testing and Materials). 1996. Standard Guide for Risk-Based Corrective Action Applied at Petroleum Sites. ES-1739.

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ISSUES NOT ADDRESSED BY THE GROUNDWATER CONTACT CRITERIA

Several chemicals have generic utility worker GCC that exceed their water solubility concentration. This is most likely due to development of generic GCC that only address protection of *systemic* (i.e., toxic effects which occur as a result of absorption and distribution of the chemical to a site/organ *within* the body) health effects. Use of oral toxicity values based on administered doses in conjunction with dermal absorbed estimates of dose may also contribute to elevated criteria. For chemicals which have water solubility values that are less than the utility worker GCC, the solubility value will become the default GCC. In addition, where data are insufficient to develop GCC and inhalation screening criteria, the water solubility values become the default GCC. Groundwater contaminant concentrations above their water solubilities may result in free product formation, which may cause non-systemic or acute health effects, as well as other physical hazards, which may need to be addressed.

Chemical-specific evaluation of the potential for non-systemic effects and/or acute health effects, as required under Section 20120a(4) and administrative rule 299.5711(6), which may be significant to dermal exposures, has not been completed. ERD toxicologists are in the process of identifying contaminants that may cause point-of-entry (e.g., contact dermatitis) and reproductive/developmental effects to assure that the most sensitive toxic endpoint is represented in the development of Part 201 criteria. In all cases, it is important that groundwater contaminant concentrations be evaluated for potential physical hazards, such as corrosivity and flammability. Until these concerns can be incorporated into the criteria development process, ERD toxicologists will use professional judgment on a facility-by-facility basis to prevent delays in remedial decisions.

It is not appropriate to use the oral slope factors for the carcinogenic polycyclic aromatic hydrocarbons (PAHs) to develop dermal exposure-based GCC since they cause skin cancer at the point of application. Therefore, criteria are not provided for the carcinogenic PAHs. Their presence in groundwater, however, will likely be limited since they are relatively immobile in soil. Professional judgment will be used to address situations where these contaminants are present in the groundwater.

REFERENCES

EPA (U.S. Environmental Protection Agency). 1989. Risk Assessment Guidance for Superfund. Volume I. Human Health Evaluation Manual. (Part A). Interim Final. Office of Emergency and Remedial Response. EPA/540/1-89/002.

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CALCULATION OF GENERIC GROUNDWATER CONTACT CRITERIA

Once the appropriate generic exposure scenario has been identified for the facility, or the party chooses to perform a facility-specific criteria calculation, the first step for generic GCC calculations is to estimate the dermal absorbed dose (DA) over the specified exposure period (time in hours). Derivation of the DA is performed differently for inorganic and organic compounds. In addition, the equations presented in EPA's (1992) dermal exposure assessment guidance for estimating chemical-specific dermal absorption have been rearranged to back-calculate the chemical concentration in water (C_w in EPA) consistent with all Part 201 generic risk-based equations; EPA determines the risk associated with exposure to a chemical-specific water concentration, whereas Part 201 derives the chemical-specific concentration in water associated with the target risk. The DA_{event} term in EPA (1992) is replaced by DA_i and DA_o to designate the chemical-specific dermal absorbed dose for inorganic and organic compounds, respectively. It also assumed for these generic calculations that only one exposure "event" occurs per day, thereby eliminating the need to consider event frequency as incorporated into the EPA (1992) method.

Current EPA (1992) guidance recommends using the steady-state approach for estimating the dermal absorbed dose for inorganic substances (DA_i), shown in the following equation:

$$DA_i = K_p * ET$$

where,

DA_i = dermal absorbed dose (cm chemical-specific)
K_p = permeability coefficient - skin penetration rate (cm/hr, chemical specific)
ET = exposure time (hr)

Permeability coefficients (K_p) for some inorganics are provided in Table 5-3 of EPA (1992). If a K_p is not listed for a particular inorganic, a default value of 0.001 cm/hour was used (EPA, 1992).

Determination of the dermal absorbed dose for organic compounds (DA_o) is more complex, because a nonsteady-state method is recommended to account for contaminant absorption that occurs after the actual exposure event due to storage of contaminant within skin lipids (fat) (EPA, 1992). Factors such as the contaminants tendency to partition between lipid and water phases influence the amount of contaminant absorbed after exposure has ceased. Table 5-7 of EPA (1992) provides estimated K_p values for several chemicals using the Potts and Guy (1992) correlation equation shown below.

$$Log\ K_p = -2.72 + 0.71 * (\log K_{ow}) - (0.0061 * MW)$$

where,

K_{ow} = octanol-water partition coefficient (L/L, chemical-specific)
MW = molecular weight (g/mole, chemical-specific)

Octanol/water partition coefficients (K_{ow}) and the molecular weights (MW) for several organics chemicals are presented in Table 5-7 of EPA (1992) along with the calculated K_p value. These estimated K_p values are then used in one of the equations presented below, depending on the ET value of the generic exposure scenario relative to the chemical-specific t^* value listed in Table 5-8. As described earlier, it is necessary to delete the concentration in water term (C_w) from EPA (1992) equations 5.20 and 5.21. The equations used to estimate organic contaminant absorption (DA_o) through the skin are as follows:

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If ET > t^*, then : $DA_o = 2 * K_p * [(6 * T * ET)/\pi]^{1/2}$

If ET < t^*, then : $DA_o = K_p * [(ET/1 + B) + 2 * T * (1 + 3*B)/(1 + B)]$

where,

DA_o	= dermal absorbed dose (cm, chemical-specific)
K_p	= permeability coefficient (cm/hr, chemical-specific)
ET	= exposure time (hr)
t^*	= time required to reach steady state (hr)
T	= lag time (hr)
B	= dimensionless constant representing the octanol-water partitioning properties of a chemical

Chemical-specific values for t^*, T and B are presented in Table 5-8 of EPA (1992). For chemicals which do not have listed K_{ow} values in Table 5-7, but are regulated under Part 201, peer-reviewed literature values were used to develop K_p values for these chemicals. EPA (1992) guidance was followed for conducting the necessary successive steps to derive chemical-specific values for t^*, T and B to complete the appropriate calculation of the DA_o.

The DA_i or DA_o are then incorporated into the appropriate generic groundwater contact equation shown below for calculation of the criteria.

Generic Groundwater Contact Equations

UTILITY WORKER

CARCINOGENS:

$$C_{gw/dc} = \frac{BW * AT * TR * 1000\ ug/mg}{SF * SA * DA * EF * ED * CF}$$

where,

$C_{gw/dc}$	risk-based groundwater concentration for dermal contact	= ug/l, or ppb
BW	body weight	= 70 kg
AT	averaging time	= 25,550 days (70 * 365)
TR	acceptable risk level	= 10^{-5}
SF	cancer slope factor	= chemical-specific $(mg/kg/day)^{-1}$
SA	skin surface area (adult)	= 3,000 cm^2/day
DA	dose absorbed (see text above for calculation)	= chemical-specific, cm
EF	exposure frequency	= 20 days/year
ED	exposure duration	= 21 years
CF	conversion factor	= 1E-3 L/cm^3

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NONCARCINOGENS:

$$C_{gw/dc} = \frac{HQ * RfD * BW * AT * 1000\ ug/mg}{SA * DA * EF * ED * CF}$$

where,

$C_{gw/dc}$	risk-based groundwater concentration for dermal contact	= ug/l, or ppb
HQ	hazard quotient	= 1
RfD	oral reference dose	= mg/kg/day
AT	averaging time	= 10,950 days (30 * 365)
SA	skin surface area (adult)	= 3,000 cm^2/day
DA	dose absorbed (see text above for calculation)	= chemical-specific, cm
EF	exposure frequency	= 20 days/year
ED	exposure duration	= 21 years
CF	conversion factor	= 1E-3 L/cm^3

REFERENCES

EPA (U.S. Environmental Protection Agency) 1992. Dermal Exposure Assessment: Principles and Applications. Interim Report. Office of Research and Development. EPA/600/R-93/089.

Potts, R.O. and Guy, R.H. 1992. Predicting skin permeability. Pharmacol. Res., accepted for publication.

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Part 201 Interim Groundwater Contact Criteria

All values below are expressed in ug/L (ppb).

Chemical	Utility Worker	Water Solubility (ug/L)
Acenaphthene	*1.7E+5	4,200
Acenaphthylene	ID	3,900
Acetaldehyde	3.3E+7	NA
Acetic acid	ID	6.0E+9
Acetone	3.1E+7	1.0E+9
Acetonitrile	5.7E+6	2.0E+8
Acrolein	3.9E+6	2.1E+8
Acrylamide	5,300	2.2E+9
Acrylic acid	ID	NA
Acrylonitrile	8,000	7.5E+7
Alachlor	ID	NA
Aldicarb	ID	6.0E+6
Aldicarb sulfoxide	ID	NA
Aldicarb sulfone	ID	NA
Aldrin	34	180
Aluminum	ID	NA
Ammonia	ID	NA
Aniline	4.3E+5	3.6E+7
Anthracene	*4.0E+5	43
Antimony	1.5E+5	NA
Arsenic	9,500	NA
Atrazine	ID	7.0E+4
Azobenzene	ID	NA
Barium	3.0E+7	NA
Benzene	9,300	1.8E+6
Benzidine	11	5.2E+5
Benzo(a)anthracene	DC	9.4
Benzo(b)fluoranthene	DC	1.5
Benzo(k)fluoranthene	DC	0.8
Benzo(g,h,i)perylene	ID	NA
Benzo(a)pyrene	DC	1.6
Benzoic acid	*8.6E+7	3.5E+6
Benzyl alcohol	*8.3E+7	4.4E+7
Benzyl chloride	2,000	4.9E+5
Beryllium	3,300	NA
bis(2-chloroethoxy)ethane	ID	NA
bis(2-Chloroethyl)ether	1,900	1.7E+7
bis(2-Ethylhexyl)phthalate	47	340
Boron	2.6E+7	NA
Bromobenzene	ID	NA
Bromodichloromethane	11,000	6.7E+6
Bromoform	1.0E+5	3.1E+6
Bromomethane	64,000	1.5E+7
n-Butanol	1.2E+7	7.4E+7
2-Butanone (MEK)	6.2E+7	2.4E+8
n-Butyl acetate	ID	6.7E+6
i-Butyl alcohol	ID	NA

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Part 201 Interim Groundwater Contact Criteria

All values below are expressed in ug/L (ppb).

Chemical	Utility Worker	Water Solubility (ug/L)
Butyl benzyl phthalate	*1.0E+5	2,900
Cadmium	2.1E+5	NA
Camphene	ID	33,000
Caprolactam	ID	5.3E+9
Carbaryl	ID	1.3E+5
Carbofuran	ID	7.0E+5
Carbon disulfide	7.7E+5	1.2E+6
Carbon tetrachloride	1,400	7.9E+5
Chlordane	10	56
Chloride	ID	NA
Chlorobenzene	69,000	4.7E+5
Chloroethane	1.9E+5	5.7E+6
2-Chloroethyl vinyl ether	ID	1.5E+7
Chloroform	89,000	7.9E+6
Chloromethane	1.1E+5	6.3E+6
4-Chloro-3-methylphenol	51,000	3.9E+6
beta-Chloronaphthalene	ID	6,700
2-Chlorophenol	78,000	2.2E+7
o-Chlorotoluene	ID	NA
Chlorpyrifos	ID	1,100
Chromium (III)	6.4E+8	NA
Chromium (VI)	2.0E+6	NA
Chrysene	DC	1.6
Cobalt	5.3E+6	NA
Copper	1.6E+7	NA
Cyanazine	ID	NA
Cyanide	ID	NA
Cyclohexanone	ID	2.3E+7
Dacthal	ID	NA
Dalapon	ID	5.0E+8
4-4'-DDD	19	90
4-4'-DDE	16	120
4-4'-DDT	6.9	25
Decabromodiphenyl ether	ID	30
Di-n-butyl phthalate	*87,000	11,000
Di(2-ethylhexyl) adipate	ID	NA
Di-n-octyl phthalate	250	3,000
Diacetone alcohol	ID	NA
Diazinon	ID	69,000
Dibenzo(a,h)anthracene	ID*	0.67
Dibenzofuran	ID	NA
Dibromochloromethane	9,500	2.6E+6
Dibromomethane	1.7E+5	1.1E+7
1,2-Dichlorobenzene	*1.8E+5	1.6E+5
1,3-Dichlorobenzene	*1.3E+5	1.1E+5
1,4-Dichlorobenzene	2,900	74,000
3,3'-Dichlorobenzidine	270	3,100

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Part 201 Interim Groundwater Contact Criteria

All values below are expressed in ug/L (ppb).

Chemical	Utility Worker	Water Solubility (ug/L)
Dichlorodifluoromethane	*2.8E+6	3.0E+5
1,1-Dichloroethane	2.1E+6	5.1E+6
1,2-Dichloroethane	11,000	8.5E+6
1,1-Dichloroethylene	1,000	2.3E+6
cis-1,2-Dichloroethylene	1.7E+5	3.5E+6
trans-1,2-Dichloroethylene	1.9E+5	6.3E+6
2,6-Dichloro-4-nitroaniline	ID	NA
2,4-Dichlorophenol	51,000	4.5E+6
2,4-Dichlorophenoxyacetic acid	ID	NA
1,2-Dichloropropane	8,100	2.8E+6
1,3-Dichloropropene	5,100	2.8E+6
Dichlorovos	9,600	1.6E+7
Dicyclohexyl phthalate	ID	NA
Dieldrin	3.3	200
Diethoxymethane	ID	NA
Diethyl ether	4.3E+6	6.1E+7
Diethyl phthalate	*1.2E+7	1.1E+6
Diethylene glycol monobutyl ether	ID	NA
Diisopropylamine	ID	NA
Dimethyl phthalate	*6.0E+8	4.2E+6
N,N-Dimethylacetamide	ID	NA
N,N-Dimethylaniline	ID	NA
Dimethylformamide	ID	NA
2,4-Dimethylphenol	4.8E+5	7.9E+6
2,6-Dimethylphenol	ID	NA
3,4-Dimethylphenol	15,000	NA
Dimethylsulfoxide	ID	NA
2,4-Dinitrotoluene	1,300	2.7E+5
Dinoseb	6,100	52,000
1,4-Dioxane	1.4E+6	9.0E+8
Diquat	ID	7.0E+5
Diuron	*46,000	37,000
Endosulfan	*950	510
Endothall	ID	1.0E+8
Endrin	*270	250
Epichlorohydrin	1.5E+6	6.6E+7
Ethanol	1.0E+9	NA
Ethyl acetate	*8.1E+7	6.4E+7
1-Ethyl-2-methylbenzene	ID	NA
Ethylbenzene	*2.0E+5	1.7E+5
Ethylene dibromide	16	4.2E+6
Ethylene glycol	ID	NA
Ethylene glycol acetate	ID	NA
Ethylene glycol monobutyl ether	1.6E+5	NA
Fluoranthene	*30,000	210
Fluorene	*76,000	2,000
Fluorine (solulble fluoride)	2.6E+7	NA

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Part 201 Interim Groundwater Contact Criteria

All values below are expressed in ug/L (ppb).

Chemical	Utility Worker	Water Solubility (ug/L)
Formaldehyde	1.5E+7	5.5E+8
Formic acid	6.2E+8	1.0E+9
1-Formylpiperidine	ID	NA
Gentian violet	ID	NA
Glyphosate	ID	1.2E+7
Heptachlor	18	180
Heptachlor epoxide	3.1	200
n-Heptane	ID	NA
Hexabromobenzene	ID	NA
Hexachlorobenzene (C-66)	4.9	6,200
Hexachlorobutadiene (C-46)	210	2,500
alpha-Hexachlorocyclohexane	16	2,000
beta-Hexachlorocyclohexane	54	240
Hexachlorocyclopentadiene (C-56)	1,400	1,800
Hexachloroethane	4,000	50,000
n-Hexane	ID	NA
2-Hexanone	ID	1.6E+7
Indeno(1,2,3-cd)pyrene	DC	0.022
Iron	ID	NA
Isobutyl alcohol	2.3E+7	7.6E+7
Isophorone	1.1E+6	1.2E+7
Isopropyl alcohol	ID	NA
Lead	ID	NA
Lindane	87	6,800
Magnesium	1.0E+9	NA
Manganese	2.0E+6	NA
Mercury (Inorganic)	*1.3E+5	56
Methanol	*2.7E+8	2.9E+7
Methoxychlor	*2,700	45
2-Methoxyethanol	3.6E+6	NA
2-Methyl-4-chlorophenoxyacetic acid	ID	NA
2-Methyl-4,6-dinitrophenol	ID	NA
4-Methyl-2-pentanone (MIBK)	2.5E+6	2.0E+7
Methyl-tert-butyl ether (MTBE)	ID	NA
N-Methyl-morpholine	ID	NA
Methylcyclopentane	ID	NA
4,4'-Methylene-bis-2-chloroaniline	70	NA
Methylene chloride	1.6E+5	1.3E+7
2-Methylnaphthalene	ID	25,000
2-Methylphenol	3.8E+5	2.6E+7
3-Methylphenol	7.6E+5	2.3E+7
4-Methylphenol	38,000	2.3E+7
Metolachlor	ID	NA
Molybdenum	2.1E+6	NA
Naphthalene	*78,000	31,000
Nickel	3.2E+8	NA
Nitrate	6.8E+8	NA

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Part 201 Interim Groundwater Contact Criteria

All values below are expressed in ug/L (ppb).

Chemical	Utility Worker	Water Solubility (ug/L)
Nitrite	4.3E+7	NA
Nitrobenzene	9,600	2.1E+6
2-Nitrophenol	74,000	2.5E+6
n-Nitroso-di-n-propylamine	220	9.9E+6
N-Nitrosodiphenylamine	30,000	35,000
Oxamyl	ID	NA
Oxo-hexyl acetate	ID	NA
Pendimethalin	ID	NA
Pentachlorobenzene	230	650
Pentachloronitrobenzene	*5,900	32
Pentachlorophenol	24	2.0E+6
Pentane	ID	NA
2-Pentene	ID	NA
Phenanthrene	*1,600	1,000
Phenol	1.7E+7	8.3E+7
Picloram	ID	4.3E+5
Piperidine	ID	NA
Polybrominated biphenyls	ID	0
Polychlorinated biphenyls (PCBs)	0.71	45
Prometon	ID	NA
Propachlor	ID	NA
Propazine	ID	NA
Propionic acid	ID	NA
Propyl alcohol	2.0E+7	NA
Propylene glycol	ID	NA
Pyrene	*14,000	140
Pyridine	92,000	3.0E+5
Selenium	2.1E+6	NA
Silver	3.3E.+6	NA
Simazine	ID	NA
Sodium	1.0E+9	NA
Styrene	3,200	3.1E+5
Sulfate	ID	NA
Tebuthiuron	ID	NA
2,3,7,8-Tetrabromodibenzo-p-dioxin	ID	NA
1,2,4,5-Tetrachlorobenzene	*1.4E+5	1,300
2,3,7,8-Tetrachlorodibenzo-p-dioxin	8.3E-6	0.019
1,1,1,2-Tetrachloroethane	5,600	1.1E+6
1,1,2,2-Tetrachloroethane	2,100	3.0E+6
Tetrachloroethylene	1,600	2.0E+5
Tetrahydrofuran	ID	NA
Thallium	29,000	NA
Toluene	8.0E+5	5.3E+5
p-Toluidine	ID	NA
Toxaphene	41	740
Triallate	ID	NA
Tributylamine	ID	NA

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Part 201 Interim Groundwater Contact Criteria

All values below are expressed in ug/L (ppb).

Chemical	Utility Worker	Water Solubility (ug/L)
1,2,4-Trichlorobenzene	16,000	3.0E+5
1,1,1-Trichloroethane	2.2E+5	1.3E+6
1,1,2-Trichloroethane	9,400	4.4E+6
Trichloroethylene	18,000	1.1E+6
Trichlorofluoromethane	*2.7E+6	1.1E+6
2,4,5-Trichlorophenol	1.3E+5	1.2E+6
2,4,6-Trichlorophenol	5,600	8.0E+5
2(2,4,5-Trichlorophenoxy)propionic acid	36,000	1.4E+5
1,2,3-Trichloropropane	42,000	1.9E+6
1,1,2-Trichloro-1,2,2-trifluoroethane	*1.1E+8	1.7E+5
Triethanolamine	ID	NA
3-Trifluoromethyl-4-nitrophenol	ID	NA
Trifluralin	ID	NA
2,2,4-Trimethyl pentane	ID	NA
2,2,4-Trimethyl-2-pentene	ID	NA
1,2,4-Trimethylbenzene	ID	NA
1,3,5-Trimethylbenzene	ID	NA
tris(2,3-Dibromopropyl)phosphate	140	NA
Urea	ID	NA
Vanadium	3.7E+6	NA
Vinyl acetate	7.7E+6	2.0E+7
Vinyl chloride	370	2.8E+6
White phosphorus	6,400	NA
Xylenes	*3.5E+6	1.9E+5
Zinc	2.3E+8	NA

* Chemicals for which water solubilities are more restrictive; water solubility becomes the criteria.

DC = Chemical is a dermal carcinogen, therefore GCC are not appropriate. Contact an ERD toxicologist.

ID = Insufficient data

NA = Not Available

ENVIRONMENTAL RESPONSE DIVISION

OPERATIONAL MEMORANDUM #14, REVISION 2

ERRATA SHEET
JUNE 3, 1995

Page 1, Disclosure statement prior to paragraph 1
~~THIS OPERATIONAL MEMORANDUM WILL TAKE EFFECT ONLY WHEN HOUSE BILL 4596 IS SIGNED INTO LAW.~~ *HOUSE BILL 4596, AS AMENDED BY THE SENATE, WAS SIGNED INTO LAW AND BECAME EFFECTIVE ON JUNE 5, 1995.*

Page 1, Paragraph 1
Revision 4 of this Operational Memorandum reflects changes made as a result of two major legislative actions: (1) the incorporation of the Michigan Environmental Response Act (MERA), 1982 PA 307, as amended, ~~(2)~~ into the Natural Resources and Environmental Protection Code, 1994 PA 451; and *(2)* the 1995 amendments to Part 201 contained in House Bill 4596, ***as amended by the Senate (1995 PA 71).***

Page 12, Last Paragraph
The ~~attenuation~~ *adherence* factor of 1.0 mg/cm^2 is the value recommended by EPA (EPA, 1991).

Page 10, Paragraph beginning with "An RSC is only..."
~~An RSC is only used for groundwater criteria; it has been eliminated from the direct contact soil equations. It's use for the industrial/commercial scenario is consistent with the residential equations.~~

Add the following sentences at the end of this paragraph:
The RSC for the direct contact soil equations is 100%. These RSC values represent default values to be used unless compound and site-specific data are available to demonstrate that a different source contribution is appropriate.

Page 11, Generic Industrial Direct Contact Soil Criterion Algorithm
Insert the RSC into the equation for the industrial direct contact soil criterion algorithm for noncarcinogens.

NONCARCINOGENS:
$$\frac{HQ \times RfD \times BW \times AT \times CF \times RSC}{EF \times ED \times FC \times [(IR_s \times AE_i) + (SA \times AF \times AE_d)]}$$

Insert the following in the list of default values for the industrial direct contact soil criterion algorithm for noncarcinogens.

RSC (relative source contribution) = *1*

Page 19, Generic Commercial Direct Contact Soil Algorithm
Insert the RSC into the equation for the commercial direct contact soil criterion algorithm for noncarcinogens.

NONCARCINOGENS:
$$\frac{HQ \times RfD \times BW \times AT \times CF \times RSC}{(EF \times FD) \times ED \times FC \times [(IR_s \times AE_i) + (SA \times AF \times AE_d)]}$$

Insert the following in the list of default values for the commercial direct contact soil criterion algorithm for noncarcinogens.

RSC (relative source contribution) = *1*

MICHIGAN DEPARTMENT OF NATURAL RESOURCES

INTEROFFICE COMMUNICATION

June 6, 1995

TO: Environmental Response Division Staff

FROM: Alan J. Howard, Chief, Environmental Response Division

SUBJECT: Environmental Response Division Operational Memorandum #14 Revision 2: Remedial Action Plans Using Generic Industrial or Generic Commercial Cleanup Criteria and Other Requirements

THIS DRAFT, INTERIM OPERATIONAL MEMORANDUM HAS BEEN PREPARED TO FACILITATE IMPLEMENTATION OF THE 1995 AMENDMENTS TO PART 201 OF THE NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION ACT, 1994 PA 451 (FORMERLY THE MICHIGAN ENVIRONMENTAL RESPONSE ACT). THIS OPERATIONAL MEMORANDUM WILL TAKE EFFECT *ONLY* WHEN HOUSE BILL 4596 IS SIGNED INTO LAW. INTERNAL REVIEW OF THIS MEMORANDUM IS ON-GOING, AND NO OUTSIDE REVIEW HAS BEEN COMPLETED. THE CONTENT OF THE MEMORANDUM, AND THE ATTACHED CRITERIA, ARE SUBJECT TO CHANGE AND SHOULD BE RELIED UPON ONLY AFTER CONFIRMATION WITH APPROPRIATE ERD STAFF.

Revision 2 of this Operational Memorandum reflects changes made as a result of two major legislative actions: (1) the incorporation of the Michigan Environmental Response Act (MERA), 1982 PA 307, as amended, (2) into the Natural Resources and Environmental Protection Code, 1994 PA 451; and the 1995 amendments to Part 201 contained in [House Bill 4596]. Enactment of the Natural Resources and Environmental Protection Act resulted in new section numbers for all of the former MERA, but did not make any substantive changes in the law. [House Bill 4596] substantially amends Part 201. Those amendments, particularly the changes in cleanup standards, are reflected in this revision of Operational Memorandum #14. Unless otherwise noted, Section references in this memorandum are to Part 201 of Act 451.

This memorandum provides direction in the preparation and review of generic industrial and commercial land use remedial action plans (RAPs) to comply with Section 20120A(1)(B) and (D). The following information highlights some important aspects of generic land use cleanups:

- The preparation, review and approval of RAPs based on the generic industrial/commercial approach is anticipated to require less effort than a site-specific RAP for most sites. In general, it will not be necessary to develop site-specific cleanup criteria for those sites which can be appropriately and completely addressed with these generic criteria.

- Site-specific RAPs are also an option under Section 20120A(2). Site-specific RAPs require the development of exposure assumptions that are representative of the activities of human receptors at the site. Site-

(1)

specific direct contact cleanup criteria may be developed by appropriately adjusting the exposure assumptions in the generic algorithms. Justification must be provided for the site-specific exposure assumptions identified.

- If a RAP relies on the attached generic risk assessment algorithms and criteria, the RAP must include a statement confirming that the generic exposure assumptions are representative of, or exceed, the expected exposure of workers at the site.

- In identifying which generic cleanup criteria are appropriate for a site, primary consideration should be given to the human receptors and the kinds of activities in which they engage. Land-use specific criteria can be used for a site not typically categorized under that specific land use, as long as the exposures do not exceed those identified in the algorithm used to derive the criteria.

- These generic industrial and commercial criteria apply only to the assessment of human health risks for workers at these sites. The need for assessment of off-site human health risks will be determined based on an evaluation of exposure potential for off-site receptors.

The direction provided in this memo is intended to facilitate the preparation of RAPs by setting forth the Environmental Response Division's (ERD) expectations for the human health risk assessment assumptions which are used to generate acceptable cleanup criteria for specific land uses. Additional information about the applicability of this approach and the criteria listed in the attached tables follows.

The attached sections on the land use-specific categories explain the basis for the exposure assumptions used in the generic approaches. In general, the exposure assumptions were established to be protective for a "reasonable maximum exposure" (RME) of a worker under the scenarios established. The RME is defined as the highest exposure that is reasonably expected to occur at a site. These exposure assumptions would also be protective of other workers at the facility who are outdoors less often. If the workers at a commercial or industrial property have a greater exposure potential (e.g., the exposure duration or exposure frequency is greater than that assumed in the generic algorithms), a site-specific RAP which reflects the exposure potential at the site should be submitted. This can be done by adjusting the exposure assumptions within the generic equation.

The criteria in the attached tables have been calculated by ERD toxicologists for the convenience of parties preparing generic industrial or commercial RAPs. The criteria are not maximum allowable criteria; they are concentrations that may be allowable for exposure in certain industrial or commercial settings. Higher concentrations may be approved as part of a limited industrial/commercial RAP if exposure barriers or engineering controls prevent or limit exposure. The criteria in the tables can be used as a screening tool to determine which areas of a site may be addressed by land use restrictions alone, and which require additional remediation or control.

The values in the table are useful in determining acceptable concentrations protective of human health through exposure pathways characterized by standardized assumptions. The text of the attachment describing the

algorithms includes discussions of other human exposure pathways which may require additional consideration in exceptional circumstances (e.g., inhalation pathway if a hazardous substance present in shallow soils is a carcinogen via inhalation but not ingestion or risks from contaminated subsurface materials to construction workers). When these special circumstances exist, contact an ERD toxicologist for guidance.

Generic Industrial and Commercial Cleanup Criteria
Groundwater and Soil Direct Contact

The attached tables list the generic industrial and commercial site criteria in a format similar to the table of residential criteria in Operational Memorandum #8. The applicability of values from the generic commercial and industrial tables may vary depending, for example, on site characteristics, reasonably foreseeable groundwater use, and the nature of the remedy being proposed. Additional guidance on the applicability of values from the chart follows.

HEALTH-BASED AND AESTHETIC DRINKING WATER CRITERIA

These criteria apply to groundwater in an aquifer. The RAP should identify whether each saturated zone underlying the site is an aquifer. Any formation which serves or may serve as a drinking water source meets the definition of "aquifer" in R 299.5101(c). Cleanup criteria for groundwater not in an aquifer must be determined by consideration of potential public health and environmental impacts associated with contamination of that groundwater (see discussion of Groundwater/Surface Water Interface Values below).

The health-based values in the attached table were calculated using the generic land use algorithms which are designed to protect workers whose drinking water is from an on-site groundwater source. If groundwater is the source of drinking water at the property, and the values in the table are exceeded, a remedial action to address groundwater will be necessary. If a state drinking water standard is available for an on-site contaminant, the drinking water standard overrides the health-based criterion and becomes the cleanup goal. In addition, if the affected groundwater is the source of drinking water at the industrial/commercial site, the aesthetic criterion (as defined by R 299.5709(2)(c) or (d)) must be met if that criterion is more restrictive than the health-based criterion unless an assessment is presented that justifies an alternative criterion. The state drinking water standard would not, however, override a more restrictive aesthetic criterion. This assures that the groundwater will not be unusable because of aesthetic impacts. If groundwater is not the source of drinking water at the property, but it is or may be the source for off-site drinking water, then the need for remedial action to address the groundwater would be determined by other rules (e.g., R 299.5709). Groundwater beyond the property boundary would need to be addressed either by remediation or exposure controls.

Consider this example: A RAP using the generic criteria is proposed for an industrial site where groundwater is used as the source of drinking water for that facility and for private wells off-site. The groundwater concentrations on site (current and expected concentrations, based on information about migration potential developed during the Remedial Investigation and explained in the RAP) do not exceed the applicable drinking water criteria in the attached table. Remedial actions to address on-site groundwater would be

(3)

determined by the requirements of R 299.5705(5) and (6) (unless the Department makes a finding pursuant to Section 20118(5) and (6) that compliance with those subrules is not required) and/or compliance with GSI criteria. However, if hazardous substance concentrations in groundwater exceed the generic residential criteria at the industrial site boundary, groundwater remediation or exposure controls, or both, may be required to address potential off-site risks.

GROUNDWATER SURFACE WATER INTERFACE (GSI) CRITERIA

The GSI values included in the attached table are the same GSI values as presented in Op Memo #8. See Op Memo #8 for a complete explanation of GSI values. The GSI values are included here because they define the maximum allowable hazardous substance concentration at the groundwater surface water interface or at the edge of the mixing zone, whichever is applicable for a specific site, in industrial/commercial situations as well as residential situations. This is a function of applicable requirements of Part 31 of Act 451. Judgments about the applicability of GSI values and the compliance point for GSI criteria are the same for residential and commercial/industrial situations.

Prior to passage of the 1995 amendments, a mixing zone was not allowed when assessing the impact of groundwater venting to a surface water. A mixing zone is now allowed for venting groundwater at those sites where an additional load to the receiving stream of site-specific contaminants is allowable and where a mixing zone is appropriate for the receiving stream. If a RAP allows for venting groundwater, the discharge must comply with requirements of Part 31 of Act 451 and the relevant rules promulgated under that Part.

TARGET METHOD DETECTION LIMITS IN WATER AND SOIL

The values in these columns are identical to those in Operational Memorandum #8 and Operational Memorandum #6. See Op Memo #6 for a complete explanation of "target method detection limits" and analytical methodology.

SOIL CRITERIA PROTECTIVE OF GROUNDWATER

The determination of a soil concentration protective of groundwater in an aquifer can be more complex at industrial/commercial sites than for some residential sites, consequently, these values are not presented on the list. If groundwater contamination is confined (and will remain) on-site, and the groundwater at the site is used as a source of drinking water, then the soil cleanup criteria protective of groundwater can be determined in one of the following ways: 1) through the use of leachate test (see Operational Memorandum #12), comparing the leachate results to the industrial/commercial health-based drinking water value or aesthetic value, whichever is more restrictive, or if available, the state drinking water standard (unless the aesthetic criterion is more restrictive); 2) by comparing the concentration in soil (i.e., measured as a total, not leachable concentration) to 20 times the appropriate groundwater criterion; or 3) by the use of other methods, such as fate and transport modeling or perched in-situ groundwater evaluation, that demonstrate that hazardous substances in soil will not result in relevant groundwater criteria being exceeded. However, if off-site groundwater is or may be used as a source of drinking water, the groundwater must meet residential criteria at the property boundary or exposure controls must be provided. In that case, on-site soils may need to be cleaned up to a level more restrictive than that described above in order to assure that residential

(24)

criteria will be met at the appropriate location, unless groundwater remediation is being used to achieve the residential groundwater criteria off-site. It is possible that acceptable soil criteria protective of groundwater may vary across the site.

For certain chemicals which strongly adsorb to soil and are known not to leach at significant concentrations (i.e., PCBs, carcinogenic polynuclear aromatic hydrocarbons and some chlorinated pesticides), the direct contact value is accepted as the soil cleanup criterion to protect groundwater in addition to the protection against long-term, systemic, direct contact hazards. However, there are certain situations (i.e., presence of solvents or collection of unfiltered groundwater samples) which could result in the presence of these types of materials in groundwater. These other conditions should be evaluated before a chemical is considered nonmobile in soil. Consult an ERD toxicologist if you think direct contact values for other contaminants would be protective of groundwater or if you have questions about conditions that could cause the transport of a nonmobile contaminant through soil.

SOIL CRITERIA PROTECTIVE OF SURFACE WATER

The default values are shown in Op Memo #8 as 20 times the GSI value. If the GSI value is the controlling factor for groundwater and/or aquifers at an industrial/commercial site, the 20 times GSI value would be applied here in the same way it would be at a residential site. See Operational Memorandum #8 for a full discussion of this issue. Since the GSI value applies only at the groundwater surface water interface it is not necessary that soil concentrations throughout the site be less than or equal to 20 times the GSI number. However, in some cases, it may be simplest to make this comparison in judging the need for soil remediation to protect surface water. Generic industrial/commercial soil cleanup criteria protective of surface water can be developed using the same approaches that apply to the soil criteria protective of drinking water (i.e., leachate tests, 20 times water concentrations, comparison of perched water quality to GSI values or fate and transport modeling). This accounts only for leaching of hazardous substances from soil into groundwater and the subsequent impact of that groundwater on surface water. If there is significant potential for runoff to carry contaminated soil into surface water (i.e., this pathway is pertinent in the risk assessment), the impact of that runoff should be characterized in the risk assessment using fate and transport modeling. This type of analysis may be necessary in cases where the hazardous substances present at the site are highly persistent and/or bioaccumulative, since transport of substances with these properties may result in unacceptable impact on surface water sediments or in the food chain.

DIRECT CONTACT CRITERIA

These values protect workers at the site against long-term, systemic health effects from ingestion and dermal absorption of hazardous substances in soil. The exposure assumptions used in the algorithms are discussed in the generic industrial and commercial sections. The generic land-use direct contact criteria are applied like the residential direct contact values, except that the requirement that direct contact concentrations be met throughout the affected media will not always apply to industrial/commercial cleanups. It is possible for a generic industrial/commercial RAP to combine the application of these values for shallow soils and land use restrictions to protect against exposure to higher concentrations in deeper soils to provide for a remedy that is, when considered in total, protective of public health. In general,

surface soils are considered to be the top 0-6 inches, unless activities at a site indicate that a greater depth is more appropriate. However, unless use restriction are in place for contaminated subsurface materials, contaminant concentrations cannot exceed the appropriate soil concentration to protect public health.

Average on-site soil concentrations, represented as a 95% upper confidence level (UCL) on the arithmetic mean, may be used to determine compliance with the soil direct contact value. On-site 95% UCLs should, however, reasonably represent the areas over which exposures are expected to occur. Refer to EPA Guidance (EPA, 1992b) on appropriate methodology for calculating the 95% UCL.

ISSUES NOT ADDRESSED BY THE DIRECT CONTACT CRITERIA

Inhalation: Since all RAPs must document that they are protective of the public health, safety and welfare and the environment, they must contain some discussion of potential inhalation risks, and whether inhalation is a pertinent pathway for human exposure at the site in question. The direct contact criteria do not address and are not applicable for the inhalation pathway because they do not incorporate the potential inhalation effects, long-term or acute, of hazardous substances in soil.

In many cases, the inhalation pathway will be addressed by a simple description of the physical characteristics of the site such as pavement, vegetative cover, depth to contamination, or characteristics of on-site contaminants, which would allow for its elimination as a pertinent pathway. Characteristics of the contaminants that should be considered are vapor pressure and/or Henry's Law constant, the potential to cause cancer via the inhalation route, the potential to cause irritation of respiratory tissue and special characteristics which may make a contaminant an inhalation hazard (e.g., friable asbestos). The RAP should indicate whether any materials with these characteristics are present. If such materials are present, it may be necessary to conduct a risk assessment of the inhalation pathway, pursuant to Rules 299.5717(3)(a) and (f) in general, and to include criteria or exposure controls which are protective under the inhalation scenario. If not, criteria and/or exposure control measures which are protective for other routes of exposure will be deemed protective for the inhalation pathway and a narrative assessment for the inhalation pathway will be sufficient. EPA guidance should be followed when evaluating the inhalation pathway (EPA, 1991).

Dermal Toxicity: The direct contact soil equations do not address acute skin toxicity or skin sensitization. These concerns may have to be addressed before chemicals with these characteristics can be left in place at the direct contact concentration.

Ecological Concerns: Industrial/commercial RAPs also must address ecological concerns. The RAP should include a description of the physical setting of the site, including any natural resources which could be affected by the release(s) addressed in the plan. In general, potential ecological impacts are defined as adverse impacts on a community or a population of organisms rather than on an individual who is the focus of a human health risk assessment. An ecological risk assessment will be required only if there is a "sensitive environmental resource" (See Rule 299.5803(j)) present at or near the site, or if there are other special circumstances such as concern for persistent or bioaccumulative hazardous substances which may adversely effect the food chain, or a physical feature that would attract wildlife to the site

(e.g., migratory waterfowl habitat). Professional judgment must be used to determine whether it is likely that criteria more restrictive than those required to protect public health, or those required pursuant to other applicable regulations (e.g., groundwater/surface water interface criteria), are necessary to protect natural resources at or near the site. If ERD staff believe that there is a need for an ecological assessment, this should be reviewed with your supervisor and other technical experts as appropriate. Ecological risk assessments will be the exception rather than the rule.

Other Requirements for Industrial and Commercial RAPs

The generic industrial and commercial cleanup criteria will simplify the human health risk assessment component of the RAP when they are applicable. If the site meets the criteria for application of the generic approach, the human health risk assessment can consist of a comparison to the generic criteria when they are proposed for use at the site. If other criteria are proposed, they must be justified as protective of public health, safety, welfare and the environment. Regardless of whether generic or site-specific criteria are proposed, the RAP must also contain a demonstration that it satisfies all other requirements of Part 201 and the administrative rules, including applicable or relevant and appropriate requirements (ARARs) from other environmental laws. You should review Rules 299.5717, 299.5719 which contain requirements applicable specifically to industrial/commercial (formerly "Type C") cleanups. Also review Rules 299.5601 and 299.5603 which describe the factors the Department must consider in deciding whether to approve a RAP. Parties preparing industrial/commercial RAPs should directly and succinctly address how the RAP is responsive to all requirements of Rules 299.5601, 299.5603, 299.5717, and 299.5719 (or explain why the requirement is not applicable to the site).

Important components of an industrial/commercial RAP, in addition to the risk assessment, include:

- a thorough description of the proposed exposure controls (including a proposed restrictive covenant which addresses the factors called for in Rule 299.5719(3)). Exposure controls can be as simple as a commitment, through the restrictive covenant, that the land use of the site will remain consistent with the industrial or commercial risk assessment assumptions. More complex controls will be required if, for example, an engineered containment structure is part of the remedy.

- an explanation of how the proposed controls will be reliable, effective and satisfy other requirements of law.

- an operation and maintenance plan (see Rule 299.5517) and a monitoring plan (see Rule 299.5519), or both, if necessary. These plans may be conceptual (e.g., they need not specify manufacturers for equipment to be used, but must describe the function of the equipment). However, the plans must be presented in sufficient detail to allow us to judge their adequacy. The plans must also include cost estimates for implementation of the operation and maintenance and/or monitoring work. The cost estimates, which will be used, in part, to determine the amount of financial assurances required pursuant to Rule 299.5719(2), should be

based on work being done by contractor personnel rather than by employees of the party responsible for implementation of the RAP. This allows us to be confident that financial assurances would cover necessary costs if the state must take over these activities.

This memo is intended to provide guidance to Division staff to foster consistent application of Part 201 of the Natural Resources and Environmental Protection Act, 1994 PA 451 and associated Administrative Rules. This document is not intended to convey any rights to any parties nor create any duties or responsibilities under law. This document and matters addressed herein are subject to revision.

Questions about the generic industrial and commercial algorithms and criteria should be directed to ERD toxicologists (Chris Flaga, at 517-373-0160; Jeff Crum, at 517-335-3092; or Linda Larsen at 517-335-3161). Questions about other aspects of generic industrial and commercial RAPs should be directed to District Supervisors.

GENERIC INDUSTRIAL LAND USE CATEGORY

A generic industrial site will include sites with the following characteristics:

- The primary activity at the site is industrial in nature (e.g., manufacturing; utilities; industrial research and development; petroleum bulk storage) and access to the site is reliably restricted consistent with its use (e.g., by fences or security personnel or both). The term industrial site does not include farms, gasoline service stations or other commercial establishments where children may commonly be present. Inactive or abandoned sites are included if the property use was industrial, as described above.

- The current zoning of the property is industrial, the zoning is anticipated to be industrial (see below), or the RAP includes documentation that the current industrial use is a legal non-conforming use. This may include different zoning designations, depending on the community, such as "light industrial" or "heavy industrial". Documentation of zoning must be provided in the form of a map or current property record card which shows the zoning status of the site and all adjacent properties. If the RAP is based on anticipated zoning changes, discussion of this issue must indicate how and when the zoning changes are to be accomplished. The RAP must identify (preferably on a map) the nearest current residential land uses and nearest parcels which are zoned for residential use. Any non-conforming land uses in the vicinity of the site must be identified in the RAP (e.g., residential use on a parcel zoned "transitional industrial").

Generic Industrial Cleanup Criteria Algorithms

The following equations represent a reasonable and conservative approach for deriving generic cleanup criteria for an industrial facility. Assumptions are conservative to include a reasonable maximum exposure. The population protected are those industrial workers who spend a significant percentage of

their work time outdoors. Algorithms are presented for both the ingestion of groundwater and for direct contact with soil.

The generic industrial equations follow.

Generic Groundwater Algorithms:

CARCINOGENS:

$$\frac{10^{-5} \times BW \times AT \times CF}{SF \times EF \times ED \times IR_{gw}}$$

where,

10^{-5} cancer risk	= acceptable risk
BW (body weight)	= 70 kg
AT (averaging time in days)	= 25,550 (70 x 365)
CF (conversion factor)	= 1000 ug/mg
SF (cancer slope factor, $mg/kg\text{-}d^{-1}$)	= chemical-specific
EF (exposure frequency)	= 245 d/yr
ED (exposure duration)	= 21 yr
IR_{gw} (drinking water ingestion rate)	= 1 liter/day

NONCARCINOGENS:

$$\frac{HQ \times RfD \times BW \times AT \times RSC \times CF}{EF \times ED \times IR_{gw}}$$

where,

HQ (hazard quotient)	= 1
RfD (oral reference dose, mg/kg/d)	= chemical-specific
BW (body weight)	= 70 kg
AT (averaging time)	= 7,665 days (21 x 365)
CF (conversion factor)	= 1000 ug/mg
RSC (relative source contribution)	= 0.2
EF (exposure frequency)	= 245 d/yr
ED (exposure duration)	= 21 yr
IR_{gw} (drinking water ingestion rate)	= 1 liter/day
ED (exposure duration)	= 21 yr
IR_{gw} (drinking water ingestion rate)	= 1 liter/day

These equations yield values which represent concentrations of contaminants in water in units of parts per billion (ppb) or micrograms per liter (ug/l). To convert to units of parts per million (ppm) or milligrams per liter (mg/l) in water, divide by 1,000.

The selection of an appropriate averaging time (AT) is dependent upon the type of toxic effect being evaluated. EPA guidance is followed on this issue (USEPA, 1989; USEPA, 1991). AT represents the number of days over which the exposure is averaged. When evaluating long-term exposure to noncarcinogenic compounds, exposures are calculated by averaging over the period of exposure (i.e., subchronic or chronic exposures). For carcinogenic compounds, exposures are calculated by prorating the total cumulative dose over a lifetime (also called lifetime average daily dose). The approach for carcinogens is based on the assumption that a high dose of a carcinogen received over a short period of time is equivalent to a corresponding low dose spread over a lifetime. The averaging time for carcinogens is 25,550 days (70 years x 365 days) and 7,665 days (21 years x 365 days) for noncarcinogens.

MDNR's recommendation of 21 years as the exposure duration (ED) for a worker is based on 1991 statistics from the U.S. Dept. of Labor. However, since the Dept. of Labor statistics did not detail the distribution for employees

(9)

working greater than 19 years at one location, the EPA 95th percentile estimate of 25 years was assumed. The 90th percentile was estimated to be 21 years. Although an ED of 21 years differs from EPA's recommendation of 25 years, our value represents more recent data. In addition, we follow general EPA guidance which recommends using a combination of exposure assumptions which represent 50th, 90th and 95th percentiles.

The exposure frequency (EF) for the drinking water scenario is derived assuming 260 work days per year minus 3 work weeks (15 days) of vacation and sick time. The assumed amount of water ingested at work (1 liter/day) is based on EPA's recommendation (USEPA, 1991). It is pointed out, however, that workers engaged in hard, physical labor could ingest a greater volume of water and this should be considered before finalizing the criteria to be used at a specific site.

The RSC of 0.2 (20%) assumes that a worker gets 80% of his/her exposure to on-site contaminants from other sources. The RSC represents a default value, and if chemical-specific data are available, they should be used in place of the default. Use of the RSC is consistent with the algorithms for the residential cleanup criteria. Justification for use of a RSC follows. There are many chemicals to which people are exposed through a variety of media and activities. For example, solvents, which are common industrial contaminants, are also commonly found in products routinely used by the general consumer. Ignoring exposures from other sources could underestimate the risk posed by that type of chemical. However, other chemicals may not occur at significant levels, or may not occur at all, outside of the work place. In light of the fact that chemical-specific data pertaining to this issue is extremely limited and significant exposures to certain chemicals do occur outside of the work place, it is necessary to identify a conservative default for this generic approach. As data suggesting something other than 20% becomes available, they will be incorporated into the chemical-specific criteria calculations.

An RSC is only used for groundwater criteria; it has been eliminated from the direct contact soil equations. It's use for the industrial/commercial scenario is consistent with the residential equations. A 20% RSC for groundwater criteria is consistent with the approach taken by U.S. EPA for establishing Maximum Contaminant Level goals (MCLg) for noncarcinogens (previously known as RMCLs). Twenty percent is used by EPA "as a reasonable approximation of the actual exposure and recognizes that this value may somewhat either overestimate or underestimate the actual drinking water contribution. EPA does not believe that it is appropriate to set the RMCL at 100 percent of the ADI, as drinking water is not the sole contributor to total exposure, and using 100 percent of the ADI would underestimate the other sources of exposure" (U.S. EPA, 1985). An RSC has also been incorporated into the Great Lakes Initiative risk assessment process and has been informally used by the Waste Management Division in establishing groundwater permit limits for noncarcinogens.

In those cases where a State Drinking Water Standard is available, it will replace the health-based drinking water criterion, unless a more conservative aesthetic criterion is available.

Generic Industrial Direct Contact Soil Criterion Algorithms

CARCINOGENS:

$$\frac{10^{-5} \times BW \times AT \times CF}{SF \times (EF \times ED) \times ED \times FC \times [(IR_s \times AE_i) + (SA \times AF \times AE_d)]}$$

where,

10^{-5} cancer risk	= acceptable risk
BW (body weight)	= 70 kg
AT (averaging time)	= 25,550 days
CF (conversion factor)	= 1E+9 ug/kg
SF (cancer slope factor, mg/kg-d^{-1})	= chemical-specific
EF (exposure frequency)	= 112 d/yr
ED (exposure duration)	= 21 yr
FC (fraction of soil contaminated)	= 1
IR_s (soil ingestion rate)	= 50 mg/day
AE_i (ingestion absorp. efficiency)	= (see text)
SA (skin surface area)	= 2570 cm^2/day
AF (soil adherence factor)	= 1.0 mg/cm^2
AE_d (dermal absorption efficiency)	= (see text)

NONCARCINOGENS:

$$\frac{HQ \times RfD \times BW \times AT \times CF}{EF \times ED \times FC \times [(IR_s \times AE_i) + (SA \times AF \times AE_d)]}$$

where,

HQ (hazard quotient)	= 1
RfD (oral ref. dose, mg/kg/day)	= chemical-specific
BW (body weight)	= 70 kg
AT (averaging time)	= 7,665 days
CF (conversion factor)	= 1E+9 ug/kg
EF (exposure frequency)	= 112 d/yr
ED (exposure duration)	= 21 yr
FC (fraction soil contam'd)	= 1
Ir_s (soil ingestion rate)	= 50 mg/day
Ae_i (ingestion absorp. efficiency)	= (see text)
SA (skin surface area)	= 2570 cm^2/day
AF (soil adherence factor)	= 1.0 mg/cm^2
AE_d (dermal absorption efficiency)	= (see text)

These equations yield values representative of concentrations of contaminants in soil in units of ppb or micrograms/kilogram (ug/kg). To convert to units of ppm or milligrams/kilogram (mg/kg) in soil, divide by 1,000.

The exposure frequency (EF) for the direct contact scenario was derived considering climatic factors (e.g., snow cover, frozen soil) and inclement weather conditions (e.g., rain) as well as variation in daily activities in which industrial workers participate. It is assumed that Michigan winters last for 4 months (120 days) making soil unavailable for contact. Allowing three weeks off for vacations and sick leave, and adjusting for a standard five day work week yields a maximum number of 160 days per year of industrial outdoor exposure in Michigan. The assumptions represent high-end values within a range of potential exposures.

$$365 - 120 - 21 \times 5/7 = 160$$

Data from the Air Quality Division indicate that, on average, precipitation exceeds 0.25 inch one day per week during the months of March through October. These data represent average values from a 30 year period, 1951 through 1980. It is assumed that rainfall which exceeds 0.25 inches makes working outdoors difficult. Incorporating this factor also assumes that this significant rainfall occurs during the work week and during the eight hour work shift, which may not always be the case. However, this assumption may be balanced or "corrected" by a few low temperature days or snow days in March or October which could prevent a worker from working outdoors. This factor results in the number of days per week which a worker comes into contact with soil to be reduced from 5 to 4.

Activity patterns of a reasonable maximum exposed worker are not likely to bring the individual into contact with bare soil each and every day, since many different duties may be performed at any given facility. As a conservative estimate, it is assumed that one half day per week is spent performing some activity which does not bring the worker into contact with bare site soil. The incorporation of this factor results in a reasonable maximum EF value of 3.5 days per week or 112 days per year.

$$160 \times 3.5/5 = 112$$

The soil ingestion rate recommended by MDNR is 50 mg/day, which follows EPA's recommendation for industrial/commercial workers.

The oral absorption efficiency default is assumed to be 100% for volatiles and 50% for semi- and nonvolatile chemicals. When chemical-specific data are available, they will be used in place of the defaults. This policy is consistent with the Type B algorithms.

The skin surface area was estimated in the following manner:

skin surface area (cm^2) =	u SA forearms	=	1140
	u SA face (1/2 head)	=	590
	u SA hands	=	840
			2570

The amount of exposed skin surface area identified represents an average scenario, realizing that at times a worker could have more or less skin exposed. For example, there may be times when a worker is working without a shirt and times when a worker may be working in a long-sleeved shirt and/or a coat. The average scenario assumes that a worker is working in a short-sleeved shirt and long pants with hair or a hat covering part of his/her head. This scenario estimates a skin surface area value of 2,570 cm^2/day. In addition to the above discussion, surface area is strongly correlated with body weight. Since the assumed body weight represents an average value, surface area should be represented by an average value as well.

The attenuation factor of 1.0 mg/cm^2 is the value recommended by EPA (EPA, 1991). After evaluating the available soil adherence studies, EPA concludes that all of the studies considered have uncertainties thereby making a recommendation difficult. The studies provide a possible range from 0.2 to 1.5 mg/cm^2. A conservative central value of 1.0 mg/cm^2 is recommended until better data are available.

The dermal absorption efficiency is assumed to be 10% for volatiles and 1% for semi- and nonvolatiles as assumed in the Type B algorithm. All absorption values represent defaults which will be replaced if chemical-specific data are or become available.

As indicated earlier, EPA provides general guidance on how to characterize exposures and risks when conducting risk assessments. For Superfund exposure assessments, intake and exposure values should be selected so that the combination of all variables results in an estimate of the reasonable maximum exposure (RME) for that pathway. The RME is the maximum exposure that is reasonably expected to occur at a site. Under this approach, some intake variables may not be at their individual maximum values, but when in combination with other variables, will result in estimates of the RME (USEPA, 1989). More recent EPA guidance (USEPA, 1992), recommends estimating the high end exposure by "...identifying the most sensitive parameters and using maximum or near-maximum values for one or a few of these variables, leaving others at their mean values". This guidance applies when only limited information on the distribution of the exposure or dose factors is available. The basis for this recommendation is that maximizing all variables will result in an estimate that is above the range of actual values seen in the population. The algorithms presented in this document follow EPA guidance by combining exposure assumptions which represent a mix of high-end and mid-range values. For example, when evaluating the direct contact equation, a 70 year life span, body weight and surface area all represent a 50th percentile, while the exposure duration of 21 years and the soil ingestion rate represent the 90th percentile.

Since no distributions exist for frequency of exposure to soil, it's difficult to estimate a value and its associated percentile. However, it's reasonable to assume that the value chosen (112 days) is representative of the higher end of the range of possible exposures. Data supporting the dermal contact rate is also lacking, making it difficult to estimate the percentile that it represents. Although we are using average skin surface area values as presented by EPA (USEPA, 1990), estimation of those areas which are exposed to soil is strictly based upon best professional judgment. Although a significant amount of uncertainty surrounds the estimated exposure frequency and the dermal contact rate, the exposure assumptions selected are reasonable and conservative for the purpose of developing state-wide, generic cleanup criteria for industrial facilities.

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GENERIC COMMERCIAL LAND USE CATEGORY

The commercial land use category is extremely varied and broad, encompassing everything from day care centers and schools to gas stations and warehouse operations. The physical setting of commercial properties and the activities which workers and the general public engage in at these sites are also extremely variable. Given the breadth of the commercial land use category, it is impossible to assign a single set of "typical" or generic exposure assumptions to characterize the activities of all potentially exposed populations.

In order to facilitate the development of generic commercial criteria, the universe of commercial land uses has been divided into four subcategories based on factors which are critical to the assessment of potential risk. These factors include the potentially exposed populations (workers or general public) and the nature, duration, and frequency of the exposures likely to occur when people occupy, work at, visit, or patronize the site. The division of the commercial land use category into subcategories allows for some useful generalizations to be made.

A substantial degree of variability remains even within the subcategories of commercial land use. It will be the responsibility of the party proposing a remedy to demonstrate that the site and exposure setting is consistent with the characteristics of the subcategory closely enough to warrant use of the criteria. Similarly, the party proposing the remedy will have to describe in the RAP those measures that will be put in place (institutional controls, restrictive covenants, access restrictions, etc.) to assure that the exposure setting of the site is maintained consistent with the exposure characteristics of the subcategory. This will serve to guarantee that uses of the site which might yield unacceptable exposures will be precluded in the future. Conversely, land uses consistent with a subcategory may not possess exposures that are similar to those used to define the category. Proper characterization of those site-specific activities or exposures may warrant the use of generic criteria from another subcategory or category.

In the following sections, exposure assumptions protective for the set of site and exposure characteristics described below for subcategory III and IV sites have been developed. Some commercial subcategory III and IV sites may be located in or near residential areas and, therefore, may be used by other populations for purposes other than the intended commercial use (e.g. recreational). It may be inappropriate to apply the generic criteria developed for a given subcategory of commercial land use, if anticipated exposure from unintended uses exceeds the exposures assumed under that subcategory. Adjustments can be made to the exposure assumptions to represent these other uses or criteria for a more representative category can be used. Alternatively, the RAP may denote measures designed to preclude unintended uses.

For the purpose of determining if the generic commercial criteria presented in this memorandum are applicable, the party proposing a remedy must first determine that the site falls within the definition of commercial land use or that the site-related exposures are similar to those assumed for this category. The definition of commercial land use includes the following two elements:

- The primary activity at the site is commercial in nature (e.g., retail; warehouse; office/business space, etc.). This could include abandoned or inactive commercial facilities as long as they fit both the definition of a commercial facility and one of the subcategory definitions described below.

- The current zoning of the property is commercial, future zoning is anticipated to be commercial, or the RAP includes documentation that the current commercial use is a legal non-conforming use. This may include different zoning designations, depending on the community, such as "community commercial", "regional commercial", "retail", or "office-business". Documentation of zoning must be provided in the form of a map or current property record card which shows the zoning status of the site and all adjacent properties. If the RAP is based on anticipated zoning changes, discussion of this issue must indicate how and when the zoning changes are to be accomplished. The RAP must identify (preferably on a map) the nearest current residential land uses and nearest parcels which are zoned for residential use. Any non-conforming land uses in the vicinity of the site must be identified in the RAP (e.g., residential use on a parcel zoned "transitional commercial").

Caution should be used when categorizing sites on the basis of facility or business type. We expect that activities may vary considerably even among facilities of the same type. Activities and exposures should be the primary considerations when determining a land use category for a specific site.

If the site meets the definition of commercial land use, the party proposing the remedy must determine which of the four subcategories of commercial land use defined below is most representative of the exposure setting of the subject site. The subcategories and the features which define them are described below:

Subcategory I: This commercial land use subcategory is characterized by any use which is intended to house, educate, or provide care for children, the elderly, the infirm, or other sensitive subpopulations. The activities engaged in by these populations at the site are characterized by exposures of relatively significant duration and/or frequency approximating the magnitude of exposures used to develop the residential criteria. The site setting may include unpaved or landscaped areas containing contaminated surficial soils which may be frequented by potentially exposed populations (e.g. play areas). Any soil contaminants present may therefore be readily accessible to the resident populations. If relied on for drinking water, exposure to groundwater would also be significant. In addition, this subcategory of commercial land use is usually, but not always, located in or near residential areas and, therefore, may be used by other populations for purposes other than the intended commercial use (e.g. recreational). This subcategory could include, but is not limited to, the following uses:

- day care centers
- any form of educational facility
- hospitals, elder care facilities, and nursing homes.

Although a site-specific risk assessment may be conducted on sites within this category, no generic commercial cleanup criteria will be developed because in

most cases, the site setting and uses will warrant the application of residential criteria. There are forms of subcategory I commercial land uses that do not possess the exposure characteristics of the residential exposure setting, for example, long-term or convalescent care facilities where patients are not expected to come into contact with soils on a frequent basis. In such cases, site-specific cleanup criteria or criteria from another subcategory can be utilized with proper justification.

Subcategory II: This commercial land use subcategory is characterized by the following features. Access to the public is reliably restricted, consistent with its use, by fences, security, or both. Affected surficial soils are located in unpaved or landscaped areas that are frequently contacted by worker populations such as groundskeepers, maintenance workers, or other employees whose primary duties are performed outdoors. If site groundwater is relied on for drinking water, worker populations would receive half of their total exposure from on site drinking water.

This subcategory could include, but is not limited to, the following uses:

- large-scale commercial warehouse operations
- wholesale lumber yards
- building supply warehouses

The degree of exposure for such employees under Subcategory II property is assumed to be equivalent to the exposures used to model outdoor activities in the development of the generic industrial criteria. As a result, a unique set of generic criteria has not been defined for this subcategory of commercial land use. Sites which fall into this subcategory should be addressed through the application of the generic industrial criteria or through a site-specific risk assessment.

Subcategory III: A subcategory III commercial site is characterized by the following features. Access to the public is unrestricted, however, the general public's occupancy of the site is expected to be intermittent and significantly less in frequency and duration relative to the population working at the site. Although some of the activities for both worker populations and the general public at a subcategory III commercial site are conducted indoors, a significant component of their activity will likely be outdoors. Affected surficial soils are located in unpaved or landscaped areas that may be contacted frequently, primarily by the worker populations (as may be the cases at gas stations, auto dealerships or building supply warehouses with unpaved or landscaped areas). If site groundwater is relied on for drinking water, worker populations would receive about half of their total exposure from the site.

This subcategory could include, but is not limited to, the following uses:

- Retail gas stations
- Auto service stations
- Auto dealerships
- Retail warehouses selling the majority of their merchandise indoors but including some limited storage or stockpiling of materials in a rear yard (building supply, retail flower and garden shops not involving on site plant horticulture and excluding open air nurseries, tree farms and sod farms which would fall into an agricultural land use).

- Repair and service establishments including but not limited to, lawn mower, boat, snowmobile, or small appliance repair shops that have small outdoor yards.
- Small warehouse operations

Subcategory IV: A subcategory IV commercial site is characterized by the following features. Access to the public is unrestricted, however, the general public's occupancy of the site is intermittent in frequency and of short duration relative to the worker populations resident at the site (i.e. the frequency and duration of general public occupancy at the site is typified by the time necessary to transact business at a retail establishment or to receive personal services). The predominant activities performed by both workers and the general public at this type of commercial property are conducted indoors. Affected surficial soils are located in unpaved or landscaped areas that are contacted by worker populations on an occasional basis, such as outdoor break or eating areas. General public contact with these areas is anticipated to be significantly less than the worker's contact, both in terms of frequency and duration. If site groundwater is relied on for drinking water, worker populations would receive one-half of their total exposure at the site.

This subcategory could include, but is not limited to, the following uses:

- Professional offices (lawyers, architects, engineers, real estate, insurance, etc.)
- Medical/dental offices and clinics (not including hospitals)
- Banks, credit unions, savings and loan institutions, etc.
- Publicly owned office buildings
- Any retail business whose principal activity is the sale of food or merchandise within an enclosed building
- Personal service establishments which perform services indoors (health clubs, barber/beauty salons, mortuaries, photographic studios, etc.).

Generic Commercial Cleanup Criteria Algorithms

The following section provides justification for the exposure assumptions used under the generic commercial subcategories III and IV. The methods used to establish the generic commercial cleanup criteria for commercial subcategories III and IV are briefly summarized below.

Groundwater: The worker population was used to establish exposure parameters for the generic commercial groundwater criteria. Because workers are expected to spend the most time on site, their exposures are assumed to be greater than exposures to the general public. Protection of the more highly exposed population assures protection of the general public.

Unlike soil exposures, the exposure assumptions which serve as the basis for the generic groundwater criteria were not varied between subcategories (except for subcategory I which assumes the ingestion of 2 liters of water/day). No meaningful distinctions could be made between commercial land use subcategories and water ingestion rates. The exposure assumptions and the resulting groundwater criteria do not differ from those developed for the generic industrial scenario. Please refer to the narrative on groundwater

exposure assumptions in the generic industrial section for details. When available, State Drinking Water Standards serve as the ultimate drinking water criterion, unless a more restrictive aesthetic cleanup criterion is available.

Soil: The exposure assumptions used in the direct contact algorithms are protective for a "reasonable maximum exposure". The focus was the worker population within each subcategory that spends the largest amount of time outdoors engaged in activities that permit contact with affected soils. The worker population in both commercial subcategory III and subcategory IV represents the segment of the population within the subcategory with the highest potential exposures. Protection of less significantly exposed populations, like customers or workers who spend less time outdoors, is thereby assured.

Generic Commercial Direct Contact Soil Algorithm

The direct contact soil algorithm for the commercial scenario is the same as the industrial direct contact soil algorithm with the exception of different values for two exposure parameters, specifically, exposure frequency (EF) and the skin surface area (SA), and incorporation of an exposure time parameter. Please refer to the generic industrial section for details on the exposure assumptions that have not changed.

CARCINOGENS:

$$\frac{10^{-5} \times BW \times AT \times CF}{SF \times (EF \times FD) \times ED \times FC \times [(IR_s \times AE_i) + (SA \times AF \times AE_d)]}$$

where,

10^{-5} cancer risk	= acceptable risk
BW (body weight)	= 70 kg
AT (averaging time)	= 25,550 days
CF (conversion factor)	= 1E+9 ug/kg
SF (cancer slope factor, mg/kg-d^{-1})	= chemical-specific
EF (exposure frequency)	= (see text)
FD (fraction of work day)	= (see text)
ED (exposure duration)	= 21 yr
FC (fraction of soil contaminated)	= 1
IR_s (soil ingestion rate)	= 50 mg/day
AE_i (ingest. absorption efficiency)	= (see text)
SA (skin surface area)	= (see text)
AF (soil adherence factor)	= 1.0 mg/cm^2
AE_d (dermal absorption efficiency)	= (see text)

NONCARCINOGENS:

$$\frac{HQ \times RfD \times BW \times AT \times CF}{(EF \times FD) \times ED \times FC \times [(IR_s \times AE_i) + (SA \times AF \times AE_d)]}$$

where,

HQ (hazard quotient)	= 1
RfD(oral reference dose, mg/kg day)	= chemical specific
BW	= 70 kg
AT	= 7,665 days
CF	= 1E+9 ug/kg
EF	= (see text)
ED	= 21 yr
FD	= (see text)
FC (fraction soil contam'd)	= 1

IR_s	= 50 mg/day
AE_i	= (see text)
SA	= (see text)
AF	= 1.0 mg/cm^2
AE_d	= (see text)

These equations yield values which represent concentrations of contaminants in soil in units of ppm or mg/kg. To convert to units of ppb or micrograms/kilogram in soil (ug/kg), multiply by 1,000.

Commercial Subcategory III
A typical receptor in this subcategory is a gas station attendant who must perform a combination of indoor and outdoor activities. The EF of 160 days/year was derived assuming that four months of winter would preclude an individual from coming into contact with soil. Rain and other inclement weather factors were not considered because it is assumed that this type of worker must still perform his/her outdoor duties. Allowing for three weeks off per year for vacations and sick leave and adjusting for a standard five day work week yields a maximum number of 160 days per year of potential exposure (i.e., 365 - 120 - 21 x 5/7 = 160). Having both indoor and outdoor responsibilities, this type of commercial worker is conservatively expected to spend four out of eight hours per work day outdoors. The FD parameter is equal to 0.5 (4/8 hours).

The area of skin exposed is assumed to be the same as for the generic industrial worker, 2570 cm^2/day. This assumes that the face, hands and forearms of the receptor are available for exposure, typified by a worker wearing a short-sleeved shirt and long pants.

Commercial Subcategory IV
The typical worker in this subcategory may be represented by an office worker who eats lunch and takes breaks outdoors. The EF was derived assuming that four months of winter would preclude an individual from coming into contact with soil. Allowing three weeks off for vacations and sick leave and adjusting for a standard five day work week yields 160 days/year. As in the generic industrial scenario, it is also assumed that it rains one day out of the week. This results in a value of 128 days/year. Since this type of receptor is outdoors only a small portion of the work day, reasonably 1.5 hours/day, a fraction of day parameter (FD) (1.5 hours out of 8) is incorporated into the algorithm. FD is equal to 0.19 (1.5/8).

This type of receptor is assumed to be a person with face, hands, forearms and lower legs exposed. This represents an individual wearing a short-sleeved shirt and a dress or skirt. The total skin surface area for these exposed areas is 4575 cm^2/day.

The assumed EF, FD, and SA values for the two commercial subcategories are summarized as follows:

(27)

	Exposure Frequency	Fraction of Day	Surface Area
Commercial Subcat. III	160	0.50	2570
Commercial Subcat. IV	128	0.19	4575

Attached as a table is a matrix presenting all commercial category and subcategory definitions and exposure assumptions. Use this table when trying to determine the most appropriate commercial land use subcategory for the site in question.

Table 1. Definitions of industrial and commercial categories and commercial subcategories and associated exposure assumptions.

LAND USE CATEGORIES AND SUBCATEGORIES	EXPOSURE ASSUMPTIONS				
	Exposure Frequency (d/year)	Fraction of Day (unitless)	Exposure Duration (years)	Soil Ingestion Rate (mg/day)	Skin Surface Area (cm^2/day)
INDUSTRIAL primary activity is industrial; property has landscaped and/or unpaved areas maintained by employees on a regular basis or employees are present whose primary duties are performed outdoors; access to general public is restricted; zoning is industrial	≤112	≤1	≤21	≤50	≤2570
COMMERCIAL primary activity is commercial; access is unrestricted; zoning is commercial; see subcategories					
SUBCATEGORY I a property where children, the elderly, the infirm or other sensitive subpopulations are housed, educated or otherwise cared for, e.g., schools, nursing homes, day cares; residential cleanup required	≤365	≤1	≤70	≤90	varies for different age grps.
SUBCATEGORY II activities similar to those characterized in industrial category; industrial cleanup required	≤112	≤1	≤21	≤50	≤2570
SUBCATEGORY III property has landscaped or unpaved areas in which some employees will spend approximately half of their work time, e.g., gas station attendants	≤160	≤0.5	≤21	≤50	≤2570
SUBCATEGORY IV a property with unpaved or landscaped areas that will be frequented by employees on an occasional basis, e.g., outdoor eating areas	≤128	≤0.19	≤21	≤50	≤4575

(22)

PART 201 OF THE NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION ACT, 1994 PA 451

GENERIC INDUSTRIAL AND COMMERCIAL CLEANUP CRITERIA FOR GROUNDWATER AND SOIL

(REVISION 2)

These criteria were calculated using currently available toxicological data. Criteria may change as new toxicity data become available. They are not necessarily final cleanup standards. The determination of a soil concentration protective of surface water and/or groundwater in an aquifer is more complex than for residential sites, consequently, there are no values shown on the list. PLEASE READ THE ATTACHED OPERATIONAL MEMORANDUM FOR DETAILS. Carcinogenic chemicals are shown in bold italics. All values are expressed in units of parts per billion (ppb); ug/l in water and ug/kg in soil. (Values are converted from units of parts per million (ppm) as generated by algorithms). Scientific notation is represented by E- or E+ a value, for example 2×10^{-6} is reported as 2E-6. Please refer to Operational Memorandum #6 and #8 for information concerning method detection limits and residential cleanup criteria, respectively.

Chemical	GROUNDWATER (ppb:ug/l)				SOIL (ppb:ug/kg)			
	Health-Based Drinking Water Value	Aesthetic Drinking Water Value	GSI Value	Target Method Detection Limit in Water	Direct Contact Value: Industrial	Direct Contact Value: Commercial Subcategory III	Direct Contact Value: Commercial Subcategory IV	Target Method Detection Limit in Soil
Acenaphthene	3,800	NA	3.8	5	8.1E+8	1.0E+9 (G)	1.0E+9 (G)	330
Acenaphthylene	75	NA	(B)	5	1.6E+7	2.3E+7	5.4E+7	330
Acetaldehyde	2,700	NA	(B)	500	9.7E+7	1.4E+8	2.7E+8	2,500
Acetic acid	12,000	NA	(B)	18,000	4.2E+8	5.9E+8	1.0E+9 (G)	9.0E+5
Acetone	2,100	NA	25,000	100	7.4E+7	1.0E+8	2.1E+8	100
Acetonitrile	400	NA	810	50	1.4E+7	2.0E+7	3.9E+7	100
Acrolein	330	NA	2.5	5	1.2E+7	1.7E+7	3.3E+7	10
Acrylamide	0.78	NA	9.1	0.5	33,000	47,000	1.1E+5	5
Acrylic acid	11,000	NA	(B)	NA	3.9E+8	5.5E+8	1.0E+9 (G)	NA
Acrylonitrile	6.4	NA	2.2	1	46,000	64,000	1.3E+5	10
Alachlor	2 (C)	NA	48	1	1.9E+6	2.9E+6	6.2E+6	20
Aldicarb	3 (C)	NA	(B)	2	4.5E+6	6.3E+6	1.5E+7	50
Aldicarb sulfoxide	4 (C)	NA	(B)	2	5.9E+6	8.2E+6	1.9E+7	50
Aldicarb sulfone	2 (C)	NA	(B)	2	5.0E+6	7.0E+6	1.6E+7	50
Aldrin	0.2	NA	0.0014	0.01	8,800	12,000	29,000	20
Aluminum	ID	50 (A,F)	(B)	100	ID	ID	ID	700
Ammonia	ID (P)	NA	20 (D)	50	ID (P)	ID (P)	ID (P)	1,000
Aniline	610	NA	4	20	2.5E+7	3.7E+7	8.7E+7	1,700
Anthracene	21,000	NA	1.1E+5	5	1.0E+9 (G)	1.0E+9 (G)	1.0E+9 (G)	330
Antimony	6 (A,C)	NA	50 (A)	5	1.6E+6	2.2E+6	5.2E+6	500
Arsenic	50 (A,C)	NA	11 (A)	5	83,000	1.2E+5	2.8E+5	100
Atrazine	3 (C)	NA	7.8	1	6.8E+5	9.5E+5	2.3E+6	50
Azobenzene	32	NA	(B)	NA	1.4E+6	1.9E+6	4.5E+6	NA
Barium	2,000 (A,C)	NA	630 (A,D)	200	3.2E+8	4.4E+8	1.0E+9 (G)	1,000
Benzene	5 (C)	NA	53	5	8.5E+5	1.2E+6	2.4E+6	10

Chemical	GROUNDWATER (ppb:ug/l)				SOIL (ppb:ug/kg)			
	Health-Based Drinking Water Value	Aesthetic Drinking Water Value	GSI Value	Target Method Detection Limit in Water	Direct Contact Value			Target Method Detection Limit in Soil
					Industrial	Commercial Subcategory III	Commercial Subcategory IV	
Benzidine	0.015	NA	0.0054	50	650	910	2,200	1,000
Benzo(a)anthracene (C)	4.8	NA	0.31	5	2.1E+5	2.9E+5	6.8E+5	330
Benzo(b)fluoranthene (C)	4.8	NA	0.31	5	2.1E+5	2.9E+5	6.8E+5	330
Benzo(k)fluoranthene (C)	48	NA	0.31	5	2.1E+6	2.9E+6	6.8E+6	330
Benzo(g,h,i)perylene	75	NA	(B)	5	1.6E+7	2.3E+7	5.4E+7	330
Benzo(a)pyrene (C)	0.2 (C)	NA	0.31	5	21,000	29,000	68,000	330
Benzoic acid	92,000	NA	(B)	50	1.0E+9 (G)	1.0E+9 (G)	1.0E+9 (G)	3,300
Benzyl alcohol	29,000	NA	22	50	1.0E+9 (G)	1.0E+9 (G)	1.0E+9 (G)	1,300
Benzyl chloride	20	NA	(B)	0.5	1.5E+5	2.0E+5	4.1E+5	200
Beryllium	4 (C)	NA	(B)	1	35,000	49,000	1.2E+5	200
Bis(2-chloroethoxy)ethane	ID	NA	(B)	5	ID	ID	ID	330
bis(2-Chloroethyl)ether	3.2	NA	4.2	5	23,000	32,000	53,000	330
bis(2-Ethylhexyl)phthalate	6 (C)	NA	59	5	1.1E+7	1.5E+7	3.5E+7	330
Boron	1,300 (A)	NA	(B)	300	2.7E+8	3.8E+8	8.9E+8	8,000
Bromobenzene	ID	NA	(B)	1	ID	ID	ID	10
Bromodichloromethane	100 (C,S)	NA	24	1	4.0E+5	5.6E+5	1.1E+6	10
Bromoform	100 (C,S)	NA	65	1	3.1E+6	4.4E+6	8.7E+6	10
Bromomethane	29	NA	11	1	1.0E+6	1.5E+6	2.9E+6	10
n-Butanol	2,700	NA	(B)	800	9.7E+7	1.4E+8	2.7E+8	4,400
2-Butanone (MEK)	38,000	NA	7,200	50	1.0E+9 (G)	1.0E+9 (G)	1.0E+9 (G)	100
n-Butyl acetate	1,500	NA	40	10	5.7E+7	7.9E+7	1.5E+8	20
t-Butyl alcohol	11,000	NA	8,300	1,000	4.0E+8	5.6E+8	1.0E+9 (G)	4,400
Butyl benzyl phthalate	3,300	NA	(B)	5	7.2E+8	1.0E+9 (G)	1.0E+9 (G)	330
Cadmium	5 (A,C)	NA	0.64 (A,D)	0.5	2.3E+6	3.2E+6	7.4E+6	50
Camphene	ID	NA	(B)	NA	ID	ID	ID	NA
Caprolactam	17,000	NA	(B)	NA	1.0E+9 (G)	1.0E+9 (G)	1.0E+9 (G)	NA
Carbaryl	2,000	NA	(B)	20	4.3E+8	6.1E+8	1.0E+9 (G)	1,000
Carbofuran	40 (C)	NA	1.6	20	3.7E+6	5.2E+6	1.0E+7	200
Carbon disulfide (R)	2,300	NA	(B)	50	8.2E+7	1.1E+8	2.3E+8	100
Carbon tetrachloride	5 (C)	NA	21	1	1.9E+5	2.7E+5	5.3E+5	10
Chlordane	2 (C)	NA	0.00053	0.02	1.2E+5	1.6E+5	3.8E+5	10
Chloride	ID	2.5E+5	(B)	10,000	ID	ID	ID	2.0E+5
Chlorobenzene	100 (C)	NA	71	1	1.4E+7	2.0E+7	3.9E+7	10
Chloroethane	910	NA	(B)	1	6.5E+6	9.1E+6	1.8E+7	10
2-Chloroethyl vinyl ether	ID	NA	(B)	10	ID	ID	ID	100
Chloroform	100 (C,S)	NA	80	1	4.1E+6	5.7E+6	1.1E+7	10
Chloromethane	270	NA	(B)	1	1.9E+6	2.7E+6	5.3E+6	10
4-Chloro-3-methylphenol	420	NA	4.4	5	1.5E+7	2.1E+7	4.1E+7	330
beta-Chloronaphthalene	5,200	NA	(B)	5	1.9E+8	2.6E+8	5.2E+8	330

(221)

Chemical	GROUNDWATER (ppb:ug/l)				SOIL (ppb:ug/kg)			
	Health-Based Drinking Water Value	Aesthetic Drinking Water Value	GSI Value	Target Method Detection Limit in Water	Direct Contact Value			Target Method Detection Limit in Soil
					Industrial	Commercial Subcategory III	Commercial Subcategory IV	
2-Chlorophenol	130	NA	10	5	4.6E-6	6.5E-6	1.3E-7	330
o-Chlorotoluene	420	NA	(B)	1	1.5E-7	2.1E-7	4.1E-7	10
Chlorpyrifos	53	NA	0.002	0.2	1.4E-7	1.9E-7	4.5E-7	10
Chromium (III) (I)	100 (A,C,J)	NA	77 (A,D)	50	1.0E-9 (G)	1.0E-9 (G)	1.0E-9 (G)	2,500
Chromium (VI) (I)	100 (A,C,J)	NA	7.3 (A)	5	2.2E-7	3.0E-7	7.1E-7	200
Chrysene (Q)	450	NA	0.31	5	2.1E-7	2.9E-7	6.8E-7	330
Cobalt	100	NA	(B)	10	2.3E-7	3.2E-7	7.4E-7	500
Copper	4,000 (A)	1,000	18 (A,D)	25	1.7E-6	2.4E-6	5.6E-6	1,000
Cyanazine	5	NA	4.7	10	2.5E-6	3.6E-6	8.5E-6	500
Cyanide (R)	200 (C)	NA	5.2	20	9.9E-7	1.4E-6	3.3E-6	500
Cyclohexanone	94,000	NA	(B)	50	1.0E-9 (G)	1.0E-9 (G)	1.0E-9 (G)	100
Dacthal	210	NA	(B)	1	4.5E-7	6.3E-7	1.5E-6	20
Dalapon	200 (C)	NA	(B)	10	6.3E-7	8.8E-7	1.8E-6	100
4,4'-DDD	14	NA	0.0084	0.02	6.3E-5	8.8E-5	2.1E-6	20
4,4'-DDE	10	NA	0.0059	0.02	4.4E-5	6.2E-5	1.5E-6	20
4,4'-DDT	10	NA	0.00023	0.02	4.4E-5	6.2E-5	1.5E-6	20
Decabromodiphenyl ether	200	NA	(B)	10	4.5E-7	6.3E-7	1.5E-6	100
Di-n-butyl phthalate	2,500	NA	12,000	5	5.4E-8	7.6E-8	1.0E-9 (G)	330
Di(2-ethylhexyl) adipate	400 (C)	NA	(B)	5	2.1E-7	2.9E-7	6.8E-7	330
Di-n-octyl phthalate	380	NA	(B)	5	8.1E-7	1.1E-6	2.7E-6	330
Diacetone alcohol	ID	NA	(B)	NA	ID	ID	ID	NA
Diazinon	3.8	NA	0.002	0.5	8.1E-5	1.1E-5	2.7E-5	10
Dibenzo(a,h)anthracene (Q)	0.48	NA	0.31	5	21,000	29,000	68,000	330
Dibenzofuran	ID	NA	(B)	5	ID	ID	ID	330
Dibromochloromethane	100 (C,S)	NA	29	1	3.0E-5	4.1E-5	8.2E-5	10
Dibromomethane	230	NA	(B)	5	5.0E-7	6.9E-7	1.6E-6	10
1,2-Dichlorobenzene	600 (C)	NA	7	1	6.4E-7	9.0E-7	1.8E-6	10
1,3-Dichlorobenzene	600 (C)	NA	180	1	6.4E-7	9.0E-7	1.8E-6	10
1,4-Dichlorobenzene	75 (C)	NA	15	1	1.0E-6	1.4E-6	2.9E-6	10
3,3'-Dichlorobenzidine	7.7	NA	0.063	20	55,000	77,000	1.5E-5	2,000
Dichlorodifluoromethane	4,800	NA	(B)	1	1.7E-6	2.4E-6	4.8E-6	10
1,1-Dichloroethane	2,500	NA	(B)	1	8.9E-7	1.3E-6	2.5E-6	10
1,2-Dichloroethane	5 (C)	NA	560	1	2.7E-5	3.8E-5	7.5E-5	10
1,1-Dichloroethylene	7 (C)	NA	32	1	7.4E-5	1.0E-6	2.1E-6	10
cis-1,2-Dichloroethylene	70 (C)	NA	(B)	1	8.2E-6	1.1E-7	2.3E-7	10
trans-1,2-Dichloroethylene	100 (C)	NA	300	1	1.3E-7	1.8E-7	3.5E-7	10
2,5-Dichloro-4-nitroaniline	6,300	NA	(B)	0.01	1.0E-9 (G)	1.0E-9 (G)	1.0E-9 (G)	0.1
2,4-Dichlorophenol	210	NA	34 (D)	5	4.5E-7	6.3E-7	1.5E-6	330
2,4-Dichlorophenoxyacetic acid	70 (C)	NA	47	10	4.5E-7	6.3E-7	1.5E-6	200

Chemical	GROUNDWATER (ppb:ug/l)				SOIL (ppb:ug/kg)			
	Health-Based Drinking Water Value	Aesthetic Drinking Water Value	GSI Value	Target Method Detection Limit in Water	Direct Contact Value			Target Method Detection Limit in Soil
					Industrial	Commercial Subcategory III	Commercial Subcategory IV	
1,2-Dichloropropane	5 (C)	NA	64	1	3.6E+5	5.1E+5	1.0E+6	10
1,3-Dichloropropene (J)	19	NA	3	1	1.4E+5	1.9E+5	3.8E+5	10
Dichlorovos	12	NA	(B)	0.1	5.2E+5	7.2E+5	1.7E+6	50
Dicyclohexyl phthalate	ID	NA	(B)	5	ID	ID	ID	330
Dieldrin	0.22	NA	3.2E-5	0.02	9,400	13,000	31,000	20
Diethoxymethane	ID	NA	(B)	10	ID	ID	ID	100
Diethyl ether	10,000	NA	(B)	50	3.7E+8	5.2E+8	1.0E+9 (G)	100
Diethyl phthalate	16,000	NA	1.2E+5	5	1.0E+9 (G)	1.0E+9 (G)	1.0E+9 (G)	330
Diethylene glycol monobutyl ether	250	NA	(B)	NA	5.4E+7	7.5E+7	1.8E+8	NA
Diisopropylamine	16	NA	(B)	NA	5.7E+5	8.0E+5	1.6E+6	NA
Dimethyl phthalate	2.1E+5	NA	2.9E+6	5	1.0E+9 (G)	1.0E+9 (G)	1.0E+9 (G)	330
N,N-Dimethylacetamide	520	NA	(B)	NA	1.9E+7	2.6E+7	5.2E+7	NA
N,N-Dimethylaniline	46	NA	(B)	NA	1.6E+6	2.3E+6	4.6E+6	NA
Dimethylformamide	2,000	NA	3,800	NA	7.1E+7	1.0E+8	2.0E+8	NA
2,4-Dimethylphenol	1,000	NA	31	5	2.3E+8	3.2E+8	7.4E+8	330
2,5-Dimethylphenol	13	NA	(B)	5	2.7E+6	3.8E+6	8.9E+6	330
3,4-Dimethylphenol	29	NA	(B)	5	6.3E+6	8.8E+6	2.1E+7	330
Dimethylsulfoxide	6.3E+5	NA	(B)	NA	1.0E+9 (G)	1.0E+9 (G)	1.0E+9 (G)	NA
2,4-Dinitrotoluene	5.1	NA	91	5	2.2E+5	3.1E+5	7.3E+5	330
Dinoseb	7 (C)	NA	0.5 (D)	1	4.5E+6	6.3E+6	1.5E+7	20
1,4-Dioxane	320	NA	2,000	1	2.3E+6	3.2E+6	6.3E+6	10
Diquat	20 (C)	NA	(B)	1	9.9E+6	1.4E+7	3.3E+7	NA
Endosulfan (J)	4.8	NA	(B)	0.01	1.0E+6	1.5E+6	3.4E+6	3.3
Endothall	100 (C)	NA	(B)	20	7.7E+7	1.1E+8	2.5E+8	NA
Endrin	2 (C)	NA	0.0023	0.02	7.7E+5	1.1E+6	2.5E+6	20
Epichlorohydrin	350	NA	(B)	5	2.5E+6	3.5E+6	7.0E+6	10
Ethanol	5.6E+6	NA	41,000	1,000	1.0E+9 (G)	1.0E+9 (G)	1.0E+9 (G)	4,400
Ethyl acetate	19,000	NA	1,000	NA	6.7E+8	9.4E+8	1.0E+9 (G)	NA
1-Ethyl-2-methylbenzene	ID	NA	(B)	NA	ID	ID	ID	NA
Ethylbenzene	700 (C)	74	31	1	7.2E+7	1.0E+8	2.0E+8	10
Ethylene dibromide	0.05 (C)	NA	1.1	1	290	410	810	10
Ethylene glycol	42,000	NA	68,000	5,000	1.0E+9 (G)	1.0E+9 (G)	1.0E+9 (G)	5,000
Ethylene glycol acetate	ID	NA	(B)	NA	ID	ID	ID	NA
Ethylene glycol monobutyl ether	270	NA	(B)	NA	9.7E+6	1.4E+7	2.7E+7	NA
Fluoranthene	2,500	NA	370	5	5.4E+8	7.5E+8	1.0E+9 (G)	330
Fluorene	2,500	NA	14,000	5	5.4E+8	7.5E+8	1.0E+9 (G)	330
Fluorine	400 (C)	2,000	1,900	NA	2.7E+8	3.8E+8	8.9E+8	NA
Formaldehyde	3,800	NA	170	100	1.3E+8	1.9E+8	3.7E+8	500
Formic acid	29,000	NA	(B)	18,000	1.0E+9 (G)	1.0E+9 (G)	1.0E+9 (G)	9.0E+5

Chemical	GROUNDWATER (ppb:ug/l)				SOIL (ppb:ug/kg)			
	Health-Based Drinking Water Value	Aesthetic Drinking Water Value	GSI Value	Target Method Detection Limit in Water	Direct Contact Value			Target Method Detection Limit in Soil
					Industrial	Commercial Subcategory III	Commercial Subcategory IV	
1-Formylpiperidine	230	NA	(B)	NA	8.2E+6	1.1E+7	2.3E+7	NA
Gentian violet	35	NA	(B)	NA	1.5E+6	2.1E+6	5.0E+6	NA
Glyphosate	700 (C)	NA	(B)	100	4.5E+8	6.3E+8	1.0E+9 (G)	NA
Heptachlor	0.4 (C)	NA	0.0016	0.01	33,000	47,000	1.1E+5	20
Heptachlor epoxide	0.2 (C)	NA	0.0011	0.01	16,000	23,000	54,000	20
n-Heptane	92,000	NA	4	NA	1.0E+9 (G)	1.0E+9 (G)	1.0E+9 (G)	NA
Hexabromobenzene	56	NA	(B)	(K)	1.3E+7	1.8E+7	4.2E+7	(K)
Hexachlorobenzene (C-86)	1 (C)	NA	0.0019	(K)	94,000	1.3E+5	3.1E+5	(K)
Hexachlorobutadiene (C-46)	45	NA	500	(K)	1.9E+6	2.7E+6	6.4E+6	(K)
alpha-Hexachlorocyclohexane	0.55	NA	0.13	0.01	24,000	33,000	79,000	20
beta-Hexachlorocyclohexane	1.9	NA	0.46	0.01	83,000	1.2E+5	2.8E+5	20
Hexachlorocyclopentadiene (C-56)	50 (C)	NA	0.54	(K)	3.2E+7	4.5E+7	1.1E+8	(K)
Hexachloroethane	250	NA	13	2	1.8E+6	2.5E+6	4.9E+6	50
n-Hexane	8,600	NA	(B)	NA	3.1E+8	4.3E+8	8.5E+8	NA
2-Hexanone	2,900	NA	(B)	50	1.0E+8	1.5E+8	2.9E+8	100
Indeno(1,2,3-cd)pyrene (Q)	4.8	NA	0.31	5	2.1E+5	2.9E+5	6.8E+5	330
Iron	ID	300 (A)	(B)	100	ID	ID	ID	2,000
Isobutyl alcohol	6,700	NA	(B)	1,000	2.4E+8	3.3E+8	6.6E+8	4,400
Isophorone	3,700	NA	860	5	2.5E+7	3.7E+7	7.3E+7	330
Isopropyl alcohol	1,300	NA	21,000	400	4.8E+7	6.7E+7	1.3E+8	4,400
Lead	4 (A,L)	NA	6.6 (A,D)	3	4.0E+5 (L)	4.0E+5 (L)	4.0E+5 (L)	1,000
Lindane	0.2 (C)	NA	0.08	0.01	1.2E+5	1.5E+5	3.8E+5	20
Magnesium	1.2E+6	NA	(B)	30	1.0E+9 (G)	1.0E+9 (G)	1.0E+9 (G)	3,000
Manganese	500 (A)	50 (A)	(B)	20	2.2E+7	3.0E+7	7.1E+7	2,000
Mercury (Inorganic)	2 (A,C)	NA	0.0013 (A)	0.2	1.4E+6	1.9E+6	4.5E+6	100
Methanol	10,000	NA	41,000	1,000	3.7E+8	5.2E+8	1.0E+9 (G)	4,400
Methoxychlor	40 (C)	NA	(B)	0.5	2.3E+7	3.2E+7	7.4E+7	50
2-Methoxyethanol	83	NA	(B)	NA	3.0E+6	4.2E+6	8.3E+6	NA
2-Methyl-4-chlorophenoxyacetic acid	21	NA	(B)	0.5	4.5E+6	6.3E+6	1.5E+7	100
2-Methyl-4,6-dinitrophenol	7.3	NA	0.59	20	1.5E+6	2.2E+6	5.2E+6	1,700
4-Methyl-2-pentanone (MIBK)	1,000	NA	(B)	50	3.7E+7	5.2E+7	1.0E+8	100
Methyl-tert-butyl ether (MTBE)	690	NA	380	50	2.5E+7	3.4E+7	6.8E+7	100
N-Methyl-morpholine	56	NA	(B)	NA	2.0E+6	2.8E+6	5.5E+6	NA
Methylcyclopentane	ID	NA	(B)	50	ID	ID	ID	500
4,4'-Methylene-bis-2-chloroaniline (M)	3.6	NA	(B)	1	1.6E+5	2.2E+5	5.1E+5	50
Methylene chloride	5 (C)	NA	59	5	3.3E+6	4.6E+6	9.2E+6	10
2-Methylnaphthalene	ID	NA	(B)	5	ID	ID	ID	330
2-Methylphenol	1,000	NA	38	5	3.7E+7	5.2E+7	1.0E+8	330
3-Methylphenol	1,000	NA	(B)	5	2.3E+8	3.2E+8	7.4E+8	330

27

Chemical	GROUNDWATER (ppb:ug/l)				SOIL (ppb:ug/kg)			
	Health-Based Drinking Water Value	Aesthetic Drinking Water Value	GSI Value	Target Method Detection Limit in Water	Direct Contact Value: Industrial	Direct Contact Value: Commercial Subcategory III	Direct Contact Value: Commercial Subcategory IV	Target Method Detection Limit in Soil
4-Methylphenol	100	NA	6.2	5	2.3E+7	3.2E+7	7.4E+7	330
Metolachlor	670	NA	150	10	2.9E+7	4.0E+7	9.5E+7	50
Molybdenum	100 (A)	NA	800 (A)	10	2.3E+7	3.2E+7	7.4E+7	100
Naphthalene	750	NA	29	5	1.6E+8	2.3E+8	5.4E+8	330
Nickel	100 (A,C)	NA	57 (A,D)	50	3.4E+8	4.8E+8	1.0E+9 (G)	1,000
Nitrate (F)	10,000 (C,F)	NA	(B)	100	ID	ID	ID	NA
Nitrite (F)	1,000 (C,F)	NA	(B)	100	ID	ID	ID	NA
Nitrobenzene	9.5	NA	1,900	5	3.4E+5	4.8E+5	9.5E+5	330
2-Nitrophenol	58	NA	(B)	5	1.3E+7	1.8E+7	4.2E+7	330
n-Nitroso-di-n-propylamine	0.5	NA	(B)	5	3,500	5,000	9,900	330
N-Nitrosodiphenylamine	710	NA	160	5	5.1E+6	7.1E+6	1.4E+7	330
Oxamyl	200 (C)	NA	(B)	NA	1.7E+8	2.4E+8	5.6E+8	NA
Oxo-hexyl acetate	210	NA	(B)	NA	7.4E+6	1.0E+7	2.1E+7	NA
Pendimethalin	2,500	NA	0.62	0.1	5.4E+8	7.5E+8	1.0E+9 (G)	20
Pentachlorobenzene	17	NA	(B)	2	3.7E+6	5.2E+6	1.2E+7	50
Pentachloronitrobenzene	150	NA	(B)	2	3.4E+7	4.7E+7	1.1E+8	50
Pentachlorophenol	1 (C)	NA	0.8 (D)	20	1.3E+6	1.8E+6	4.1E+6	3,400
Pentane	ID	NA	(B)	100	ID	ID	ID	1,000
2-Pentene	ID	NA	(B)	NA	ID	ID	ID	NA
Phenanthrene	75	NA	(B)	5	1.6E+7	2.3E+7	5.4E+7	330
Phenol	13,000	NA	1,100	5	4.5E+8	6.2E+8	1.0E+9 (G)	330
Picloram	500 (C)	NA	(B)	10	3.2E+8	4.4E+8	1.0E+9 (G)	100
Piperidine	9.2	NA	(B)	NA	3.3E+5	4.6E+5	9.1E+5	NA
Polybrominated biphenyls (J)	0.39	NA	(B)	NA	17,000	24,000	55,000	NA
Polychlorinated biphenyls (PCBs) (J,T)	0.5 (C)	NA	2.0E-5	0.2	21,000	30,000	58,000	330
Prometon	460	NA	(B)	0.5	9.9E+7	1.4E+8	3.3E+8	20
Propachlor	270	NA	(B)	1	5.9E+7	8.2E+7	1.9E+8	20
Propazine	560	NA	(B)	0.5	1.2E+8	1.7E+8	4.0E+8	20
Propionic acid	35,000	NA	(B)	100	1.0E+9 (G)	1.0E+9 (G)	1.0E+9 (G)	6,700
Propyl alcohol	4,000	NA	15,000	NA	1.4E+8	2.0E+8	3.9E+8	NA
Propylene glycol	4.2E+5	NA	1.9E+5	5,000	1.0E+9 (G)	1.0E+9 (G)	1.0E+9 (G)	5,000
Pyrene	1,500	NA	11,000	5	3.4E+8	4.7E+8	1.0E+9 (G)	330
Pyridine	21	NA	20	20	7.4E+5	1.0E+6	2.1E+6	330
Selenium	50 (A,C)	NA	5 (A)	5	2.3E+7	3.2E+7	7.4E+7	500
Silver	98 (A)	100	0.1 (A)	0.5	2.1E+7	3.0E+7	7.0E+7	500
Simazine	4 (C)	NA	3.4	10	2.3E+7	3.3E+7	7.7E+7	40
Sodium	4.5E+5	NA	(B)	NA	1.0E+9 (G)	1.0E+9 (G)	1.0E+9 (G)	NA
Styrene	100 (C)	NA	19	1	8.3E+5	1.2E+6	2.3E+6	10
Sulfate	ID	2.5E+5	(B)	NA	ID	ID	ID	NA

(28)

Chemical	GROUNDWATER (ppb:ug/l)				SOIL (ppb:ug/kg)			
	Health-Based Drinking Water Value	Aesthetic Drinking Water Value	GSI Value	Target Method Detection Limit in Water	Direct Contact Value			Target Method Detection Limit in Soil
					Industrial	Commercial Subcategory III	Commercial Subcategory IV	
Tebuthiuron	1,500	NA	(B)	NA	3.2E+8	4.4E+8	1.0E+9 (G)	NA
2,3,7,8-Tetrabromodibenzo-p-dioxin (O)	(C)	NA	(C)	0.0001	(C)	(C)	(C)	0.01
1,2,4,5-Tetrachlorobenzene	7,100	NA	0.4	0.1	1.0E+9 (G)	1.0E+9 (G)	1.0E+9 (G)	20
2,3,7,8-Tetrachlorodibenzo-p-dioxin (O)	3.0E-5 (C)	NA	1.4E-8	1.0E-5	0.99	1.4	2.9	0.001
1,1,1,2-Tetrachloroethane	130	NA	(B)	1	9.5E+5	1.3E+6	2.7E+6	10
1,1,2,2-Tetrachloroethane	17	NA	22	1	1.2E+5	1.7E+5	3.5E+5	10
Tetrachloroethylene	5 (C)	NA	22	1	4.9E+5	6.8E+5	1.4E+6	10
Tetrahydrofuran	650	NA	3,300	1,000	2.5E+7	3.4E+7	6.8E+7	10,000
Thallium	2 (A,C)	NA	5.4 (A)	2	3.0E+5	4.2E+5	1.0E+6	500
Toluene	1,000 (C)	790	110	1	1.6E+8	2.3E+8	4.6E+8	10
p-Toluidine	18	NA	(B)	NA	7.9E+5	1.1E+6	2.5E+6	NA
Toxaphene	3 (C)	NA	0.0002	1	23,000	32,000	63,000	170
Triallate	270	NA	(B)	1	5.9E+7	8.2E+7	1.9E+8	20
Tributylamine	29	NA	(B)	NA	1.0E+6	1.5E+6	2.9E+6	NA
1,2,4-Trichlorobenzene	70 (C)	NA	22	5	6.8E+7	9.5E+7	2.2E+8	330
1,1,1-Trichloroethane	200 (C)	NA	120	1	2.1E+7	2.9E+7	5.8E+7	10
1,1,2-Trichloroethane	5 (C)	NA	65	1	4.4E+5	6.1E+5	1.2E+6	10
Trichloroethylene	5 (C)	NA	94	1	1.5E+6	2.2E+6	4.3E+6	10
Trichlorofluoromethane	7,300	NA	580	1	2.5E+8	3.6E+8	7.3E+8	10
2,4,5-Trichlorophenol	2,100	NA	25	50	4.5E+8	6.3E+8	1.0E+9 (G)	1,700
2,4,6-Trichlorophenol	320	NA	27 (D)	5	1.4E+7	1.9E+7	4.5E+7	330
2(2,4,5-Trichlorophenoxy)propionic acid (N)	50 (C)	NA	21	1	3.4E+7	4.7E+7	1.1E+8	50
1,2,3-Trichloropropane	120	NA	(B)	1	2.5E+7	3.6E+7	8.5E+7	10
1,1,2-Trichloro-1,2,2-trifluoroethane	5.6E+5	NA	33	NA	1.0E+9 (G)	1.0E+9 (G)	1.0E+9 (G)	NA
Triethanolamine	10,000	NA	(B)	NA	3.7E+8	5.2E+8	1.0E+9 (G)	NA
3-Trifluoromethyl-4-nitrophenol	13,000	NA	32 (D)	NA	1.0E+9 (G)	1.0E+9 (G)	1.0E+9 (G)	NA
Trifluralin	450	NA	(B)	1	2.0E+7	2.7E+7	6.4E+7	50
2,2,4-Trimethyl pentane	ID	NA	(B)	50	ID	ID	ID	500
2,2,4-Trimethyl-2-pentene	ID	NA	(B)	NA	ID	ID	ID	NA
1,2,4-Trimethylbenzene	86	NA	22	1	3.1E+6	4.3E+6	8.5E+6	10
1,3,5-Trimethylbenzene	65	NA	26	1	2.3E+6	3.2E+6	6.4E+6	10
tris(2,3-Dibromopropyl)phosphate	1.9	NA	(B)	NA	83,000	1.2E+5	2.8E+5	NA
Urea	ID (P)	NA	(B)	400	ID (P)	ID (P)	ID (P)	20,000
Vanadium	180 (A)	NA	8 (A)	20	3.9E+7	5.5E+7	1.3E+8	1,000
Vinyl acetate	1,800	NA	(B)	50	6.5E+7	9.2E+7	1.8E+8	100
Vinyl chloride	2 (C)	NA	3.1	1	11,000	16,000	31,000	10
White phosphorus (R)	0.31	NA	(B)	NA	68,000	95,000	2.2E+5	NA
Xylenes	10,000 (C)	280	59	3	1.0E+9 (G)	1.0E+9 (G)	1.0E+9 (G)	30
Zinc	6,900 (A)	5,000 (A)	81 (A,D)	20	1.0E+9 (G)	1.0E+9 (G)	1.0E+9 (G)	1,000

..es

Background, as defined in Rule 701(c), may be substituted if higher than the cleanup criteria.

{B} Chemical has either not been evaluated or an inadequate data base precludes the development of a GSI value. Contact an ERD toxicologist for assistance.

{C} State of Michigan Drinking Water Standard established pursuant to Section 5 of the Safe Drinking Water Act, Act No. 399 of the Public Acts of 1976 used as the default.

{D} GSI value is pH, temperature, or water hardness dependent. Contact an ERD toxicologist for details.

{E} Chemical, due to its physicochemical properties, is not expected to leach through soils to groundwater under most conditions.

{F} Professional judgment used to determine that 50 ppb of aluminum in drinking water is protective of human health.

{G} Criteria exceeds 100% in soil, hence it is reduced to 100%.

{H} Criteria is based on agricultural impacts (phytotoxicity), not 20X groundwater criterion.

{I} Valence-specific chromium data (Cr III and Cr VI) must be compared to the same valence-specific cleanup criteria. If analytical data are provided for "total" chromium only, then values for chromium VI must be applied as the cleanup criteria. Chromium III cleanup criteria can only be used at sites where groundwater is prevented from being used as a public water supply, currently or in the future.

{J} Chemical may be present in several isomer forms. Isomer specific concentrations must be combined for comparison to criteria. Contact an ERD toxicologist for further explanation.

{K} Two different analytical methods and target method detection limits are available for this chemical. Refer to Operational Memorandum #6 for details.

{L} Criteria developed using the U.S. EPA Integrated Uptake Biokinetic Model for children. No risk assessment method(s) is currently available to evaluate lead toxicity in adults. Higher level may be acceptable if soil concentration is less than 400 ppm and groundwater migrating off-site will not impact adjacent properties. Contact an ERD toxicologist for further explanation.

{M} Also known as MBOCA.

{N} Also known as Silvex.

{O} Use 2,3,7,8-TCDD "toxicity equivalence factors" (TEFs) for other chlorinated and /or brominated dibenzo-p-dioxins and chlorinated and/or brominated dibenzofurans for comparison to cleanup criteria. Contact an ERD toxicologist for details.

{P} All potential sources of nitrogen-nitrate must be combined and compared to nitrate criteria. Contact an ERD toxicologist for details.

{Q} Criteria for carcinogenic polynuclear aromatic hydrocarbons (PAHs) were developed using "relative potential potencies" (RPPs) to benzo(a)pyrene.

{R} Chemical may be reactive in soil.

{S} Concentrations of trihalomethanes in groundwater must be combined to determine compliance with the health-based drinking water value of 100 ppb.

{T} Toxic Substances Control Act, Subpart G - PCB Spill Cleanup Policy standards may be more restrictive.

ID = Inadequate data to develop criterion; NA = Not available.

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY

INTEROFFICE COMMUNICATION

April 29, 1997

RECEIVED

MAY 14 1997

TO: Environmental Response Division Staff

FROM: Alan J. Howard, Chief
Environmental Response Division

SUBJECT: Part 201 Generic Soil Inhalation Criteria for Ambient Air: Addendum to Interim Operational Memoranda #8, Revision 4 (June 5, 1995) and #14, Revision 2 (June 6, 1995)

Attached is the technical support document (TSD) for the generic Part 201 Soil Inhalation Criteria for Ambient Air (SIC) which includes a list of the criteria. The generic SIC have been developed to assess the potential for human health effects from long-term exposure to airborne soil contaminants in ambient air. The TSD describes the development and application of the criteria which are applicable in determining the adequacy of a remedial action plan and whether a property is a facility. This version replaces all previously distributed versions of the SIC.

Any questions related to the cleanup criteria can be directed to the toxicologists Christine Flaga, 517-373-0160; Jeffrey Crum, 517-335-3092; or Linda Larsen, 517-335-3161.

Attachments

cc: Mr. Arthur Nash, USTD
Mr. James Sygo, WMD
Mr. Harold Fitch, GSD

A Howard

(1)

Generic Soil Inhalation Criteria For Ambient Air: Technical Support Document

Environmental Response Division
Michigan Department of Environmental Quality

(3)

The Michigan Department of Environmental Quality (MDEQ) will not discriminate against any individual or group on the basis of race, sex, religion, age, national origin, color, marital status, disability, or political beliefs. Questions or concerns should be directed to the Office of Personnel Services, PO Box 30473, Lansing, MI 48909.

For information or assistance on this publication, contact MDEQ, Environmental Response Division, PO Box 30426, Lansing, MI 48909-7926; 517-241-7651.

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PART 201
GENERIC SOIL INHALATION CRITERIA FOR AMBIENT AIR: TECHNICAL SUPPORT DOCUMENT

Environmental Response Division
Michigan Department of Environmental Quality
April 23, 1997

This memorandum provides draft interim generic soil inhalation criteria (SIC) for ambient air that may be used to address inhalation exposures to soil contaminants under residential, industrial and commercial land use scenarios. These criteria have been developed pursuant to sections 20120a(1)(a) through (d) and 20120(a)(3) of Part 201 of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended. Section 20120a(3) requires the department to develop cleanup criteria based on human health risk assessment assumptions utilizing reasonable and relevant exposure pathways. Current soil direct contact values presented in Interim Operational Memorandum #8, Revision #4 (June 5, 1995) and #14, Revision #2 (June 6, 1995) are only protective of chronic, systemic health effects which may result from incidental ingestion of soil or direct dermal contact with soil. For some chemicals, the inhalation route of exposure may present a greater risk of harm. Therefore, the generic SIC have been developed to assess the potential for human health effects from exposure to airborne soil contaminants in ambient air.

Part 201 administrative rule 299.5711(4) provides that contaminant concentrations in soil "shall not result in an air emission that causes an increased cancer risk of 1 in 1,000,000 or a concentration that causes, alone or through reaction with other air contaminants, injurious effects to human health, safety, or welfare; animal life; plant life of significant value; or to property." (The target cancer risk for Part 201 facilities was changed by the 1995 amendments to 1 in 100,000.) In addition, rule 299.5715(2) states, "Hazardous substance concentrations shall not produce any emission which results in a violation of the provisions of Act No. 348 of the Public Acts of 1965, as amended," (now known as Part 55 of Act 451). Emissions from Part 201 facilities are not subject to the permit requirements of the Air Toxics Rules, however, Part 55 administrative rule 336.1901(a) and (b) contains general provisions similar to those in Part 201 rule 299.5711(4). Compliance with ambient air screening levels developed under the authority of the Air Toxics Rules has been determined to be one way of demonstrating compliance with rule 901. Therefore, the methods used to develop Air Quality Division (AQD) screening values and the regulations governing application of those values have been considered and employed in the development of SIC for ambient air where appropriate. Some modifications in AQD methods and applications were made in consideration of the use of these screening values for SIC development.

The criteria presented in the attached tables are not protective of indoor air contamination which may result from vapor intrusion from soil into buildings. A generic approach under Part 201 to address the potential for indoor air risks which may result from soil contaminants is not available but is under development. At sites where vapor intrusion may occur, including all sites in the unlimited residential category, a site-specific evaluation must be performed to determine if this pathway poses a human health concern. Site-specific evaluations of the indoor air pathway should be submitted to the ERD Toxicology Unit for review.

The generic SIC are intended to be protective of chronic human health effects which may result from exposure to ambient airborne contaminants. The allowable levels in soil developed under this scenario do not completely account for and may not be protective of other endpoints such as acute human health effects, ocular irritation, dermal irritation or sensitization, physical hazards such as reactivity, corrosivity, or ignitability, and/or ecological impacts. The potential for these effects to occur must be considered to determine if more restrictive criteria are needed to ensure protection for these endpoints.

TECHNICAL DEVELOPMENT OF SIC

GENERIC ALGORITHMS

The generic residential SIC algorithms presented below are consistent with the revised Environmental Protection Agency (EPA) Soil Screening Guidance: Technical Background Document (EPA, 1996). These algorithms yield values which represent concentrations of contaminants in soil in units of micrograms per kilogram (ug/kg or ppb). All exposure assumptions represent current EPA guidance. A discussion of the default exposure assumptions for residential land use may be found in Operational Memorandum #8 (Revision 4). Discussion of parameters which are specific to the inhalation pathway is presented below.

Please note that the reference concentration (RfC) is presented in units of milligrams per cubic meter of air (mg/m^3) and the inhalation unit risk (IURF) for carcinogens is presented in micrograms per cubic meter of air $(ug/m^3)^{-1}$. The RfC and the IURF differ from oral toxicity values in that they represent a concentration in the media of concern (i.e., air) rather than a dose to the receptor in units of mg/kg-day. These values are presumed to be protective of most human receptors, therefore, it is not necessary to include either body weight or inhalation rate (intake) in the generic equation. Air Quality Division (AQD) screening values developed under the authority of Part 55 of Act 451 were used in lieu of EPA developed RfC's where those values are not available. Please consult the Part 55 Air Toxics Rules for information regarding development of screening values.

Generic Residential SIC Algorithms Protective of Ambient Air Exposures

Carcinogens:

$$\text{Volatile Soil Inhalation Criteria} = \frac{10^{-5} \times AT}{IURF \times EF \times ED \times (1/VF)}$$

where,

10^{-5} cancer risk	= target risk
AT (averaging time)	= 25,550 days (70 x 365)
IURF (inhalation unit risk factor)	= chemical-specific $(ug/m^3)^{-1}$
EF (exposure frequency)	= 350 days/year
ED (exposure duration)	= 30 years
VF (volatilization factor)	= chemical-specific in m^3/kg

$$\text{Particulate Soil Inhalation Criteria} = \frac{10^{-5} \times AT}{IURF \times EF \times ED \times (1/PEF)}$$

where,

10^{-5} cancer risk	= target risk
AT (averaging time)	= 25,550 days (70 x 365)
IURF (inhalation unit risk factor)	= chemical-specific $(ug/m^3)^{-1}$
EF (exposure frequency)	= 350 days/year
ED (exposure duration)	= 30 years
PEF (particulate emission factor)	= chemical-specific in m^3/kg

Noncarcinogens:

$$\text{Volatile Soil Inhalation Criteria} = \frac{THQ \times AT \times CF}{EF \times ED \times (1/RfC \times 1/VF)}$$

where,

THQ (target hazard quotient)	= 1
AT (averaging time)	= 10,950 days (30 x 365)
CF (conversion factor)	= 1000 ug/mg
EF (exposure frequency)	= 350 days/year
ED (exposure duration)	= 30 years
RfC (reference concentration)	= chemical-specific in mg/m^3
VF (volatilization factor)	= chemical-specific in m^3/kg

$$\text{Particulate Soil Inhalation Criteria} = \frac{THQ \times AT \times CF}{EF \times ED \times (1/RfC \times 1/PEF)}$$

where,

THQ (target hazard quotient)	= 1
AT (averaging time)	= 10,950 days (30 x 365)
CF (conversion factor)	= 1000 ug/mg
EF (exposure frequency)	= 350 days/year
ED (exposure duration)	= 30 years
RfC (reference concentration)	= chemical-specific in mg/m^3
PEF (particulate emission factor)	= chemical-specific in m^3/kg

The volatilization factor (VF) and the particulate emission factor (PEF) in the equations above are used to define the relationship of the acceptable level of contaminant in air to a corresponding concentration of contaminant in soil. This relationship is dependent upon the emission of contaminant from soil and the subsequent dispersion of the airborne contaminant. Emission of volatile contaminants from soil will be discussed under the Soil to Air Volatilization Factor section below. Emission of particulates from soil will be discussed under the Particulate Emission Factor section, also below. Since the dispersion of airborne contaminants affects both the VF and the PEF, this parameter will be discussed separately under the heading of Q/C: Air Dispersion Factor.

SOIL TO AIR VOLATILIZATION FACTOR

The soil to air volatilization factor (VF) relates the concentration of a contaminant in the soil to the concentration of volatilized contaminant in the ambient air. VF is calculated from the equation below using chemical-specific properties and default values for soil properties that are representative of generic conditions for Michigan.

$$VF = (Q / C) \times (1 / J_s^{ave})$$

J_s^{ave}, using the Jury infinite source model is calculated as:

$$J_s^{ave} = \rho_b (4 D_A / \pi t)^{1/2} \times 10^4 \ cm^2/m^2$$

and D_A is calculated as:

$$D_A = \frac{[(\Theta_a^{10/3} D_i H' + \Theta_w^{10/3} D_w) / n^2]}{\rho_b K_d + \Theta_w + \Theta_a H'}$$

where,

VF	Volatilization Factor	= chemical-specific in m^3/kg
J_s^{ave}	Normalized Average Flux from Soil	= chemical-specific in g/m^2-s
D_A	Apparent Diffusivity	= chemical-specific in cm^2/s
Q/C	Dispersion Factor	= source size-specific in g/m^2-s per kg/m^3
t	Exposure Time	= scenario specific in s (ED x 3.1536E+7 sec/yr)
Θ_a	Air-filled Soil Porosity	= 0.28 L_{air}/L_{soil}
n	Total Soil Porosity	= 0.43 L_{pore}/L_{soil}
Θ_w	Water-filled Soil Porosity	= 0.15 L_{water}/L_{soil}
ρ_b	Dry Soil Bulk Density	= 1.5 g/cm^3
ρ_s	Soil Particle Density	= 2.65 g/cm^3
D_i	Diffusivity in Air	= chemical-specific in cm^2/s
D_w	Diffusivity in Water	= chemical-specific in cm^2/s
H'	Henry's Law Constant x 41	= chemical-specific (unitless)
K_{oc}	Soil Organic Partition Coefficient	= chemical-specific in cm^3/g
f_{oc}	Organic Carbon Content of Soil	= 0.006 g/g (0.6%)
K_d	Soil-water Partition Coefficient	= chemical-specific (cm^3/g)
	Organic Compounds	= K_{oc} (cm^3/g) x f_{oc} (g/g)
	Inorganic Compounds	= calculated value (EPA, 1996)

The VF equation above is based on the assumption of an infinite source of contamination. In effect, this assumes that the concentration of contaminant in the soil remains constant throughout the entire exposure duration. The contaminant flux from soil predicted by this model is, therefore, unchanging and air concentrations would remain constant throughout the exposure duration. Under these assumptions, exposure to airborne contaminants on the last day of the exposure duration is the same as on the first.

The VF may also be calculated based on a known mass of contaminant using a finite source model. Both the infinite and finite source models assume that the contamination exists from ground surface to a subsurface depth. However, the vertical extent of the contaminant source (i.e., the source thickness or depth) must be adequately characterized throughout the facility to use the finite source model.

Finite Source VF

The finite source model for calculation of the VF incorporates two concepts which are not included in the infinite source model. First, that the vertical extent of the contamination is of a discreet thickness. Second, that as volatile contaminants are emitted from soil to air, an ever larger zone of depletion is created at the soil surface. This zone (as its name implies) is depleted of contaminants over a period of time and serves to retard volatilization of contaminants present at lower depths.

The simplified finite source model equation for VF is

$$VF = (Q/C) \times (C_0/\rho_b) \times (1/J_s^{ave})$$

(10)

and

$$J_s = C_0(D_A/\pi t))^{1/2}[1-e^{(-ds2/4DAt)}] \times 1E\text{-}4\ m^2/cm^2$$

where,

VF	Volatilization Factor	= chemical-specific in m^3/kg
Q/C	Dispersion Factor	= source size-specific in g/m^2-s per kg/m^3
C_0	Uniform Contaminant Concentration at t=0	= 1.5 E-6 g/cm^3
ρ_b	Dry Soil Bulk Density	= 1.5 g/cm^3
J_s^{ave}	Normalized Average Flux from Soil	= chemical-specific in g/m^2-s
J_s	Instantaneous Flux from Soil at time t	= chemical-specific in g/m^2-s
D_A	Apparent Diffusivity (see equation above)	= chemical-specific in cm^2/s
t	Time	= seconds (s)
d_s	Thickness of Source	= site-specific in meters

The finite equation is solved iteratively for time dependent volatile emissions and emissions are averaged over 30 years for residential exposures and 21 years for industrial/commercial exposures. The numerical integration of these calculations may be performed using a spreadsheet program. However, it is important that a minimum of 1 day intervals between time steps be used to calculate the average emission rate (EPA, 1996). Use of larger time intervals may result in mass balance violations and overestimation of volatile flux and the resultant finite VSIC (see mass balance discussion below).

The US EPA has funded the development of the Exposure Model for Soil Organic Fate and Transport (EMSOFT) which provides an integral solution for these calculations which eliminates the problems associated with time intervals and mass balance violations. The EMSOFT model was used to predict average flux rates for the finite source VSIC in the attached tables. The EMSOFT program also permits calculation of emission rates from contaminant sources where an overlying layer of clean soil is present or where several soil layers of differing levels of contamination are present at a facility. It is not feasible to provide generic criteria for all possible scenarios, however, the EMSOFT model may be used to support facility-specific assessment of the soil to ambient air pathway. The EMSOFT computer model and user manual may be obtained from the EPA Office of Research and Development.

In order to back calculate a normalized average flux for finite source VSIC values, a uniform contaminant concentration at time zero must be assumed. This value is set equal to 1 ppm (0.001 mg/g) and adjusted using the default dry soil bulk density of 1.5 g/cm^2. This yields a contaminant concentration at time zero of 1.5E-6 g/cm^2 when converted to the appropriate units (Jury, 1983).

Since the finite VSIC are based upon a limited volume of contaminated soil, these values are generally less restrictive than the infinite source VSIC for the same contaminant (i.e. finite VSIC permit a higher level of contaminant to be left in place). However, for chemicals which exhibit a combination of low volatility, high affinity for soil particles and/or a molecular weight approaching or greater than 200 g/mol, the finite model may produce VSIC which are slightly more restrictive than the infinite model. This difference is a calculation artifact and becomes more probable as the source thickness is increased. Under these circumstances the infinite source VSIC is considered to be protective and is substituted for the finite VSIC where appropriate.

The finite source model averages emissions and accounts for source depletion over extended periods of time. It is important to ensure that contaminants left in place will not present an acute inhalation risk early in the assumed exposure duration. The EMSOFT model provides not only the

average flux over a specified time period, but also the estimated flux rate at discreet intervals of time. These estimates may be used to predict time, duration and magnitude of peak emissions.

Mass Balance VF

The Jury model under both the infinite and finite assumption may result in mass balance violations under some conditions (i.e., the model may predict loss from soil of more contaminant than was initially present). This problem is likely to occur with very volatile chemicals which may be depleted from the soil in a shorter time period than the assumed exposure duration. To prevent mass balance violations, an alternative VF is calculated using the mass balance model equation presented below:

$$VF\,(m^3/kg) = Q/C \times \frac{AT \times (3.15E+1E+7\ s/yr)}{\rho_b \times d_s \times 10^6\ g/Mg}$$

where,

VF	Volatilization Factor	= chemical-specific in m^3/kg
Q/C	Dispersion Factor	= source size-specific in g/m^2-s per kg/m^3
AT	Exposure Period	= scenario specific in years
ρ_b	Dry Soil Bulk Density	= 1.5 Mg/m^3
d_s	Average Source Depth	= site specific in meters

The mass balance model cannot be calculated without knowledge of the depth of the contaminant source (d_s). This check for mass balance violations cannot, therefore, be applied to the infinite source model without facility-specific information regarding the vertical extent of contaminated soils. A mass balance VSIC greater than the infinite source VSIC and/or a finite source VSIC indicates that the Jury model is over predicting volatile flux from soil. When this occurs, the mass balance VSIC may be used in place of either the infinite or finite VSIC. As discussed above, finite VSIC generated using the EMSOFT model are not subject to mass balance violations.

Soil Properties for the VF

The default values for the soil properties in the VF equations above are representative of generic conditions for Michigan. The air-filled soil porosity property has the most significant effect on the emission of contaminants from soil and is dependent upon the assumed moisture content of the soil. The Jury model adjusts the air-filled and soil-filled porosity values to account for the difference between total and effective porosity. Effective porosity is that portion of the total porosity that is actively engaged in transport of contaminants through the soil pore space. The EPA default values given in the SSG will therefore be used for these soil properties without additional adjustment. The EPA default value of 0.006 g/g or 0.6 percent for the fraction of organic content (f_{oc}) in the soil is the mean value for the top 0.3 meters of Class B soils from Carsel et al. (1988) and is consistent with the range of f_{oc} for Michigan.

Decay Constants

Many contaminants will decay or degrade over time through various mechanisms such as hydrolysis, photolysis and microbial degradation. However, environmental degradation is a complex process and is dependent upon several site-specific conditions which are not easily amenable to a generic approach. MDEQ may consider methods to incorporate decay constants into the generic VSIC and this issue may be addressed in future guidance. In the interim, no degradation will be assumed in the calculation of generic VSIC. A responsible party has the option of demonstrating a site-specific rate of decay which can be used to adjust the generic VSIC. Use of site-specific decay rates will not preclude closure under a generic land use category.

(12)

Soil Saturation Limit

The development of chemical-specific soil saturation limits (Csat) is discussed in "Draft Part 201 Generic Soil Saturation Screening Concentrations: Technical Support Document" (October 9, 1996). Csat is defined as the level in soil at which the soil pore water, pore air and surface sorption facilities are saturated with contaminant. At or above this level, free phase contaminant may be present in soil. Under these conditions, the Jury model can no longer predict an accurate VSIC because Henry's law constants which predict partitioning of a chemical between the vapor phase and water are not applicable to free phase contaminants. However, at Csat, the emission of a volatile contaminant from soil to ambient air reaches a plateau and does not increase even when more chemical is added to the soil matrix (EPA, 1996). Target risk levels for ambient air are not exceeded at Csat or greater concentrations for those chemicals with calculated VSIC which exceed Csat. Therefore, the soil to ambient air pathway does not appear to be a human health concern for those chemicals with calculated VSIC greater than Csat. Final cleanup criteria for these chemicals is determined through consideration of other relevant pathways.

Chemical-specific Parameter Values

The EPA SSG Technical Support Document (1996) contains guidance on the collection and handling of chemical-specific values reported in the scientific literature. The values presented in the Technical Support Document were derived for EPA under contract with Research Triangle Institute (RTI). Since reported values for some chemical parameters vary widely, a qualitative review was conducted of the available values and geometric means were calculated as appropriate. Reported organic carbon partition coefficient (Koc) values were found by RTI to vary widely and no values are reported for many chemicals. Therefore, EPA relied upon the relationship of octanol water partition coefficient (Kow) values to Koc values to predict Koc values by employing a regression analysis. This approach has been followed to calculate the Koc values used to develop the Part 201 VSIC. The regression equation is presented below.

$$\log Koc_{(L/kg)} = 0.00028 + (0.983 \times \log Kow)$$

This equation performs well for most chemicals but consistently over predicts Koc values for volatile organic compounds, chlorinated benzenes and some chlorinated pesticides. For these compounds the following equation is used to calculate Koc.

$$\log Koc_{(L/kg)} = 0.0784 + (0.7919 \times \log Kow)$$

If no values were available from the Soil Screening Guidance, the following sources were consulted (in order of preference): the Draft Development of Human Health Based and Ecologically Based Exit Criteria for the Hazardous Waste Identification Project (HWIR), Howard et al. (1989), and the Chemical Evaluation Search and Retrieval System (CESARS) database.

A table containing the chemical-specific values used to develop the generic VSIC will be provided by the ERD Toxicology Unit upon request. VSIC cannot be calculated for all chemicals on the Part 201 list due to the lack of values for one or more chemical parameters. Additional VSIC will be developed as more chemical-specific values are identified.

PARTICULATE EMISSION FACTOR

The particulate emission factor (PEF) relates the concentration of a contaminant in the soil to the concentration of particulates in the air. The PEF equation incorporates factors which account both for

emission of particulates from soil and dispersion after the particulates become airborne. The general equation is presented below. Default values for PEF parameters are identified in Attachment A.

$$PEF = (Q/C) \times 1/[(Ew \times (1-V)) + Ev]$$

where,

PEF	Particulate Emission Factor	= chemical-specific in m^3/kg
Q/C	Dispersion Factor	= source size-specific in g/m^2-s per kg/m^3
Ew	Emission due to wind	= g/m^2 per s
Ev	Emission due to vehicle traffic	= g/m^2 per s
V	Vegetative Cover (unitless)	= 0.5 (50%)

Particulate Emission due to Wind Erosion (Ew)

Ew represents the emission of a chemical from soil due to wind erosion. Parameters which influence this value include meteorological factors such as the mean wind speed and the equivalent threshold value of wind speed at 7 meters. Default values for meteorological factors have been obtained from the data set selected to model the Q/C dispersion factor discussed below. Attachment A, the PEF Worksheet, presents the assumptions and calculations used in developing the generic Ew values.

Ew may be adjusted to account for vegetative cover at a facility. No data are available to estimate the distribution of vegetative cover values for Michigan. In the absence of data, the mid-range value of 0.5 (50%) was chosen as a central tendency value. If vegetative cover at a facility differs significantly from this value, a facility-specific evaluation may be necessary. There is no adjustment for precipitation or snow cover due to the variability statewide of these factors and the inability to correlate them with actual wind erosion events.

Meteorological data characteristic of a specific location may be used to generate alternative cleanup criteria. However, it is not appropriate to combine facility-specific meteorological data with the defaults used to calculate generic criteria. It may not be necessary to generate data for a particular location, rather, data from an existing monitoring location more appropriate for a facility may be used in place of the defaults presented in Attachment A. Please contact an ERD toxicologist for further information concerning location-specific meteorological analysis. Use of location-specific meteorological data does not preclude closure under a generic land use category.

Particulate Emission due to Vehicle Traffic (Ev)

Ev accounts for emission of chemicals from soil due to passenger vehicle traffic. This source of emission was not considered by the EPA in the Soil Screening Guidance, therefore, the vehicle traffic emissions equation in Cowherd (1985) was used to generate default vehicle emission rates. Attachment B contains the default assumptions and equations used to calculate Ev's for residential and industrial/commercial scenarios. Note that the value for Ev is directly proportional to the number of passenger vehicle trips per day assumed for each scenario (e.g. the residential Ev for 10 round trips per day is twice that for 5 round trips per day). A responsible party may use this relationship to adjust the Ev value if it can be demonstrated that vehicle traffic at a facility differs from the default assumptions. The Ev values assume that vehicles at the facility are primarily passenger automobiles. At facilities where trucks and other heavy equipment are expected to be present, a facility-specific assessment of particulate emission due to vehicle traffic may be required.

Q/C: AIR DISPERSION FACTOR

The Q/C factor accounts for dispersion of airborne contaminants. The SSG presents a default value for this parameter which represents the 90th percentile of the distribution of nationally modeled Q/C values from 29 facilities. No Michigan facilities were included in these modeling efforts, therefore, air dispersion modeling was used to develop a Michigan-specific default dispersion factor for Part 201 SIC. A half-acre (0.5) default source size is considered to be representative of a residential property and is consistent with current EPA recommendations for residential facilities. Adaptation of the generic half-acre SIC for other source sizes will be discussed under "Application of SIC" below.

Location Selection of Q/C modeling data.

A half-acre source was modeled with 15 sets of meteorological data routinely used in Michigan air dispersion modeling. The most recent year of available data for each location was chosen (in most cases this was 1991). Maximum, annual average concentrations were obtained using EPA's ISCST3 model assuming a standard emission rate of contaminant from soil of 1 g/m^2-sec.

From these results, three meteorological locations were selected and modeled with the most recent 5 years of data (in all 3 cases this was 1987-1991). These datasets were selected based on location within an area of the state that is both agricultural and industrial, availability of 5 years of recent meteorological data and the conservativeness of the 1991 data. However, the three locations selected do not represent "worst case" meteorological conditions for the State. The 5-year analysis was necessary to ensure that the year of data chosen to calculate the Q/C values was representative of general weather conditions for that area (i.e., the year did not represent unusual weather events). The three meteorological locations selected were Midland-Bay City-Saginaw (MBS), Grand Rapids (GRR) and South Bend (SBN). While South Bend does not lie within the geographical boundaries of the State of Michigan, the dataset from this location is considered representative of southwest Michigan and is routinely used in air modeling by AQD. South Bend was chosen as the default location for conducting the air dispersion modeling for the generic SIC. This location represents roughly the 50th percentile of the 15 Michigan meteorological monitoring locations originally modeled.

Air Dispersion Model

The EPA ISCST3 area source model is used with rural dispersion coefficients and several default assumptions to estimate the dispersion of airborne contaminants. In the SIC scenario, contaminants are emitted directly from the soil, therefore, the emission height was set at zero (0). Additional assumptions are discussed below.

Receptor Height - The Source Receptor Analysis Branch of the EPA Office of Air Quality Planning Standards (OAQPS) has historically recommended a receptor height of zero for air dispersion modeling. MDEQ AQD policy agrees with this position and supports the use of a receptor height of zero to represent a ground level receptor.

The appropriate receptor height for the ISCST3 area source model for ground level receptors and emissions was investigated by Environmental Quality Management (EQM) under contract with EPA. In a technical memorandum dated November 6, 1996, Mr. Craig Mann conveyed EQM's findings to the EPA. The wind tunnel experiments conducted to verify the ISCST3 area source algorithm indicate that the model performs well in the horizontal direction and accurately predicts down-wind concentrations. However, the model algorithm does not account for phenomena such as ground turbulence and temperature cycles which act to mix air concentrations in the first few feet above the ground surface. As a result, the model overpredicts the concentration gradient in the vertical direction resulting in an underestimation of concentrations at elevated heights. Algorithms which account for ground level

phenomena may be available but have not been incorporated into the ISCST3 area source model or any other available program.

In consideration of the above discussion, EPA recommends a zero foot receptor height be used to assess ground level exposures to soil emissions and acknowledges this to be a conservative assumption. Therefore, in keeping with both EPA and MDEQ AQD recommendations, a zero foot receptor height was used to calculate the air dispersion factor for the SIC in the attached tables.

Modeled Air Concentration - Dispersion analysis for SIC development requires modeling of predicted air concentrations based on an assumed uniform emission rate from the source area of 1 g/m^2-sec. A receptor grid is imposed on the half acre source area and average air concentrations are estimated for each discrete receptor location based on annual meteorological data. The Q/C for Part 201 SIC development is the 90th percentile of the distribution of modeled annual average air concentrations for all on-site receptor locations.

Short-term Emission and Dispersion of Volatiles and Particulates

While some variation in the emission of volatile contaminants from soil as a result of changing air temperature and meteorological conditions may occur, these variations are not expected to result in significant fluctuation in ambient air concentrations. Therefore, all VSIC are based on annual average air dispersion modeling. Since both the emission and dispersion of particulates are dependent upon meteorological conditions, day-to-day variations may have significant effects on the resulting ambient air concentration. The PSIC must, therefore, be adjusted to protect against likely short-term peaks in particulate ambient air concentrations.

The formula for PEF presented above represents annual average emission and dispersion of PM-10 particulates. It is not appropriate for evaluating short-term exposures. However, the available models for predicting short-term particulate emission rates are very conservative and not intended for the currently proposed use. Therefore, AQD field monitoring data are used to characterize the likely variation between annual and short term ambient air particulate levels for Michigan.

Data are available for several land use categories at various locations in Michigan for both PM-10 levels and total suspended particulates (TSP). PM-10 is that fraction of the total suspended particulate matter less than or equal to 10 microns in diameter. Particles of this size are considered to be fine enough to enter the respiratory system and to become lodged in the alveoli. PM-10 levels were chosen as the appropriate standard for comparison to the particulate levels predicted by the annual PEF equation. The data indicate that Wayne County has high particulate levels relative to the remainder of the state. However, levels are consistent for the remainder of the state across all land uses and settings. These data, excluding those datasets from Wayne County, are used to establish average annual and 24-hour PM-10 concentrations for Michigan.

The annual average PM-10 level is based on a dataset of 24-hour averages. This allows for the construction of a distribution of 24-hour values and associated percentiles. The average PM-10 level from this distribution (equivalent to an annual average) is 20 ug/m^3 and the 90th percentile is 40 ug/m^3. This suggests that peak particulate levels for a given 24-hour period are likely to be twice as high as an annual average. This assumption is used to adjust the PSIC for the subset of chemicals for which short-term levels may pose a human health risk. PSIC were adjusted by a factor of 2 for all chemicals which are associated with quarterly, 24-hour, 8-hour or 1-hour averaging times under the Air Toxics Rules. No Michigan-specific particulate data are available for less than 24-hour time periods. However, data are available from several other states which indicates that the ratio of annual to 1 hour or 8 hour particulate levels is not greatly different from the annual to 24-hour ratio.

SIC FOR INDUSTRIAL/COMMERCIAL FACILITIES

Two distinct receptor populations must be considered in the development of SIC for industrial and commercial facilities: on-site workers and off-site, near-by residents. Since both Part 201 and Part 55 rules require compliance with residential criteria at the property boundary of a facility, industrial/commercial SIC must consider the need to protect off-site receptors if they represent the more highly impacted receptor group.

Off-site Residential Receptor

In order to assess which of these two receptor populations would control development of industrial/commercial SIC, additional dispersion modeling was conducted to predict air impacts to off-site, near-by receptors. Inputs to the ISCST3 model were identical to those used to predict on-site impacts, however, the Q/C values for off-site impacts are based on the 90th percentile of the concentrations predicted by the model for the perimeter of the source area. This Q/C term was then used to calculate VF and PEF values which were used in the generic SIC equations with residential default exposure values to calculate on-site SIC protective of off-site exposure to ambient air contaminants.

On-site Worker

Calculation of industrial/commercial SIC for on-site workers relied upon the initial modeling efforts for the generic residential SIC to predict the Q/C values. Several parameters were adjusted in the generic equation, however, to characterize the worker population. Consistent with the default exposure values discussed in Operational Memo #14, the exposure duration (ED) was adjusted to 21 years and the exposure frequency (EF) to 245 days.

Intake rate (i.e., inhalation rate) is not explicitly included in the generic residential equations. It is, however, implicit in development of the inhalation toxicity values and the default intake rate for adults is assumed to be 20 m^3/day. In order to adjust this rate to account for the volume of air intake for an on-site worker, an adjusted intake rate (AIR) of 20 m^3/day /10 m^3/day was added to the equation. The 10 m^3/day intake rate for workers is consistent with both EPA and Occupational Safety and Health Administration (OSHA) standard default values and assumes that a worker engaged in moderate activity will respire more heavily while on the job than during light activity and resting portions of a day.

Adjustments to the VF and PEF for on-site workers

The VF for the on-site worker scenario is different than that for the residential scenario since the exposure period used in the calculation for the J_s^{ave} corresponds to the ED of 21 years (see discussion of the J_s^{ave} equation above).

The PEF is adjusted to account for the greater level of vehicular traffic at industrial or commercial facilities (see attachment B). The residential default of 50% vegetative cover was retained for this calculation, however, it is anticipated that some industrial facilities may not be as heavily vegetated. Therefore, this value must be evaluated for its appropriateness to the facility in question.

Results

A comparison of SIC generated under these two scenarios indicates that the on-site worker scenario generates more restrictive industrial/commercial PSIC than the off-site residential scenario. Conversely, the off-site residential scenario produces more restrictive industrial/commercial VSIC. However, the disparity between the on-site worker VSIC and the off-site residential VSIC is minimal. Given the level of uncertainty surrounding the SIC and the conservativeness of perimeter modeling to develop the VF for the off-site scenario, this disparity does not appear to be significant. Therefore, both the VSIC and the PSIC for industrial/commercial sites will be based on protection of the on-site worker.

Generic Industrial/Commercial SIC Algorithms Protective of Ambient Air Exposures

Generic industrial/commercial SIC equations with worker exposure default values are presented below. Default exposure assumptions for industrial and commercial land uses are discussed in Operational Memorandum #14 (Revision 2).

No adjustment for weather conditions has been made to the exposure frequency (EF) for the industrial/commercial scenario. As stated in the discussion of the Q/C dispersion factor, it is not possible to correlate weather conditions and/or temperature with actual wind erosion events. Under some conditions, frozen soil may result in an equal, if not greater, level of particulate emission and exposure.

It is not appropriate to adjust the EF for the VSIC on the assumption that no volatilization occurs during the colder months of the year. While it is true that volatilization rates are correlated with temperatures, some chemicals exhibit high vapor pressures (VP) even at freezing temperatures. Many chemicals are selected for industrial use because they display properties of low freezing points and volatilization for these compounds, while possibly affected, would not be eliminated completely during the colder months of the year. The Henry's Law Constant (HLC) used in the VF equation is typically reported at 20^0 C (68^0 F). The VF equation thus assumes a constant temperature of 68^0 F to predict volatilization without adjustment for either cold temperatures in winter or higher temperatures (and greater volatilization) in summer.

Carcinogens:

$$\text{Volatile Soil Inhalation Criteria} = \frac{10^{-5} \times AT \times AIR}{IURF \times EF \times ED \times (1/VF)}$$

where,

10^{-5} cancer risk	= target risk
AT (averaging time)	= 25,550 days (70 x 365)
AIR (adjusted inhalation rate)	= 20 m^3/d /10 m^3/d
IURF (inhalation unit risk factor)	= chemical-specific $(ug/m^3)^{-1}$
EF (exposure frequency)	= 245 days/year
ED (exposure duration)	= 21 years
VF (volatilization factor)	= chemical-specific in m^3/kg

$$\text{Particulate Soil Inhalation Criteria} = \frac{10^{-5} \times AT \times AIR}{IURF \times EF \times ED \times (1/PEF)}$$

where,

10^{-5} cancer risk	= target risk
AT (averaging time)	= 25,550 days (70 x 365)
AIR (adjusted inhalation rate)	= 20 m^3/d /10 m^3/d
IURF (inhalation unit risk factor)	= chemical-specific $(ug/m^3)^{-1}$
EF (exposure frequency)	= 245 days/year
ED (exposure duration)	= 21 years
PEF (particulate emission factor)	= chemical-specific in m^3/kg

Noncarcinogens:

$$\text{Volatile Soil Inhalation Criteria} = \frac{THQ \times AT \times CF \times AIR}{EF \times ED \times (1/RfC \times 1/VF)}$$

where,

THQ (target hazard quotient)	= 1
AT (averaging time)	= 7,665 days (21 x 365)
CF (conversion factor)	= 1000 ug/mg
AIR (adjusted inhalation rate)	= 20 m^3/d /10 m^3/d
EF (exposure frequency)	= 245 days/year
ED (exposure duration)	= 21 years
RfC (reference concentration)	= chemical-specific in mg/m^3
VF (volatilization factor)	= chemical-specific in m^3/kg

$$\text{Particulate Soil Inhalation Criteria} = \frac{THQ \times AT \times CF \times AIR}{EF \times ED \times (1/RfC \times 1/PEF)}$$

where,

THQ (target hazard quotient)	= 1
AT (averaging time)	= 7,665 days (21 x 365)
CF (conversion factor)	= 1000 ug/mg
AIR (adjusted inhalation rate)	= 20 m^3/d /10 m^3/d
EF (exposure frequency)	= 245 days/year
ED (exposure duration)	= 21 years
RfC (reference concentration)	= chemical-specific in mg/m^3
PEF (particulate emission factor)	= chemical-specific in m^3/kg

APPLICATION OF SIC

The values listed in the attached tables are generated using generic default assumptions concerning meteorological conditions, soil characteristics and human exposure parameters. If default values for either meteorological modeling (i.e., the Q/C dispersion factor) or soil characteristics (e.g. dry soil bulk density, soil porosity) are replaced by facility-specific values, generic closure under sections 20120a(1)(a) through (d) of Part 201 is still likely for the facility. Substitution of facility-specific values for these parameters is acceptable under the generic approach if adequate support for the use of these values is provided. For soil characteristics, facility-specific field evaluation is necessary to support use of values which differ from generic defaults. Use of facility-specific values for exposure parameters (e.g. exposure duration, exposure frequency) will necessitate closure under section 20120a(2).

As indicated by the discussion of the development of SIC values, separate criteria are provided for volatile and particulate emissions. To determine overall compliance with soil cleanup criteria for the soil to ambient air pathway, compliance must be demonstrated for both the VSIC and PSIC values for each chemical of concern.

VSIC

Since the entire column of soil may contribute to volatile emissions, VSIC apply to both surficial and subsurface soil for a generic land use category. Compliance with the VSIC is not required under a limited category, if volatilization of contaminant to the ambient air is determined by the department to be prevented by an engineered exposure barrier.

The soil to ambient air pathway is not a concern for chemicals with calculated VSIC greater than their respective Csat screening value. VSIC which exceed the chemical-specific Csat value are shaded in the attached tables. Please see the Part 201 Generic Soil Saturation Screening Concentrations: Technical Support Document (October 9, 1996) for guidance on how to address soil concentrations which exceed Csat screening values.

Infinite source VSIC are to be used as a "first cut" screening tool. These values may be used as screening values at facilities where the vertical extent of contamination is not well characterized (e.g. Baseline Environmental Assessments, determination of facility status). If contaminant concentrations **do not** exceed these values, the soil to ambient air pathway is not a concern for the facility. If contaminant concentrations **do** exceed infinite source VSIC, the vertical extent of contamination must be characterized before application of the finite source VSIC. Infinite source VSIC are not to be used either to determine the need for a response action to address soil contamination or to verify the adequacy of soil remediation.

Finite source VSIC may be used to determine the need for a response action to address soil contamination or to verify the adequacy of soil remediation when the soil-to-air pathway is the most restrictive and relevant pathway. Since VSIC are protective of long term, systemic health effects only, a responsible party has the responsibility to demonstrate that soil contaminants left in place will not result in unacceptable acute exposures or other health effects such as ocular irritation, dermal irritation or sensitization, physical hazards such as reactivity, corrosivity, or ignitability, and/or ecological impacts.

Finite VSIC are provided for 2 and 5 meter source thickness. These values may be applied where the vertical extent (i.e. thickness) of the contaminant source is no greater than the thickness assumed for these scenarios. The responsible party retains the option of developing finite VSIC based on facility specific characteristics.

Mass balance VSIC are not included in the attached tables since the finite source VSIC generated using the EMSOFT computer model do not result in mass balance violations. Mass balance values may be calculated using the equation discussed above for site-specific reviews.

PSIC

Application of the particulate soil inhalation criteria (PSIC) may differ for the limited and generic land use categories. Under most circumstances, the PSIC will apply to the entire soil column for a generic land use category. For a limited use category, the PSIC will apply only to surficial soils (i.e., the top 6 inches of soil) when excavation of subsurface soils is reliably restricted. In addition, under a limited category, compliance with the PSIC is not required in either surficial or subsurface soils if emission of particulate contaminant to the ambient air is determined by the department to be prevented by an engineered exposure barrier.

Please note: 50% vegetative cover is assumed for all land uses and is used in the PEF equation to adjust the expected emission of particulates from soil due to wind erosion. Professional judgment must be used to determine if the vegetative cover at a facility is consistent with this value, particularly at industrial facilities where activities may prevent vegetative growth. Additionally, professional judgment must be used in situations where vehicle traffic at a facility will be greater than that assumed for the generic scenarios.

APPLICATION OF SIC FOR OTHER SOURCE SIZES

An underlying assumption of the values presented in the attached tables is that the area of soil contamination is equal to 1/2 acre. The source size is defined as the areal extent of contaminated soil and is specified in inputs to the ISCST3 model. In order to adapt the generic SIC for half-acre sources to larger and smaller source sizes, air dispersion modeling was used to provide a set of modifiers to adjust the values presented in the attached tables. The modifier corresponding to a source size which is at least as large as the source size of the facility in question should be chosen. For example if the source size at a facility is 8 acres, the generic SIC for 1/2 acre is multiplied by the modifier for 10 acres to provide generic SIC values for a 10 acre facility. The PRP retains the option to conduct facility-specific meteorological modeling for other source sizes. Values for a 1/2 acres source size in the attached tables which exceed 100% (i.e. 1.0E+9) have been presented as calculated. This was done to ensure that the correct value is used to adapt the 1/2 acre criteria for larger or smaller source sizes. Modifiers are presented below.

Modifiers		
Source Size sq. feet or acres	Q/C g/m^2-s per kg/m^3	Modifier
400 sq feet	261.26	3.17
1000 sq feet	180.76	2.2
2000 sq feet	144.91	1.76
1/2 acre	82.33	1
1 acre	71.74	0.87
5 acre	54.62	0.66
10 acre	49.13	0.6
32 acre	41.55	0.5
100 acre	35.66	0.43

Source Size Characterization

Characterization of the source size need not be precise to determine compliance with screening values. For example, if the source size is estimated to be greater than 1 acre but less than 5 acres, the 5 acre SIC

(31)

may be applied as a conservative screen. The soil to ambient air pathway would not be a concern at this facility if soil concentrations do not exceed the 5 acre SIC. If exceedances are noted, the responsible party may then refine the source size characterization to more accurately define the applicable criteria.

Land Use Categories

Generic exposure assumptions for residential, industrial and commercial land use are discussed in Part 201 Operational Memorandum #8 (Revision 4) and #14 (Revision 2). Consistent with the discussion in Memorandum #14, Commercial Subcategory I land use requires the application of residential criteria. This land use category may include but is not limited to day care centers, any form of educational use, hospitals, elder care centers and nursing homes. Industrial/Commercial SIC are applicable under the Industrial and Commercial II through IV land use categories. Documentation must be provided to ensure that facility activities are consistent with the assumed exposure assumptions used in the development of cleanup criteria.

SIC Application Example

An additional underlying assumption of the generic SIC is that soil contaminants are homogeneous throughout the source area and that this homogeneous source produces a modeled concentration in air. A homogeneous pattern of contamination is unlikely at most Part 201 facilities with the possible exception of uniform fill material. It is not possible to address all possible scenarios under the generic approach, however, consider the following example of a multiacre facility with several small source areas. The entire facility covers 10 acres. There are 5 source areas at the facility which cover 1 acre each and have been impacted with similar contaminants. It is not acceptable to compare the concentration in each source area to the SIC for 1 acre without consideration of the combined effect of all 5 source areas. The contamination emitted from all 5 source areas will commingle in ambient air at the facility to produce an air concentration greater than would be expected from a single 1 acre source. Two questions are foremost: which SIC to apply and to what extent must the source areas be characterized? The answers are interrelated

If the portion of the facility which is outside of the 5 source areas is sampled and demonstrated to be non-detect, the sizes of the source areas can be added together and the detected concentrations within the source areas can be compared to the criteria which best fits the sum of those areas. In this example, the SIC for a 5 acre source size could be used as a first cut screen for ambient air impacts. This is a conservative screen since the airborne contamination emitted from these 5 non-contiguous source areas would be more greatly dispersed over the 10 acre facility than would be the case if all 5 areas of contaminated soil were contiguous. Professional judgment and information concerning site activities should be used to determine the extent of sampling required to characterize the areas between sources. Only samples taken from within the source areas should be included in statistical analysis of the data. Sampling results from the area outside of the source areas cannot be included since this would, in effect, dilute the 95% UCL concentration to be compared to the SIC. The PRP retains the option to conduct a site-specific analysis of the soil to ambient air pathway.

Another possible scenario is that soils outside of and between the 5 source areas are also impacted, but to a lesser extent than the source areas themselves. Since all areas of soil contamination contribute to ambient air levels, the expected air concentration would be somewhat greater than in the example above but not as great as predicted by the generic air dispersion modeling for a 10 acre facility. As a conservative screen for this scenario, facility concentrations are compared to the SIC for 10 acres. Careful professional judgment should be used to determine if the variability in the data indicates that source areas must be considered separately from the remainder of the facility. If variability in the data is reasonable, facility-wide averaging may be acceptable. Consult an ERD toxicologist for further guidance on statistical analysis of source areas. As always, the PRP retains the option to conduct a facility-specific analysis of the soil to ambient air pathway.

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Attachment A

PEF WORKSHEET

Ew - emissions due to wind erosion

$$Ew = (0.036(Um/Ut_{adj})^3 F(x))/3600$$

where:

Um(z) = mean windspeed (m/s) = 4.56 for South Bend (at 6.4m)
Um = Um(z) adjusted to 7 meters (m/s) = $Um(z)(7.0/6.4)^{.15}$ = 4.62
assume: z_0 = 0.005 m
assume: U*t = 0.42 m/s for 0.35 mm aggregate mode
Ut = threshold friction velocity at 7 m (adjust U*t to 7m) = 0.42/0.4*ln(7.0/0.005)) = 7.61 m/s
Ut_{adj} = 7.61 m/s (1.25) = 9.51 m/s
X = 0.886*Ut_{adj}/Um = 1.824 (unitless)
F(x) = 0.48 (unitless)

$Ew = (0.036(4.62/9.51)^3\ 0.48)/3600 = 5.5E\text{-}7\ g/m^2\text{-}s$

Ev- emissions due to vehicle traffic

Ev = 6.90E-7 g/m^2-s (from attachment B)

PEF - particulate emission factor for annual averaging

$$PEF = (Q/C) \times 1/(Ew((1-V)) + Ev)$$

where:

PEF = Particulate Emission Factor	
Residential	= 8.79E+7 m^3/kg
Industrial/Commercial	= 2.32E+7 m^3/kg
Q/C = (Dispersion Factor)	= 82.33 g/m^2-s per kg/m^3
Ew (Emission due to wind erosion)	= 5.5E-7 g/m^2-s
V (Assumed vegetative cover)	= 50% (0.5)
Ev (Emission due to vehicle traffic)	
Residential	= 6.62E-7 g/m^2-s
Industrial/Commercial	= 3.27E-6 g/m^2-s

Attachment B

TO DERIVE A VEHICLE EMISSIONS RATE FOR INCLUSION IN EQN. 7 OF SSG FOR PEF:

Revision Date: **5-May-97**

For vehicle emissions, use Eqn. 4-7 in Cowherd, 1985 (EPA/600/8-85/002) :

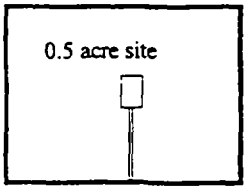
$$E_{10} = 0.85 * (s/10) * (S/24)^{0.8} * (W/7)^{0.3} * (w/6)^{1.2} * ((365-p)/365)$$

Where		Cowherd Residential Default Nos.
E_{10} =	PM_{10} emissions per vehicle-kilometer of travel, (kg/VKT)	
s =	silt content of road surface material, (%)	15
	(Cowherd, 1985 shows a range of 5-68%, with default s = 15%)	
S =	mean vehicle speed, (km/hr)	20
	(Cowherd, 1985 default of S = 48 km/hr. was not used for this driveway scenario)	
W =	mean vehicle weight, (Mg)	2
w =	mean number of wheels	4
p =	number of days with at least 0.254 mm (0.01 inch) of precipitation per year (Figure 4-4 of Cowherd).	135

ASSUMPTIONS: These parameters may be changed if site specific information is available.

Units must be in (grams/m^2-sec) for use in the SSG equation 7.

Size of site	=	0.5	acres
Size of home	=	25	feet per side
Round trips/day	=	**10**	trips away from home/day
Length of driveway	=	20	metres **(unpaved)**
Time period	=	350	days



CALCULATIONS:

Area of home	=	58.06	square metres
Dimension of site	=	44.98	metres per side
Area of site	=	*1965*	*square metres, excluding area of the house*
Dist. travelled/day	=	0.40	Kilometres/day
	=	140.00	Kilometres/year
Vehicle emission	=	0.2931	kg/VKT
	=	0.1172	kg/day
	=	41.034	kg/year at 10 round trips per day

Vehicle emis. at	5 round trips per day	=	20.517	Kg/year
Vehicle emis. at	2 round trips per day	=	8.207	Kg/year

NOTE: The emissions from the vehicle traffic is averaged over the area of the entire site rather than just the area of the driveway (excluding the area of the house).

(I) For ANNUAL averaging time,

Vehicle emissions in grams per square metre per second (10 round trips per day)

$$= 41.034 \frac{Kg}{year} \times \frac{1000\ gm}{Kg} \times \frac{1}{31{,}536{,}000} \frac{year}{sec} \times \frac{1}{1965\ m^2}$$

= **6.62E-07** grams per square metre per second for 0.5 acre site with one home

For comparison:

Vehicle emission rate at	5 round trip per day	=	**3.310E-07**	grams/sq. metre/second for 0.5 acre site with one home
Vehicle emission rate at	2 round trip per day	=	**1.324E-07**	grams/sq. metre/second for 0.5 acre site with one home

Attachment B

VEHICLE EMISSIONS FOR SITE WITH COMMERCIAL ACTIVITIES:

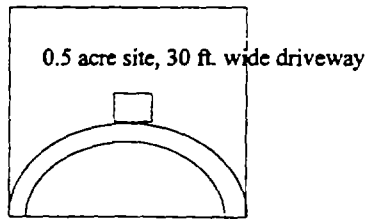
For vehicle emissions, use Eqn. 4-7 in Cowherd, 1985 (EPA/600/8-85/002) :

$$E_{10} = 0.85 * (s/10) * (S/24)^{0.8} * (W/7)^{0.3} * (w/6)^{1.2} * ((365-p)/365)$$

Where			Cowherd Residential Default Nos.
E_{10}	=	PM_{10} emissions per vehicle-kilometer of travel, (kg/VKT)	
s	=	silt content of road surface material, (%)	15
S	=	mean vehicle speed, (km/hr)	20
W	=	mean vehicle weight, (Mg)	2
w	=	mean number of wheels	4
p	=	number of days with at least 0.254 mm (0.01 inch) of precipitation per year (Figure 4-4 of Cowherd).	135

ASSUMPTIONS: These parameters may be changed if site specific information is available.

Size of site	=	0.5	acres
Size of building	=	25	feet per side
Round trips/day	=	50	vehicles/day
Length of driveway	=	45.0	metres **(unpaved)**
Time period	=	307	days (6 days/wk, - 5 holidays)



CALCULATIONS:

Area of building	=	58.06	square metres
Dimension of site	=	44.98	metres per side
Area of site	=	1965	square metres, excluding area of the building
Dist. travelled/day	=	2.25	Kilometres

Vehicle emission = 0.293 kg/VKT * 690.75 Kilometres/year
= 202.484 Kg/year

NOTE: **The emissions from the vehicle traffic is averaged over the area of the entire site rather than just the area of the driveway (excluding the area of the building).**

(I) For ANNUAL averaging time,

Vehicle emissions in grams per square metre per second

$$= 202.484 \frac{Kg}{year} \times \frac{1000\ gm}{Kg} \times \frac{1}{31{,}536{,}000} \frac{year}{sec} \times \frac{1}{1965\ m^2}$$

= **3.27E-06** grams per square metre per second for 0.5 acre "commercial" site with one building

This "commercial" site has 4.93 times the emission rate of a residential scenario of 10 trips per day.

(26)

GENERIC SOIL INHALATION CRITERIA (SIC)
FOR RESIDENTIAL LAND USE
1/2 ACRE SOURCE SIZE

Criteria may change as toxicity and chemical-specific parameter values are updated. The SIC presented are only protective of chronic systemic health effects. Assessment of acute systemic or non-systemic effects must be conducted to determine if more restrictive criteria are necessary.

All values are presented in ug/kg (ppb).

Chemical	RESIDENTIAL SIC				
	Infinite Source VSIC	Finite Source VSIC for 5m source thickness	Finite Source VSIC for 2m source thickness	Csat	PSIC
Acenaphthene	5.7E+7	1.5E+9	1.5E+9	NA	9.6E+9
Acenaphthylene	ID	ID	ID	NA	1.6E+9
Acetaldehyde	ID	ID	ID	1.0E+7	9.7E+8
Acetic acid	ID	ID	ID	1.0E+7	1.1E+10
Acetone	9.2E+7	9.2E+7	1.7E+8	6.4E+7	2.7E+11
Acetonitrile	4.1E+5	4.1E+5	6.8E+5	1.3E+7	9.6E+8
Acrolein	220	270	590	1.4E+7	9.2E+5
Acrylamide	3,300	9,000	9,000	NA	1.6E+6
Acrylic acid	ID	ID	ID	1.0E+7	4.6E+7
Acrylonitrile	3,500	4,600	10,000	5.4E+6	3.1E+7
Alachlor	ID	ID	ID	NA	ID
Aldicarb	ID	ID	ID	NA	ID
Aldicarb sulfoxide	ID	ID	ID	NA	ID
Aldicarb sulfone	ID	ID	ID	NA	ID
Aldrin	41,000	41,000	41,000	NA	4.4E+5
Aluminum	ID	ID	ID	NA	ID
Ammonia	ID	ID	ID	1.0E+7	4.6E+9
Aniline	98,000	98,000	98,000	4.1E+6	4.6E+7
Anthracene	9.8E+8	9.8E+8	9.8E+8	NA	4.E6+10
Antimony	ID	ID	ID	NA	6.4E+7
Arsenic	ID	ID	ID	NA	5.0E+5
.trazine	ID	ID	ID	NA	ID
Azobenzene	ID	ID	ID	NA	6.9E+7
Barium	ID	ID	ID	NA	2.3E+8
Benzene	9,600	33,000	78,000	7.7E+5	2.6E+8
Benzidine	100	4,000	4,000	NA	32,000
Benzo(a)anthracene	ID	ID	ID	NA	ID
Benzo(b)fluoranthene	ID	ID	ID	NA	ID
Benzo(k)fluoranthene	ID	ID	ID	NA	ID
Benzo(g,h,i)perylene	ID	ID	ID	NA	5.5E+8
Benzo(a)pyrene	3.4E+5	4.4E+5	4.4E+5	NA	1.0E+6
Benzoic acid	ID	ID	ID	2.2E+5	ID
Benzyl alcohol	9.5E+8	9.5E+8	9.5E+8	5.9E+6	2.3E+11
Benzyl chloride	10,000	10,000	16,000	5.7E+5	4.3E+7
Beryllium	ID	ID	ID	NA	8.9E+5
bis(2-chloroethoxy)ethane	ID	ID	ID	1.0E+7	ID
bis(2-Chloroethyl)ether	2,700	2,700	2,700	2.2E+6	6.5E+6
bis(2-Ethylhexyl)phthalate	1.4E+9	1.6E+10	1.6E+10	3.1E+7	4.8E+8
Boron	ID	ID	ID	NA	ID
Bromobenzene	ID	ID	ID	1.0E+7	3.7E+8
Bromodichloromethane	6,500	8,700	19,000	2.7E+6	5.8E+7

GENERIC SOIL INHALATION CRITERIA (SIC)
FOR RESIDENTIAL LAND USE
1/2 ACRE SOURCE SIZE

Chemical	RESIDENTIAL SIC				
	Infinite Source VSIC	Finite Source VSIC for 5m source thickness	Finite Source VSIC for 2m source thickness	Csat	PSIC
Bromoform	6.4E+5	6.4E+5	7.7E+5	1.8E+6	1.9E+9
Bromomethane	ID	ID	ID	3.0E+6	2.3E+8
n-Butanol	1.6E+7	1.6E+7	1.6E+7	6.9E+6	1.6E+10
2-Butanone (MEK)	2.1E+7	2.1E+7	3.2E+7	1.7E+7	4.6E+10
n-Butyl acetate	ID	ID	ID	1.0E+7	4.4E+10
t-Butyl alcohol	ID	ID	ID	1.0E+7	1.4E+11
Butyl benzyl phthalate	7.3E+9	7.8E+9	7.8E+9	9.3E+5	3.2E+10
Cadmium	ID	ID	ID	NA	1.2E+6
Camphene	ID	ID	ID	NA	ID
Caprolactam	ID	ID	ID	NA	4.6E+8
Carbaryl	ID	ID	ID	NA	ID
Carbazole	ID	ID	ID	NA	ID
Carbofuran	ID	ID	ID	NA	ID
Carbon disulfide	1.0E+6	7.8E+6	1.9E+7	5.6E+5	3.2E+10
Carbon tetrachloride	2,600	11,000	27,000	9.8E+5	9.1E+7
Chlordane	2.4E+5	2.4E+5	6.4E+5	NA	5.8E+6
Chloride	ID	ID	ID	NA	ID
Chlorobenzene	5.5E+5	9.1E+5	2.0E+6	6.6E+5	3.2E+9
Chloroethane	ID	ID	ID	NA	4.6E+11
2-Chloroethyl vinyl ether	ID	ID	ID	1.0E+7	ID
Chloroform	32,000	1.1E+5	2.7E+5	2.5E+6	8.9E+8
Chloromethane	35,000	4.1E+5	1.0E+6	1.9E+6	3.3E+9
4-Chloro-3-methylphenol	ID	ID	ID	NA	ID
beta-Chloronaphthalene	ID	ID	ID	NA	ID
2-Chlorophenol	ID	ID	ID	1.9E+7	ID
o-Chlorotoluene	ID	ID	ID	1.0E+7	3.2E+9
Chlorpyrifos	ID	ID	ID	NA	9.2E+7
Chromium (III)	ID	ID	ID	NA	2.3E+8
Chromium (VI)	ID	ID	ID	NA	1.8E+5
Chrysene	ID	ID	ID	NA	ID
Cobalt	ID	ID	ID	NA	9.2E+6
Copper	ID	ID	ID	NA	9.2E+7
Cyanazine	ID	ID	ID	NA	ID
Cyanide	ID	ID	ID	NA	2.3E+9
Cyclohexanone	ID	ID	ID	1.0E+7	4.6E+10
Dacthal	ID	ID	ID	NA	ID
Dalapon	ID	ID	ID	1.0E+7	ID
4-4'-DDD	ID	ID	ID	NA	ID
4-4'-DDE	ID	ID	ID	NA	ID
4-4'-DDT	9.1E+6	1.0E+7	1.0E+7	NA	2.2E+7
Decabromodiphenyl ether	ID	ID	ID	NA	5.3E+9
Di-n-butyl phthalate	4.9E+8	2.7E+10	2.7E+10	2.3E+6	2.3E+9
Di(2-ethylhexyl) adipate	ID	ID	ID	1.0E+7	ID
Di-n-octyl phthalate	ID	ID	ID	4.3E+8	ID
Diacetone alcohol	ID	ID	ID	1.0E+7	1.1E+11
Diazinon	ID	ID	ID	1.0E+7	ID

GENERIC SOIL INHALATION CRITERIA (SIC)
FOR RESIDENTIAL LAND USE
1/2 ACRE SOURCE SIZE

Chemical	RESIDENTIAL SIC				
	Infinite Source VSIC	Finite Source VSIC for 5m source thickness	Finite Source VSIC for 2m source thickness	Csat	PSIC
Dibenzo(a,h)anthracene	ID	ID	ID	NA	ID
Dibenzofuran	ID	ID	ID	NA	ID
Dibromochloromethane	17,000	17,000	30,000	1.1E+6	8.7E+7
Dibromomethane	ID	ID	ID	3.3E+6	ID
1,2-Dichlorobenzene	5.5E+6	5.5E+6	9.7E+6	5.9E+5	1.4E+10
1,3-Dichlorobenzene	ID	ID	ID	5.7E+5	ID
1,4-Dichlorobenzene	55,000	55,000	1.1E+5	NA	3.1E+8
3,3'-Dichlorobenzidine	76,000	4.3E+5	4.3E+5	NA	4.5E+6
Dichlorodifluoromethane	7.4E+5	7.8E+6	1.9E+7	3.5E+6	3.2E+10
1,1-Dichloroethane	2.2E+7	9.3E+7	2.2E+8	1.1E+6	3.7E+11
1,2-Dichloroethane	4,400	11,000	25,000	1.4E+6	8.2E+7
1,1-Dichloroethylene	830	5,300	13,000	1.2E+6	4.3E+7
cis-1,2-Dichloroethylene	2.9E+7	9.3E+7	2.2E+8	1.0E+6	3.6E+11
trans-1,2-Dichloroethylene	2.0E+5	8.1E+5	1.9E+6	2.6E+6	3.2E+9
2,6-Dichloro-4-nitroaniline	ID	ID	ID	NA	ID
2,4-Dichlorophenol	2.2E+7	5.7E+7	5.7E+7	2.7E+8	3.5E+9
2,4-Dichlorophenoxyacetic acid	ID	ID	ID	NA	1.6E+9
1,2-Dichloropropane	18,000	48,000	1.1E+5	9.4E+5	1.8E+8
1,3-Dichloropropene	1,000	5,100	12,000	1.2E+6	4.1E+7
Dichlorovos	ID	ID	ID	1.0E+7	2.3E+7
Dicyclohexyl phthalate	ID	ID	ID	NA	ID
Dieldrin	14,000	14,000	14,000	NA	4.6E+5
Diethoxymethane	ID	ID	ID	1.0E+7	ID
Diethyl ether	3.6E+6	8.4E+6	2.0E+7	6.3E+6	3.2E+10
Diethyl phthalate	4.1E+7	4.6E+7	4.6E+7	1.9E+6	2.3E+9
Diethylene glycol monobutyl ether	ID	ID	ID	1.0E+7	9.2E+8
Diisopropylamine	ID	ID	ID	1.0E+7	ID
Dimethyl phthalate	1.3E+7	1.3E+7	1.3E+7	1.3E+6	2.3E+9
N,N-Dimethylacetamide	ID	ID	ID	1.0E+7	ID
N,N-Dimethylaniline	ID	ID	ID	1.0E+7	1.8E+8
Dimethylformamide	ID	ID	ID	1.0E+7	1.4E+9
2,4-Dimethylphenol	2.3E+7	2.3E+7	2.3E+7	NA	3.2E+9
2,6-Dimethylphenol	ID	ID	ID	NA	ID
3,4-Dimethylphenol	ID	ID	ID	NA	ID
Dimethylsulfoxide	ID	ID	ID	1.0E+7	ID
2,4-Dinitrotoluene	1.4E+6	2.4E+6	2.4E+6	NA	1.1E+7
Dinoseb	ID	ID	ID	4.0E+5	ID
1,4-Dioxane	1.4E+5	1.4E+5	2.8E+5	5.7E+7	3.8E+8
Diquat	ID	ID	ID	NA	ID
Diuron	ID	ID	ID	NA	ID
Endosulfan	ID	ID	ID	NA	ID
Endothall	ID	ID	ID	NA	1.6E+9
Endrin	ID	ID	ID	NA	ID
Epichlorohydrin	4.3E+5	4.3E+5	6.3E+5	4.7E+6	1.8E+9
Ethanol	ID	ID	ID	1.0E+7	8.7E+11
Ethyl acetate	3.5E+7	4.4E+7	9.5E+7	5.7E+6	1.5E+11

GENERIC SOIL INHALATION CRITERIA (SIC)
FOR RESIDENTIAL LAND USE
1/2 ACRE SOURCE SIZE

Chemical	RESIDENTIAL SIC				
	Infinite Source VSIC	Finite Source VSIC for 5m source thickness	Finite Source VSIC for 2m source thickness	Csat	PSIC
1-Ethyl-2-methylbenzene	ID	ID	ID	1.0E+7	1.8E+6
Ethylbenzene	6.7E+6	6.7E+6	6.7E+6	3.8E+5	4.6E+10
Ethylene dibromide	1,200	1,500	3,200	1.6E+6	9.7E+6
Ethylene glycol	ID	ID	ID	1.0E+7	5.7E+10
Ethylene glycol acetate	ID	ID	ID	1.0E+7	ID
Ethylene glycol monobutyl ether	ID	ID	ID	1.0E+7	1.1E+10
Fluoranthene	5.3E+8	5.3E+8	5.3E+8	NA	6.4E+9
Fluorene	8.9E+7	8.9E+7	8.9E+7	NA	6.4E+9
Fluorine (soluble fluoride)	ID	ID	ID	NA	ID
Formaldehyde	8,900	22,000	55,000	3.7E+7	1.6E+8
Formic acid	1.5E+5	1.5E+5	1.5E+5	6.3E+7	9.2E+7
1-Formylpiperidine	ID	ID	ID	1.0E+7	ID
Gentian violet	ID	ID	ID	NA	ID
Glyphosate	ID	ID	ID	NA	ID
Heptachlor	43,000	43,000	44,000	NA	1.6E+6
Heptachlor epoxide	58,000	58,000	58,000	NA	8.2E+5
n-Heptane	ID	ID	ID	1.0E+7	1.6E+11
Hexabromobenzene	ID	ID	ID	NA	ID
Hexachlorobenzene (C-66)	12,000	12,000	12,000	NA	4.6E+6
Hexachlorobutadiene (C-46)	95,000	95,000	95,000	1.0E+6	9.7E+7
alpha-Hexachlorocyclohexane	19,000	19,000	19,000	NA	1.2E+6
beta-Hexachlorocyclohexane	1.5E+5	1.9E+5	1.9E+5	NA	4.0E+6
Hexachlorocyclopentadiene (C-56)	ID	ID	ID	2.4E+5	ID
Hexachloroethane	1.4E+6	1.4E+6	1.4E+6	NA	5.3E+8
n-Hexane	ID	ID	ID	1.0E+7	9.2E+9
2-Hexanone	ID	ID	ID	1.0E+7	1.8E+9
Indeno(1,2,3-cd)pyrene	ID	ID	ID	NA	ID
Iron	ID	ID	ID	NA	ID
Isobutyl alcohol	4.0E+7	4.0E+7	4.0E+7	7.1E+6	4.8E+10
Isophorone	2.9E+7	2.9E+7	2.9E+7	4.1E+6	1.3E+10
Isopropyl alcohol	ID	ID	ID	1.0E+7	1.0E+10
Isopropyl benzene	ID	ID	ID	1.2E+6	ID
Lead	ID	ID	ID	NA	6.9E+7
Lindane	ID	ID	ID	NA	ID
Magnesium	ID	ID	ID	NA	4.6E+9
Manganese	ID	ID	ID	NA	2.3E+6
Mercury (Inorganic)	ID	ID	ID	NA	1.4E+7
Methanol	4.9E+6	4.1E+7	9.3E+7	1.8E+6	1.5E+11
Methoxychlor	ID	ID	ID	NA	ID
2-Methoxyethanol	ID	ID	ID	1.0E+7	9.2E+8
2-Methyl-4-chlorophenoxyacetic acid	ID	ID	ID	NA	ID
2-Methyl-4,6-dinitrophenol	ID	ID	ID	NA	ID
Methyl parathion	ID	ID	ID	NA	ID
4-Methyl-2-pentanone (MIBK)	3.2E+7	3.2E+7	6.3E+7	3.0E+6	9.4E+10
Methyl-tert-butyl ether (MTBE)	ID	ID	ID	6.1E+6	1.4E+11
N-Methyl-morpholine	ID	ID	ID	1.0E+7	ID

GENERIC SOIL INHALATION CRITERIA (SIC)
FOR RESIDENTIAL LAND USE
1/2 ACRE SOURCE SIZE

Chemical	RESIDENTIAL SIC				
	Infinite Source VSIC	Finite Source VSIC for 5m source thickness	Finite Source VSIC for 2m source thickness	Csat	PSIC
Methylcyclopentane	ID	ID	ID	1.0E+7	ID
4,4'-Methylene-bis-2-chloroaniline	ID	ID	ID	NA	5.8E+7
Methylene chloride	1.5E+5	5.7E+5	1.4E+6	2.4E+6	4.6E+9
2-Methylnaphthalene	ID	ID	ID	NA	ID
2-Methylphenol	1.7E+7	1.7E+7	1.7E+7	NA	4.6E+9
3-Methylphenol	ID	ID	ID	7.4E+6	ID
4-Methylphenol	ID	ID	ID	NA	ID
Metolachlor	ID	ID	ID	1.0E+7	ID
Molybdenum	ID	ID	ID	NA	ID
Naphthalene	9.8E+6	9.8E+6	9.8E+6	NA	6.4E+9
Nickel	ID	ID	ID	NA	8.9+E6
Nitrate	ID	ID	ID	NA	ID
Nitrite	ID	ID	ID	NA	ID
Nitrobenzene	96,000	96,000	96,000	9.4E+5	8.0E+7
2-Nitrophenol	ID	ID	ID	NA	ID
n-Nitroso-di-n-propylamine	1,600	1,600	1,600	2.4E+6	1.1E+6
N-Nitrosodiphenylamine	ID	ID	ID	NA	ID
Oxo-hexyl acetate	ID	ID	ID	1.0E+7	3.7E+9
Pendimethalin	ID	ID	ID	NA	ID
Pentachlorobenzene	ID	ID	ID	5.8E+5	ID
Pentachloronitrobenzene	1.6E+5	1.6E+5	1.6E+5	NA	2.3E+8
Pentachlorophenol	1.1E+6	4.9E+7	4.9E+7	NA	7.1E+7
Pentane	ID	ID	ID	1.0E+7	8.1E+11
2-Pentene	ID	ID	ID	1.0E+7	ID
Phenanthrene	ID	ID	ID	NA	9.2E+7
Phenol	1.2E+8	1.2E+8	1.2E+8	1.4E+7	2.8E+10
Phosphorus (total)	ID	ID	ID	NA	ID
Phosphorus (total)	ID	ID	ID	NA	ID
Picloram	ID	ID	ID	NA	ID
Piperidine	ID	ID	ID	1.0E+7	6.4E+9
Polybrominated biphenyls	ID	ID	ID	NA	ID
Polychlorinated biphenyls (PCBs)	ID	ID	ID	NA	2.1E+6
Prometon	ID	ID	ID	NA	ID
Propachlor	ID	ID	ID	NA	ID
Propazine	ID	ID	ID	NA	ID
Propionic acid	ID	ID	ID	1.0E+7	1.4E+10
Propyl alcohol	ID	ID	ID	1.0E+7	3.3E+10
Propylene glycol	ID	ID	ID	1.0E+7	2.8E+11
Pyrene	4.7E+8	4.7E+8	4.7E+8	NA	4.6E+9
Pyridine	6,300	39,000	96,000	35,000	1.6E+8
Selenium	ID	ID	ID	NA	9.2E+7
Silver	ID	ID	ID	NA	4.6E+6
Simazine	ID	ID	ID	NA	ID
Sodium	ID	ID	ID	NA	ID
Styrene	6.6E+5	6.6E+5	1.3E+6	1.5E+6	3.6E+9
Sulfate	ID	ID	ID	NA	ID

GENERIC SOIL INHALATION CRITERIA (SIC)
FOR RESIDENTIAL LAND USE
1/2 ACRE SOURCE SIZE

Chemical	RESIDENTIAL SIC				
	Infinite Source VSIC	Finite Source VSIC for 5m source thickness	Finite Source VSIC for 2m source thickness	Csat	PSIC
Tebuthiuron	ID	ID	ID	NA	ID
2,3,7,8-Tetrabromodibenzo-p-dioxin	ID	ID	ID	NA	ID
1,2,4,5-Tetrachlorobenzene	ID	ID	ID	NA	ID
2,3,7,8-Tetrachlorodibenzo-p-dioxin	19	20	20	NA	49
1,1,1,2-Tetrachloroethane	41,000	47,000	96,000	2.6E+6	2.9E+8
1,1,2,2-Tetrachloroethane	7,100	7,100	13,000	1.8E+6	3.7E+7
Tetrachloroethylene	1.3E+5	4.7E+5	1.1E+6	2.1E+5	3.7E+9
Tetrahydrofuran	ID	ID	ID	1.0E+7	2.7E+11
Thallium	ID	ID	ID	NA	ID
Toluene	2.0E+6	4.9E+6	1.1E+7	6.2E+5	1.8E+10
p-Toluidine	ID	ID	ID	1.5E+6	6.9E+7
Toxaphene	3.4E+5	3.4E+5	3.4E+5	NA	6.7E+6
Triallate	ID	ID	ID	1.0E+7	ID
Tributylamine	ID	ID	ID	1.0E+7	3.2E+8
1,2,4-Trichlorobenzene	1.9E+6	1.9E+6	1.9E+6	3.2E+6	1.6E+9
1,1,1-Trichloroethane	5.2E+7	2.2E+8	5.3E+8	1.1E+6	8.7E+11
1,1,2-Trichloroethane	12,000	19,000	42,000	1.6E+6	1.3E+8
Trichloroethylene	56,000	1.6E+5	3.9E+5	1.2E+6	1.3E+9
Trichlorofluoromethane	1.4E+6	1.4E+6	1.4E+6	1.5E+6	4.8E+10
2,4,5-Trichlorophenol	3.0E+8	6.4E+8	6.4E+8	NA	1.6E+10
2,4,6-Trichlorophenol	2.4E+6	8.0E+6	8.0E+6	NA	6.9E+8
2(2,4,5-Trichlorophenoxy)propionic acid	ID	ID	ID	NA	ID
1,2,3-Trichloropropane	ID	ID	ID	2.0E+6	ID
1,1,2-Trichloro-1,2,2-trifluoroethane	1.4E+8	8.7E+8	2.1E+9	1.7E+6	3.5E+12
Triethanolamine	ID	ID	ID	1.0E+7	2.3E+9
3-Trifluoromethyl-4-nitrophenol	ID	ID	ID	NA	ID
Trifluralin	ID	ID	ID	NA	ID
2,2,4-Trimethyl pentane	ID	ID	ID	1.0E+7	ID
2,2,4-Trimethyl-2-pentene	ID	ID	ID	1.0E+7	ID
1,2,4-Trimethylbenzene	ID	ID	ID	1.0E+7	5.6E+10
1,3,5-Trimethylbenzene	ID	ID	ID	1.0E+7	5.6E+10
tris(2,3-Dibromopropyl)phosphate	ID	ID	ID	80,000	4.0E+6
Urea	ID	ID	ID	NA	ID
Vanadium	ID	ID	ID	NA	ID
Vinyl acetate	1.2E+6	2.5E+6	5.7E+6	1.9E+6	9.2E+9
Vinyl chloride	11,000	98,000	2.4E+5	8.0E+5	8.0E+8
White phosphorus	ID	ID	ID	NA	ID
Xylenes	3.2E+7	5.7E+7	1.3E+8	4.0E+5	2.0E+11
Zinc	ID	ID	ID	NA	ID

ID = Insufficient Data
NA = Not Applicable
Shading indicates VSIC values which exceed Csat screening levels.

(37)

GENERIC SOIL INHALATION CRITERIA (SIC) FOR INDUSTRIAL/COMMERCIAL LAND USE 1/2 ACRE SOURCE SIZE

Criteria may change as toxicity and chemical-specific parameter values are updated. The SIC presented are only protective of chronic systemic health effects. Assessment of acute systemic or non-systemic effects must be conducted to determine if more restrictive criteria are necessary.

All values are presented in ug/kg (ppb).

Chemical	INDUSTRIAL/COMMERCIAL SIC				
	Infinite Source VSIC	Finite Source VSIC for 5m source thickness	Finite Source VSIC for 2m source thickness	Csat	PSIC
Acenaphthene	1.4E+8	3.7E+9	4.3E+9	NA	7.3E+9
Acenaphthylene	ID	ID	ID	NA	1.2E+9
Acetaldehyde	ID	ID	ID	1.0E+7	1.0E+9
Acetic acid	ID	ID	ID	1.0E+7	8.6E+9
Acetone	2.2E+8	2.2E+8	3.4E+8	6.4E+7	2.0E+11
Acetonitrile	9.7E+5	9.7E+5	1.4E+6	1.3E+7	7.3E+8
Acrolein	520	570	1,200	1.4E+7	6.9E+5
Acrylamide	11,000	33,000	33,000	NA	1.8E+6
Acrylic acid	ID	ID	ID	1.0E+7	3.5E+7
Acrylonitrile	12,000	14,000	29,000	5.4E+6	3.4E+7
Alachlor	ID	ID	ID	NA	ID
Aldicarb	ID	ID	ID	NA	ID
Aldicarb sulfoxide	ID	ID	ID	NA	ID
Aldicarb sulfone	ID	ID	ID	NA	ID
Aldrin	1.4E+5	1.4E+5	1.4E+5	NA	4.7E+5
Aluminum	ID	ID	ID	NA	ID
Ammonia	ID	ID	ID	1.0E+7	3.5E+9
Aniline	2.3E+5	2.3E+5	2.3E+5	4.1E+6	3.5E+7
Anthracene	2.3E+9	2.3E+9	2.3E+9	NA	3.5E+10
Antimony	ID	ID	ID	NA	4.8E+7
Arsenic	ID	ID	ID	NA	5.4E+5
Atrazine	ID	ID	ID	NA	ID
Azobenzene	ID	ID	ID	NA	7.4E+7
Barium	ID	ID	ID	NA	1.7E+8
Benzene	33,000	95,000	2.3E+5	7.7E+5	2.8E+8
Benzidine	350	16,000	16,000	NA	34,000
Benzo(a)anthracene	ID	ID	ID	NA	ID
Benzo(b)fluoranthene	ID	ID	ID	NA	ID
Benzo(k)fluoranthene	ID	ID	ID	NA	ID
Benzo(g,h,i)perylene	ID	ID	ID	NA	4.1E+8
Benzo(a)pyrene	1.2E+6	1.6E+6	1.6E+6	NA	1.1E+6
Benzoic acid	ID	ID	ID	2.2E+5	ID
Benzyl alcohol	2.3E+9	2.3E+9	2.3E+9	5.9E+6	1.7E+11
Benzyl chloride	34,000	34,000	46,000	5.7E+5	4.6E+7
Beryllium	ID	ID	ID	NA	9.6E+5
bis(2-chloroethoxy)ethane	ID	ID	ID	1.0E+7	ID
bis(2-Chloroethyl)ether	9,300	9,300	9,300	2.2E+6	9.6E+5
bis(2-Ethylhexyl)phthalate	4.8E+9	6.2E+10	6.2E+10	3.1E+7	5.2E+8
Boron	ID	ID	ID	NA	ID
Bromobenzene	ID	ID	ID	1.0E+7	2.8E+8
Bromodichloromethane	22,000	26,000	55,000	2.7E+6	6.2E+7

GENERIC SOIL INHALATION CRITERIA (SIC) FOR INDUSTRIAL/COMMERCIAL LAND USE 1/2 ACRE SOURCE SIZE

Chemical	INDUSTRIAL/COMMERCIAL SIC				
	Infinite Source VSIC	Finite Source VSIC for 5m source thickness	Finite Source VSIC for 2m source thickness	Csat	PSIC
Bromoform	2.2E+6	2.2E+6	2.3E+6	1.8E+6	2.1E+9
Bromomethane	ID	ID	ID	3.0E+6	1.7E+8
n-Butanol	3.8E+7	3.8E+7	3.8E+7	6.9E+6	1.2E+10
2-Butanone (MEK)	5.0E+7	5.0E+7	6.6E+7	1.7E+7	3.5E+10
n-Butyl acetate	ID	ID	ID	1.0E+7	3.3E+10
t-Butyl alcohol	ID	ID	ID	1.0E+7	1.0E+11
Butyl benzyl phthalate	1.7E+10	1.9E+10	1.9E+10	9.3E+5	2.4E+10
Cadmium	ID	ID	ID	NA	1.3E+6
Camphene	ID	ID	ID	NA	ID
Caprolactam	ID	ID	ID	NA	3.5E+8
Carbaryl	ID	ID	ID	NA	ID
Carbazole	ID	ID	ID	NA	ID
Carbofuran	ID	ID	ID	NA	ID
Carbon disulfide	2.5E+6	1.6E+7	3.9E+7	5.6E+5	2.4E+10
Carbon tetrachloride	8,700	33,000	79,000	9.8E+5	9.8E+7
Chlordane	8.1E+5	8.1E+5	8.1E+5	NA	6.2E+6
Chloride	ID	ID	ID	NA	ID
Chlorobenzene	1.3E+6	1.9E+6	4.1E+6	6.6E+5	2.4E+9
Chloroethane	ID	ID	ID	NA	3.5E+11
2-Chloroethyl vinyl ether	ID	ID	ID	1.0E+7	ID
Chloroform	1.1E+5	3.3E+5	7.8E+5	2.5E+6	9.6E+8
Chloromethane	1.2E+5	1.2E+6	2.9E+6	1.9E+6	3.6E+9
4-Chloro-3-methylphenol	ID	ID	ID	NA	ID
beta-Chloronaphthalene	ID	ID	ID	NA	ID
2-Chlorophenol	ID	ID	ID	1.9E+7	ID
o-Chlorotoluene	ID	ID	ID	1.0E+7	2.4E+9
Chlorpyrifos	ID	ID	ID	NA	6.9E+7
Chromium (III)	ID	ID	ID	NA	6.9E+7
Chromium (VI)	ID	ID	ID	NA	1.9E+5
Chrysene	ID	ID	ID	NA	ID
Cobalt	ID	ID	ID	NA	6.9E+6
Copper	ID	ID	ID	NA	6.9E+7
Cyanazine	ID	ID	ID	NA	ID
Cyanide	ID	ID	ID	NA	1.7E+9
Cyclohexanone	ID	ID	ID	1.0E+7	3.5E+10
Dacthal	ID	ID	ID	NA	ID
Dalapon	ID	ID	ID	1.0E+7	ID
4-4'-DDD	ID	ID	ID	NA	ID
4-4'-DDE	ID	ID	ID	NA	ID
4-4'-DDT	3.1E+7	3.8E+7	3.8E+7	NA	2.4E+7
Decabromodiphenyl ether	ID	ID	ID	NA	5.8E+9
Di-n-butyl phthalate	1.2E+9	7.6E+10	7.6E+10	2.3E+6	1.7E+9
Di(2-ethylhexyl) adipate	ID	ID	ID	1.0E+7	ID
Di-n-octyl phthalate	ID	ID	ID	4.3E+8	ID
Diacetone alcohol	ID	ID	ID	1.0E+7	8.3E+10
Diazinon	ID	ID	ID	1.0E+7	ID

GENERIC SOIL INHALATION CRITERIA (SIC) FOR INDUSTRIAL/COMMERCIAL LAND USE 1/2 ACRE SOURCE SIZE

Chemical	INDUSTRIAL/COMMERCIAL SIC				
	Infinite Source VSIC	Finite Source VSIC for 5m source thickness	Finite Source VSIC for 2m source thickness	Csat	PSIC
Dibenzo(a,h)anthracene	ID	ID	ID	NA	ID
Dibenzofuran	ID	ID	ID	NA	ID
Dibromochloromethane	57,000	57,000	90,000	1.1E+6	9.4E+7
Dibromomethane	ID	ID	ID	3.3E+6	ID
1,2-Dichlorobenzene	1.3E+7	1.3E+7	2.0E+7	5.9E+5	1.0E+10
1,3-Dichlorobenzene	ID	ID	ID	5.7E+5	ID
1,4-Dichlorobenzene	1.9E+5	1.9E+5	3.2E+5	NA	3.3E+8
3,3'-Dichlorobenzidine	2.6E+5	1.6E+6	1.6E+6	NA	4.8E+6
Dichlorodifluoromethane	1.8E+6	1.6E+7	3.8E+7	3.5E+6	2.4E+10
1,1-Dichloroethane	5.3E+7	1.9E+8	4.5E+8	1.1E+6	2.8E+11
1,2-Dichloroethane	15,000	32,000	73,000	1.4E+6	8.9E+7
1,1-Dichloroethylene	2,800	16,000	37,000	1.2E+6	4.6E+7
cis-1,2-Dichloroethylene	6.9E+7	1.9E+8	4.5E+8	1.0E+6	2.7E+11
trans-1,2-Dichloroethylene	4.8E+5	1.6E+6	3.9E+6	2.6E+6	2.4E+9
2,6-Dichloro-4-nitroaniline	ID	ID	ID	NA	ID
2,4-Dichlorophenol	5.3E+7	1.4E+8	1.4E+8	2.7E+8	2.7E+9
2,4-Dichlorophenoxyacetic acid	ID	ID	ID	NA	1.2E+9
1,2-Dichloropropane	43,000	98,000	2.3E+5	9.4E+5	1.4E+8
1,3-Dichloropropene	3,500	15,000	36,000	1.2E+6	4.4E+7
Dichlorovos	ID	ID	ID	1.0E+7	1.7E+7
Dicyclohexyl phthalate	ID	ID	ID	NA	ID
Dieldrin	47,000	47,000	47,000	NA	5.0E+5
Diethoxymethane	ID	ID	ID	1.0E+7	ID
Diethyl ether	8.5E+6	1.7E+7	4.0E+7	6.3E+6	2.4E+10
Diethyl phthalate	9.8E+7	1.1E+8	1.1E+8	1.9E+6	1.7E+9
Diethylene glycol monobutyl ether	ID	ID	ID	1.0E+7	6.9E+8
Diisopropylamine	ID	ID	ID	1.0E+7	ID
Dimethyl phthalate	3.1E+7	3.1E+7	3.1E+7	1.3E+6	1.7E+9
N,N-Dimethylacetamide	ID	ID	ID	1.0E+7	ID
N,N-Dimethylaniline	ID	ID	ID	1.0E+7	2.0E+8
Dimethylformamide	ID	ID	ID	1.0E+7	1.0E+9
2,4-Dimethylphenol	5.5E+7	5.5E+7	5.5E+7	NA	2.4E+9
2,6-Dimethylphenol	ID	ID	ID	NA	ID
3,4-Dimethylphenol	ID	ID	ID	NA	ID
Dimethylsulfoxide	ID	ID	ID	1.0E+7	ID
2,4-Dinitrotoluene	4.9E+6	8.6E+6	8.6E+6	NA	1.2E+7
Dinoseb	ID	ID	ID	4.0E+5	ID
1,4-Dioxane	4.6E+5	5.2E+5	9.1E+5	5.7E+7	4.2E+8
Diquat	ID	ID	ID	NA	ID
Diuron	ID	ID	ID	NA	ID
Endosulfan	ID	ID	ID	NA	ID
Endothall	ID	ID	ID	NA	1.2E+9
Endrin	ID	ID	ID	NA	ID
Epichlorohydrin	1.5E+6	1.5E+6	1.9E+6	4.7E+6	1.9E+9
Ethanol	ID	ID	ID	1.0E+7	6.6E+11
Ethyl acetate	8.4E+7	9.2E+7	1.9E+8	5.7E+6	1.1E+11

GENERIC SOIL INHALATION CRITERIA (SIC)
FOR INDUSTRIAL/COMMERCIAL LAND USE
1/2 ACRE SOURCE SIZE

Chemical	INDUSTRIAL/COMMERCIAL SIC				
	Infinite Source VSIC	Finite Source VSIC for 5m source thickness	Finite Source VSIC for 2m source thickness	Csat	PSIC
1-Ethyl-2-methylbenzene	ID	ID	ID	1.0E+7	1.4E+6
Ethylbenzene	1.6E+7	2.6E+7	5.9E+7	3.8E+5	3.5E+10
Ethylene dibromide	4,100	4,600	9,200	1.6E+6	1.0E+7
Ethylene glycol	ID	ID	ID	1.0E+7	4.3E+10
Ethylene glycol acetate	ID	ID	ID	1.0E+7	ID
Ethylene glycol monobutyl ether	ID	ID	ID	1.0E+7	8.3E+9
Fluoranthene	1.3E+9	1.3E+9	1.3E+9	NA	4.8E+9
Fluorene	2.1E+8	2.1E+8	2.1E+8	NA	4.8E+9
Fluorine (soluble fluoride)	ID	ID	ID	NA	ID
Formaldehyde	3,000	83,000	1.5E+5	3.7E+7	1.8E+8
Formic acid	3.6E+5	3.6E+5	3.6E+5	6.3E+7	6.9E+7
1-Formylpiperidine	ID	ID	ID	1.0E+7	ID
Gentian violet	ID	ID	ID	NA	ID
Glyphosate	ID	ID	ID	NA	ID
Heptachlor	1.5E+5	1.5E+5	1.5E+5	NA	1.8E+6
Heptachlor epoxide	2.0E+5	2.0E+5	2.0E+5	NA	8.9E+5
n-Heptane	ID	ID	ID	1.0E+7	1.2E+11
Hexabromobenzene	ID	ID	ID	NA	ID
Hexachlorobenzene (C-66)	40,000	40,000	40,000	NA	5.0E+6
Hexachlorobutadiene (C-46)	3.2E+5	3.2E+5	3.2E+5	1.0E+6	1.0E+8
alpha-Hexachlorocyclohexane	64,000	64,000	64,000	NA	1.3E+6
beta-Hexachlorocyclohexane	5.1E+5	6.5E+5	6.5E+5	NA	4.3E+6
Hexachlorocyclopentadiene (C-56)	ID	ID	ID	2.4E+5	ID
Hexachloroethane	4.9E+6	4.9E+6	4.9E+6	NA	5.8E+8
n-Hexane	ID	ID	ID	1.0E+7	6.9E+9
2-Hexanone	ID	ID	ID	1.0E+7	1.4E+9
Indeno(1,2,3-cd)pyrene	ID	ID	ID	NA	ID
Iron	ID	ID	ID	NA	ID
Isobutyl alcohol	9.5E+7	9.5E+7	9.5E+7	7.1E+6	3.6E+10
Isophorone	6.9E+7	6.9E+7	6.9E+7	4.1E+6	9.7E+9
Isopropyl alcohol	ID	ID	ID	1.0E+7	7.6E+9
Isopropyl benzene	ID	ID	ID	1.2E+6	ID
Lead	ID	ID	ID	NA	5.2E+7
Lindane	ID	ID	ID	NA	ID
Magnesium	ID	ID	ID	NA	3.5E+9
Manganese	ID	ID	ID	NA	1.7E+6
Mercury (Inorganic)	ID	ID	ID	NA	1.0E+7
Methanol	1.2E+7	8.5E+7	1.9E+8	1.8E+6	1.1E+11
Methoxychlor	ID	ID	ID	NA	ID
2-Methoxyethanol	ID	ID	ID	1.0E+7	6.9E+8
2-Methyl-4-chlorophenoxyacetic acid	ID	ID	ID	NA	ID
2-Methyl-4,6-dinitrophenol	ID	ID	ID	NA	ID
Methyl parathion	ID	ID	ID	NA	ID
4-Methyl-2-pentanone (MIBK)	7.6E+7	7.6E+7	1.3E+8	3.0E+6	7.1E+10
Methyl-tert-butyl ether (MTBE)	ID	ID	ID	6.1E+6	1.0E+11
N-Methyl-morpholine	ID	ID	ID	1.0E+7	ID

GENERIC SOIL INHALATION CRITERIA (SIC)
FOR INDUSTRIAL/COMMERCIAL LAND USE
1/2 ACRE SOURCE SIZE

Chemical	INDUSTRIAL/COMMERCIAL SIC				
	Infinite Source VSIC	Finite Source VSIC for 5m source thickness	Finite Source VSIC for 2m source thickness	Csat	PSIC
Methylcyclopentane	ID	ID	ID	1.0E+7	ID
4,4'-Methylene-bis-2-chloroaniline	ID	ID	ID	NA	6.2E+7
Methylene chloride	5.1E+5	1.7E+6	4.0E+6	2.4E+6	4.9E+9
2-Methylnaphthalene	ID	ID	ID	NA	ID
2-Methylphenol	4.1E+7	4.1E+7	4.1E+7	NA	3.5E+9
3-Methylphenol	ID	ID	ID	7.4E+6	ID
4-Methylphenol	ID	ID	ID	NA	ID
Metolachlor	ID	ID	ID	1.0E+7	ID
Molybdenum	ID	ID	ID	NA	ID
Naphthalene	2.3E+7	2.3E+7	2.3E+7	NA	4.8E+9
Nickel	ID	ID	ID	NA	9.6E+6
Nitrate	ID	ID	ID	NA	ID
Nitrite	ID	ID	ID	NA	ID
Nitrobenzene	2.3E+5	2.3E+5	2.3E+5	9.4E+5	6.0E+7
2-Nitrophenol	ID	ID	ID	NA	ID
n-Nitroso-di-n-propylamine	5,500	5,500	5,500	2.4E+6	1.2E+6
N-Nitrosodiphenylamine	ID	ID	ID	NA	ID
Oxo-hexyl acetate	ID	ID	ID	1.0E+7	2.8E+9
Pendimethalin	ID	ID	ID	NA	ID
Pentachlorobenzene	ID	ID	ID	5.8E+5	ID
Pentachloronitrobenzene	3.9E+5	3.9E+5	4.0E+5	NA	1.7E+8
Pentachlorophenol	3.8E+6	1.9E+8	1.9E+8	NA	7.7E+7
Pentane	ID	ID	ID	1.0E+7	6.1E+11
2-Pentene	ID	ID	ID	1.0E+7	ID
Phenanthrene	ID	ID	ID	NA	6.9E+7
Phenol	2.8E+8	2.8E+8	2.8E+8	1.4E+7	2.1E+10
Phosphorus (total)	ID	ID	ID	NA	ID
Phosphorus (total)	ID	ID	ID	NA	ID
Picloram	ID	ID	ID	NA	ID
Piperidine	ID	ID	ID	1.0E+7	4.8E+9
Polybrominated biphenyls	ID	ID	ID	NA	ID
Polychlorinated biphenyls (PCBs)	ID	ID	ID	NA	2.3E+6
Prometon	ID	ID	ID	NA	ID
Propachlor	ID	ID	ID	NA	ID
Propazine	ID	ID	ID	NA	ID
Propionic acid	ID	ID	ID	1.0E+7	1.0E+10
Propyl alcohol	ID	ID	ID	1.0E+7	2.5E+10
Propylene glycol	ID	ID	ID	1.0E+7	2.1E+11
Pyrene	1.1E+9	1.1E+9	1.1E+9	NA	3.5E+9
Pyridine	15,000	79,000	1.9E+5	35,000	1.2E+8
Selenium	ID	ID	ID	NA	6.9E+7
Silver	ID	ID	ID	NA	3.5E+6
Simazine	ID	ID	ID	NA	ID
Sodium	ID	ID	ID	NA	ID
Styrene	2.3E+6	2.3E+6	3.7E+6	1.5E+6	3.9E+9
Sulfate	ID	ID	ID	NA	ID

GENERIC SOIL INHALATION CRITERIA (SIC)
FOR INDUSTRIAL/COMMERCIAL LAND USE
1/2 ACRE SOURCE SIZE

Chemical	INDUSTRIAL/COMMERCIAL SIC				
	Infinite Source VSIC	Finite Source VSIC for 5m source thickness	Finite Source VSIC for 2m source thickness	Csat	PSIC
Tebuthiuron	ID	ID	ID	NA	ID
2,3,7,8-Tetrabromodibenzo-p-dioxin	ID	ID	ID	NA	ID
1,2,4,5-Tetrachlorobenzene	ID	ID	ID	NA	ID
2,3,7,8-Tetrachlorodibenzo-p-dioxin	64	73	73	NA	52
1,1,1,2-Tetrachloroethane	1.4E+5	1.4E+5	2.8E+5	2.6E+6	3.0E+8
1,1,2,2-Tetrachloroethane	24,000	24,000	38,000	1.8E+6	4.0E+7
Tetrachloroethylene	4.4E+5	1.4E+6	3.2E+6	2.1E+5	4.0E+9
Tetrahydrofuran	ID	ID	ID	1.0E+7	2.0E+11
Thallium	ID	ID	ID	NA	ID
Toluene	4.7E+6	1.0E+7	2.3E+7	6.2E+5	1.4E+10
p-Toluidine	ID	ID	ID	1.5E+6	7.4E+7
Toxaphene	1.2E+6	1.2E+6	1.2E+6	NA	7.2E+6
Triallate	ID	ID	ID	1.0E+7	ID
Tributylamine	ID	ID	ID	1.0E+7	2.4E+8
1,2,4-Trichlorobenzene	4.5E+6	4.5E+6	4.5E+6	3.2E+6	1.2E+9
1,1,1-Trichloroethane	1.3E+8	4.4E+8	1.1E+9	1.1E+6	6.6E+11
1,1,2-Trichloroethane	40,000	57,000	1.2E+5	1.6E+6	1.4E+8
Trichloroethylene	1.9E+5	4.8E+5	1.1E+6	1.2E+6	1.4E+9
Trichlorofluoromethane	3.4E+6	2.4E+7	5.8E+7	1.5E+6	3.6E+10
2,4,5-Trichlorophenol	7.2E+8	1.5E+9	1.5E+9	NA	1.2E+10
2,4,6-Trichlorophenol	8.2E+6	2.7E+7	2.7E+7	NA	7.4E+8
2(2,4,5-Trichlorophenoxy)propionic	ID	ID	ID	NA	ID
1,2,3-Trichloropropane	ID	ID	ID	2.0E+6	ID
1,1,2-Trichloro-1,2,2-trifluoroethane	3.3E+8	1.7E+9	4.2E+9	1.7E+6	2.7E+12
Triethanolamine	ID	ID	ID	1.0E+7	1.7E+9
3-Trifluoromethyl-4-nitrophenol	ID	ID	ID	NA	ID
Trifluralin	ID	ID	ID	NA	ID
2,2,4-Trimethyl pentane	ID	ID	ID	1.0E+7	ID
2,2,4-Trimethyl-2-pentene	ID	ID	ID	1.0E+7	ID
1,2,4-Trimethylbenzene	ID	ID	ID	1.0E+7	4.3E+10
1,3,5-Trimethylbenzene	ID	ID	ID	1.0E+7	4.3E+10
tris(2,3-Dibromopropyl)phosphate	ID	ID	ID	80,000	4.3E+6
Urea	ID	ID	ID	NA	ID
Vanadium	ID	ID	ID	NA	ID
Vinyl acetate	2.9E+6	5.0E+6	1.1E+7	1.9E+6	6.9E+9
Vinyl chloride	39,000	2.8E+5	6.9E+5	8.0E+5	8.7E+8
White phosphorus	ID	ID	ID	NA	ID
Xylenes	7.7E+7	1.2E+8	2.6E+8	4.0E+5	1.5E+11
Zinc	ID	ID	ID	NA	ID

ID = Insufficient Data
NA = Not Applicable
Shading indicates VSIC values which exceed Csat screening levels.

34