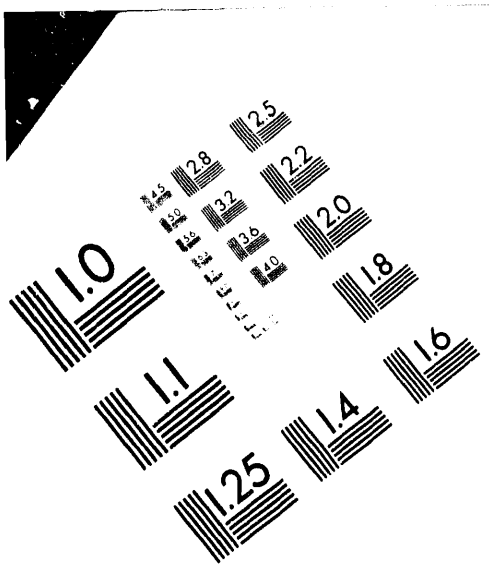

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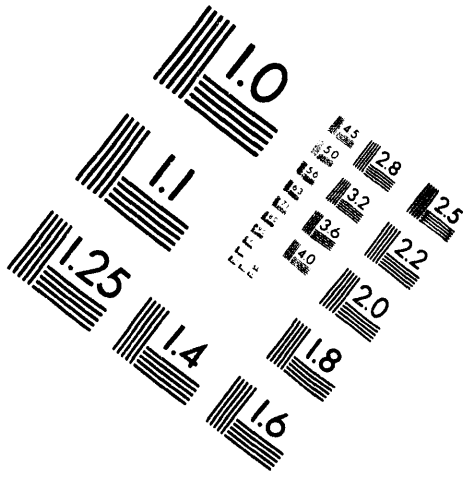

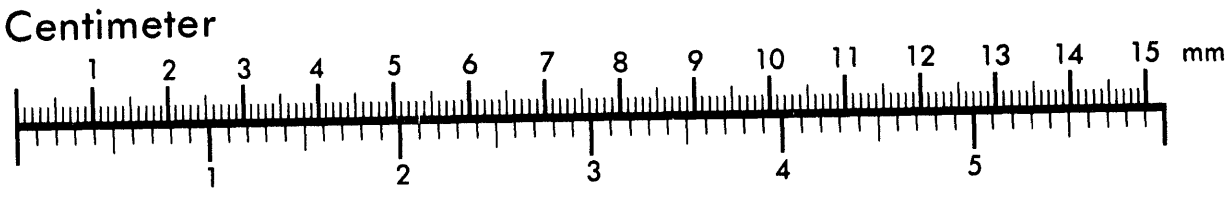

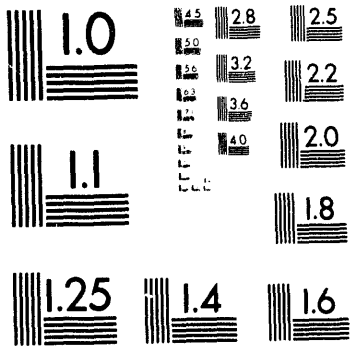

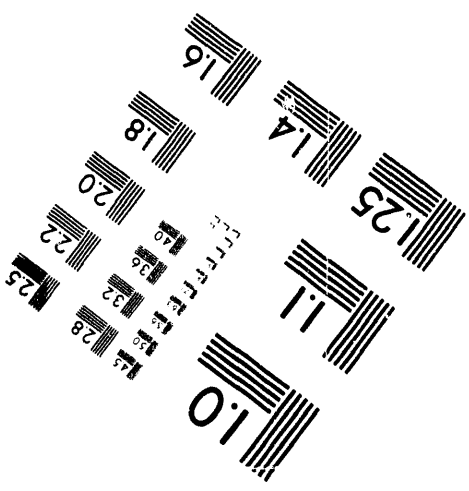

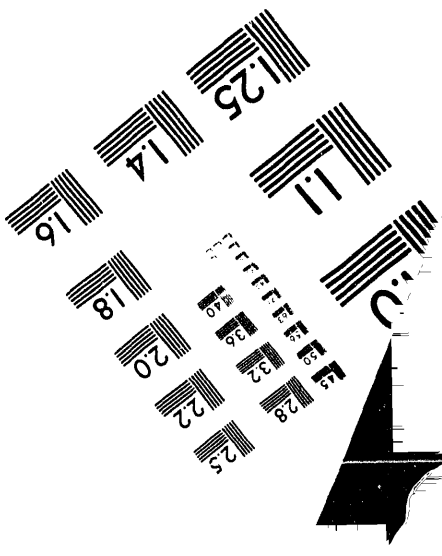

1 of 1

ES/ER/TM-1/R2

Applicable or Relevant and Appropriate Requirements (ARARs) for Remedial Action at the Oak Ridge Reservation

A Compendium of Major Environmental Laws

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CONTENTS

TABLES

ACRONYMS

ACL	alternate concentration limit
AEA	Atomic Energy Act
ALARA	as low as reasonably achievable
ARAP	Aquatic Resource Alteration Permit
ARAR	applicable or relevant and appropriate requirement
BAT	best available technology
BDAT	best demonstrated available technology
CAA	Clean Air Act
CAMU	corrective action management unit
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	*Code of Federal Regulations*
CSF	carcinogen slope factor
CWA	Clean Water Act
DCG	derived concentration guide
DOE	Department of Energy
DOI	Department of Interior
DOT	Department of Transportation
EPA	Environmental Protection Agency
EO	Executive Order
FFA	Federal Facility Agreement
FFCA	Federal Facilities Compliance Agreement
FR	*Federal Register*
FWS	Fish and Wildlife Service
GOCO	government owned, contractor operated
HA	Health Advisory
HSWA	Hazardous and Solid Waste Amendments of 1984
IRIS	*Integrated Risk Information System*
LDR	land disposal restrictions
LLW	low-level waste
MCL	maximum contaminant level
MCLG	maximum contaminant level goal
MTR	minimum technology requirements
NA	Natural Area
NAAQS	National Ambient Air Quality Standards
NARM	naturally occurring and accelerator-produced radioactive material
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NEPA	National Environmental Policy Act
NERP	National Environmental Research Park
NESHAP	National Emission Standards for Hazardous Air Pollutants
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NPRM	Notice of Proposed Rulemaking
NRC	Nuclear Regulatory Commission

NSDWS	National Secondary Drinking Water Standards
NSPS	New Source Performance Standards
ODW	Office of Drinking Water
ORNL	Oak Ridge National Laboratory
ORR	Oak Ridge Reservation
OSHA	Occupational Safety and Health Administration
OSWER	Office of Solid Waste and Emergency Response
PCB	polychlorinated biphenyl
RA	Reference Area
RCRA	Resource Conservation and Recovery Act
RDPW	Report on Defense Plan Wastes
RfC	reference concentration
RfD	reference dose
RI/FS	remedial investigation/feasibility study
RSA	Research Area
SARA	Superfund Amendments and Reauthorization Act
SDWA	Safe Drinking Water Act
SEN	Secretary of Energy Notice
SMCL	secondary maximum contaminant level
SNA	State Natural Area
SWMU	Solid Waste Management Unit
TBC	to be considered
TCA	Tennessee Code Annotated
TDEC	Tennessee Department of Environment and Conservation
TPH	total petroleum hydrocarbons
TSD	treatment, storage, and disposal facilities
TSCA	Toxic Substances Control Act
TT	treatment technology
TU	temporary unit
UIC	underground injection control
USC	United States Code
UST	underground storage tank
WIPP LWA	Waste Isolation Pilot Plant Land Withdrawal Act
WQC	water quality criteria

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EXECUTIVE SUMMARY

Section 121 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 specifies that remedial actions for cleanup of hazardous substances must comply with applicable or relevant and appropriate requirements (ARARs) or standards under federal and state environmental laws. The U.S. Department of Energy (DOE) Oak Ridge Reservation (ORR) was placed on the National Priorities List by the U.S. Environmental Protection Agency (EPA) on November 21, 1989, effective December 21, 1989. As a result of this listing, DOE, EPA, and the Tennessee Department of Environment and Conservation have signed a Federal Facility Agreement (FFA) for the environmental restoration of the ORR. Section XXI(F) of the FFA calls for the preparation of a draft listing of all ARARs as mandated by CERCLA §121.

This report supplies a preliminary list of available federal and state ARARs that might be considered for remedial response at the ORR. A description of the terms "applicable" and "relevant and appropriate" is provided, as well as definitions of chemical-, location-, and action-specific ARARs. ARARs promulgated by the federal government and by the state of Tennessee are listed in tables. In addition, the major provisions of the Resource Conservation and Recovery Act, the Safe Drinking Water Act, the Clean Water Act, the Clean Air Act, and other acts, as they apply to hazardous waste cleanup, are discussed.

In the absence of ARARs, CERCLA §121 provides for the use of nonpromulgated federal criteria, guidelines, and advisories in evaluating the human risk associated with remedial action alternatives. Such nonpromulgated standards are classified as "to-be-considered" (TBC) guidance. A discussion of available guidance is given; summary tables list the available federal standards and guidance information. In addition, the substantive contents of the DOE orders as they apply to remediation of radioactively contaminated sites are discussed as TBC guidance.

1. INTRODUCTION

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 was passed by Congress and signed into law on December 11, 1980 (Public Law 96-510). This act was intended to provide for "liability, compensation, cleanup, and emergency response for hazardous substances released into the environment and the cleanup of inactive waste disposal sites." The Superfund Amendments and Reauthorization Act (SARA), adopted on October 17, 1986 (Public Law 99-499), did not substantially alter the original structure of CERCLA but provided extensive amendments to it.

In particular, §121 of CERCLA specifies that remedial actions for cleanup of hazardous substances must comply with requirements or standards under federal or more stringent state environmental laws that are applicable or relevant and appropriate to the hazardous substances or particular circumstances at a site. Inherent in the interpretation of applicable or relevant and appropriate requirements (ARARs) is the assumption that protection of human health and the environment is ensured. The preamble to Subpart E, "Hazardous Substance Response," of the final National Oil and Hazardous Substances Pollution Contingency Plan (NCP) [55 *Federal Register* (*FR*) 8687-8775, March 8, 1990] discusses the identification and use of ARARs as the Remedial Investigation/Feasibility Study (RI/FS) progresses for a site. The U.S. Environmental Protection Agency (EPA) has provided two reports entitled *CERCLA Compliance with Other Laws Manual*, Volumes I and II (EPA 1988, EPA 1989), which are intended as guidance documents for CERCLA compliance with environmental and public health statutes in implementing remedial actions. Much of the information found in this report was developed from those documents. Subpart K of the NCP, "Federal Facilities," is intended to provide guidance to federal agencies conducting response actions at federal facilities and, when proposed, will be considered for response actions at the Oak Ridge Reservation (ORR) [Notice of Proposed Rulemaking (NPRM) July 1993, Final Rule expected July 1994].

The U.S. Department of Energy (DOE) ORR was proposed by EPA for listing on the National Priorities List (NPL) on July 14, 1989 (54 *FR* 29820), with final NPL listing on November 21, 1989, effective December 21, 1989 (54 *FR* 48184). As a result of this listing, DOE, EPA, and the Tennessee Department of Environment and Conservation (TDEC) have signed a Federal Facility Agreement (FFA) for the environmental restoration of ORR (effective date January 1, 1992). Section XXI(F) of the FFA calls for the preparation of a draft listing of all ARARs as mandated by §121 of CERCLA. The FFA §IV discusses the coordination between the Resource Conservation and Recovery Act (RCRA) and CERCLA and states that corrective actions previously established under DOE's current RCRA permit (HSWA TN 001) and the TDEC RCRA permit (TN1 890 090 003) will be supplemented with response actions under CERCLA to ensure comprehensive remediation at ORR. The FFA states that RCRA will be considered an ARAR with respect to releases of hazardous constituents from facilities that are or were authorized to operate under §3005(e) of RCRA. DOE's RCRA permits will be modified, as necessary, to incorporate a CERCLA remedial response selected as a corrective measure to satisfy RCRA §3004(u) and (v).

The purpose of this report is to supply a preliminary list of available federal and state chemical-, location-, and action-specific ARARs that might be considered for ORR. It is stated in Chapter XXI(F)(2) of the FFA that actual ARARs are identified only on a site-specific basis and that the process of ARAR identification is an iterative one that is continually changing as the RI/FS progresses. Therefore, this list of ARARs represents a compilation of potential ARARs, of which subsets will be used or additional ARARs added as site-specific contamination at ORR is characterized. No attempt will be made in this report to determine whether the regulations will be either applicable or relevant and appropriate. This will be done on a site-specific basis.

It is understood that DOE will comply with the requirements of the National Environmental Policy Act (NEPA) as specified in DOE Order 5440.1D ("National Environmental Policy Act Compliance Program"). Further, DOE Order 5400.4 ("Comprehensive Environmental Response, Compensation, and Liability Act Requirements") calls for integration of NEPA and CERCLA requirements for DOE remedial actions at CERCLA sites. This issue has been reaffirmed in FFA §I(A)(3) and §III(A)(2) and the Secretary of Energy Notice (SEN) of February 5, 1990 (SEN-15-90), which was issued to ensure that DOE's NEPA activities are carried out in a centralized and uniform manner. Therefore, the regulations found in NEPA will not be addressed in this report as ARARs; however, the federal and state regulations protecting environmental resources that may be identified at a site during a NEPA assessment are discussed in Sect. 4.

Title I, §111(c)(6), of CERCLA mandated that the Occupational Safety and Health Agency (OSHA) promulgate standards for regulation of employee health and safety during hazardous waste operations at RCRA or CERCLA sites and during emergency response to hazardous substance releases. The final regulations for "Hazardous Waste Operations and Emergency Response" (29 *CFR* 1910) have appeared in 54 *FR* 9294 (Final Rule, March 6, 1989). These regulations are designed to protect workers involved in cleanup operations at uncontrolled hazardous waste sites and to provide worker protection during initial site characterization and analysis, monitoring activities, materials handling activities, training, and emergency response. These regulations do not apply to those workers who would not be exposed.

Federal construction activities involving no potential for hazardous substance exposure are covered by the OSHA standards in 29 *CFR* 1926 ("Federal Service Contracts") and 29 *CFR* 1910 ("General Industry"). DOE also addresses occupational safety in DOE Orders 5480.11 ("Radiation Protection for Occupational Workers"), 5480.4 ("Environmental Protection, Safety, and Health Protection Standards"), 5483.1A ("Occupational Safety and Health Program for Contractors at Government Owned, Contractor Operated Facilities"), 5480.9 ("Construction Safety and Health Program"), and 5480.10 ("Contractor Industrial Hygiene Program"). ARARs apply to those federal and state regulations that are designed to protect the environment and do not generally apply to occupational safety regulations. EPA requires compliance with the OSHA standards in §300.150 of the NCP, not through the ARARs process. Therefore, neither the regulations promulgated by OSHA nor the DOE Orders related to occupational safety are addressed as ARARs; these regulations appear in site-specific Health and Safety Plans.

The following is a listing of the definitions of terms used throughout this report:

Applicable requirements are "those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental, state environmental, or facility siting law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site" (40 *CFR* 300.5).

Relevant and appropriate requirements are "those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental, state environmental, or facility siting law that, while not applicable to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site" (40 *CFR* 300.5).

Requirements under federal or state law may be *either* applicable *or* relevant and appropriate to CERCLA cleanup actions, but not both. However, requirements must be *both* relevant *and* appropriate for compliance to be necessary. In the case where a federal and a state ARAR are available, or where there are two potential ARARs addressing the same issue, the more stringent regulation must be selected. However, CERCLA §121(d)(4) provides several ARAR waiver options that may be invoked, providing that the basic premise of protection of human health and the environment is not ignored. A waiver is available for state standards that have not been applied uniformly in similar circumstances across the state. In addition, CERCLA §121(d)(2)(C) forbids state standards that effectively prohibit land disposal of hazardous substances.

CERCLA on-site remedial response actions must only comply with the substantive requirements of a regulation and not the administrative requirements to obtain federal, state, or local permits [CERCLA §121(e) and FFA §XXII]. In order to ensure that CERCLA response actions proceed as rapidly as possible, EPA has reaffirmed this position in the final NCP (55 *FR* 8756). **Substantive requirements** pertain directly to the actions or conditions at a site; **administrative requirements** facilitate their implementation. EPA recognizes that certain of the administrative requirements, such as consultation with state agencies, reporting, etc., are accomplished through the state involvement and public participation requirements of the NCP. These administrative requirements should be observed if they are useful in determining cleanup standards at the site (55 *FR* 8757).

In the absence of federal- or state-promulgated regulations, there are many criteria, advisories, guidance values, and proposed standards that are not legally binding but may serve as useful guidance for setting protective cleanup levels. These are not potential ARARs but are **"to be considered"** (TBC) guidance.

2. CHEMICAL-SPECIFIC ARARs

Chemical-specific requirements set health- or risk-based concentration limits or discharge limitations in various environmental media for specific hazardous substances, pollutants, or contaminants (53 *FR* 51437). These requirements generally set protective cleanup levels for the chemicals of concern in the designated media or else indicate a safe level of discharge that may be incorporated when considering a specific remedial activity. A variety of hazardous substances, including radioactive, nonradioactive, and mixed hazardous wastes, have been disposed of for many years at ORR. Metals, organic chemicals, and radionuclides have been detected in all environmental media: air, surface water, groundwater, soil, and sediment.

Although limited in number, chemical-specific standards have been established under several statutes, including RCRA, the Safe Drinking Water Act (SDWA), the Clean Water Act (CWA), and the Clean Air Act (CAA).

2.1 GROUNDWATER AND SURFACE WATER

Table 1 lists available chemical-specific ARARs that have been promulgated under federal law for groundwater, drinking water, and air at ORR. The regulations for air are listed on the table and described in Sect. 2.2.

As stated in the NCP (55 *FR* 8666), the goal of EPA's approach to cleanup of contaminated groundwater is to return usable groundwater to its beneficial use within a given time frame that is reasonable for the particular circumstances at a CERCLA site. Groundwater at ORR has not been given an EPA classification. Although not an ARAR unless promulgated, the EPA guidance on groundwater classification should be used to determine whether groundwater at ORR falls within Class I, II, or III. Classes I and IIA represent current sources of drinking water of varying value, Class IIB represents potential sources of drinking water, and Class III groundwater is not considered to be a potential source of drinking water and is of limited beneficial use. Restoration time periods vary, depending on the use classification of the groundwater, and may range from 1 year to several decades.

In the NCP, EPA states the preference for SDWA maximum contaminant levels (MCLs) and non-zero maximum contaminant level goals (MCLGs) or other health-based standards, criteria, or guidance for cleanup of Class I and II groundwater at CERCLA sites (55 *FR* 8732). Alternate concentration limits (ACLs) may also be used when active restoration of the groundwater to MCLs or non-zero MCLGs is not practicable (55 *FR* 8754). For Class III groundwaters, EPA establishes remediation levels based on specific site conditions, the beneficial use of the groundwater, and environmental receptors (55 *FR* 8732). Final determination of ARARs for site-specific cleanup of groundwater at ORR will depend on the chosen groundwater classification.

Table 1. Chemical-specific federal regulations for protection of human health[a]

Chemical	RCRA[b] maximum concentration limits (μg/L)	Safe Drinking Water Act MCLs[c] (μg/L)	Safe Drinking Water Act MCLGs[d] (μg/L)	Clean Air Act NAAQS[e] (μg/m³)
Acrylamide		TT[f]	0	
Adipates [di(ethylhexyl)adipate]		400[g]	400[g]	
Alachlor		2	0	
Aldicarb		3[h]	1[h]	
Aldicarb sulfone		2[h]	1[h]	
Aldicarb sulfoxide		4[h]	1[h]	
Antimony		6[g]	6[g]	
Arsenic	50	50	NA	
Asbestos (fibers >10 μm)		7[i]	7[i]	
Atrazine		3	3	
Barium	1,000	2,000	2,000	
Benzene		5	0	
Benzo(a)pyrene		0.2[g]	0[g]	
Beryllium		4[g]	4[g]	
Cadmium	10	5	5	
Carbofuran		40	40	
Carbon monoxide				40,000 (1-hour)[j] 10,000 (8-hour)[j]
Carbon tetrachloride		5	0	
Chlordane		2	0	
Chromium (total)	50	100	100	
Copper		TT[f,k]	1,300	
Cyanide		200[g]	200[g]	
Dalapon		200[g]	200[g]	
1,2-Dibromo-3-chloropropane		0.2	0	
o-Dichlorobenzene		600	600	
p-Dichlorobenzene		75	75	
1,2-Dichloroethane		5	0	
1,1-Dichloroethylene		7	7	

Table 1 (continued)

Chemical	RCRA[b] maximum concentration limits (µg/L)	Safe Drinking Water Act MCLs[c] (µg/L)	Safe Drinking Water Act MCLGs[d] (µg/L)	Clean Air Act NAAQS[e] (µg/m^3)
cis-1,2-Dichloroethylene		70	70	
trans-1,2-Dichloroethylene		100	100	
Dichloromethane (methylene chloride)		5[g]	0[g]	
2,4-Dichlorophenoxyacetic acid (2,4-D)	100	70	70	
1,2-Dichloropropane		5	0	
Dinoseb		7[g]	7[g]	
Diquat		20[g]	20[g]	
Endothall		100[g]	100[g]	
Endrin	0.2	2[g]	2[g]	
Epichlorohydrin		TT[f]	0	
Ethylbenzene		700	700	
Ethylene dibromide		0.05	0	
Fluoride		4,000[l]	4,000	
Glyphosate		700[g]	700[g]	
Heptachlor		0.4	0	
Heptachlor epoxide		0.2	0	
Hexachlorobenzene		1[g]	0[g]	
Hexachlorocyclopentadiene		50[g]	50[g]	
Lead	50	TT[f,k]	0	1.5 (90-day)[m]
Lindane (*gamma*-HCCH)	4	0.2	0.2	
Mercury	2	2	2	
Methoxychlor	100	40	40	
Monochlorobenzene		100	100	
Nickel		100[g]	100[g]	
Nitrate (as N)		10,000	10,000	
Nitrite (as N)		1,000	1,000	
Nitrate + Nitrite (as N)		10,000	10,000	
Nitrogen dioxide				100 (1-year)[n]

Table 1 (continued)

Chemical	RCRA[b] maximum concentration limits (µg/L)	Safe Drinking Water Act MCLs[c] (µg/L)	Safe Drinking Water Act MCLGs[d] (µg/L)	Clean Air Act NAAQS[e] (µg/m³)
Ozone				235 (1-year)[j,o]
Oxamyl (Vydate)		200[g]	200[g]	
Particulate matter				260 (24-hour)[j] 75 (1-year)[p]
Pentachlorophenol		1	0	
Phthalates [di(ethylhexyl)phthalate]		6[g]	0[g]	
Picloram		500[g]	500[g]	
Polychlorinated biphenyls		0.5	0	
Selenium	10	50	50	
Silver[q]	50			
Simazine		4[g]	4[g]	
Styrene		100	100	
Sulfate		400,000/500,000[r]	400,000/500,000[r]	
Sulfur oxides				365 (24-hour)[j] 80 (1-year)[n]
Tetrachloroethylene		5	0	
2,3,7,8-Tetrachlorodibenzo-*p*-dioxin (Dioxin)		0.00003[g]	0[g]	
Thallium		2[g]	0.5[g]	
Toluene		1,000	1,000	
Toxaphene	5	3	0	
1,2,4-Trichlorobenzene		70[g]	70[g]	
1,1,1-Trichloroethane		200	200	
1,1,2-Trichloroethane		5[g]	3[g]	
Trichloroethylene		5	0	
Trihalomethanes (total)[s]		100	NA	
2,4,5-Trichlorophenoxy-propionic acid (2,4,5-TP)	10	50	50	

Table 1 (continued)

Chemical	RCRA[b] maximum concentration limits (µg/L)	Safe Drinking Water Act MCLs[c] (µg/L)	Safe Drinking Water Act MCLGs[d] (µg/L)	Clean Air Act NAAQS[e] (µg/m³)
Vinyl chloride		2	0	
Xylenes (total)		10,000	10,000	

[a]Federally promulgated regulations under RCRA, the SDWA, and the CAA are included in this table. Clean Water Act regulations are listed in Tables 3 and 4. Tennessee state drinking water MCLs/MCLGs (Chapter 1200-5-1 of the Rules of the TDEC) are identical to the federal.

[b]RCRA = Resource Conservation and Recovery Act (40 *CFR* 264.94).

[c]MCL = maximum contaminant level (40 CFR 141).

[d]MCLG = maximum contaminant level goal (40 CFR 141).

[e]NAAQS = National Ambient Air Quality Standards (40 *CFR* 50.4, 50.6, 50.8 and 50.9-50.12).

[f]TT = treatment technology.

[g]57 *FR* 31776 (July 17, 1992). Effective January 17, 1994 except for the MCL/MCLG for Endrin which became effective August 17, 1992.

[h]Effective date for aldicarb compounds, originally set for January 1, 1993, is postponed indefinitely pending further study (57 *FR* 22178, May 27, 1992).

[i]Million fibers per liter.

[j]Maximum concentration not to be exceeded more than once per year.

[k]When the "action level" of 15 or 1300 µg/L for lead or copper, respectively, measured in the 90th percentile at the consumer's tap, is exceeded, corrosion control studies and treatment requirements are triggered. However, an OSWER memorandum (dated June 21, 1990) recommends that a final cleanup level of 15 µg/L for lead in groundwater usable for drinking water is protective of sensitive subpopulations; this is guidance, not an ARAR.

[l]Applies to community water systems only.

[m]Three-month maximum arithmetic mean concentration.

[n]Annual arithmetic mean concentration.

[o]Hydrocarbon emissions are controlled as part of the ozone NAAQS strategy.

[p]Annual geometric mean.

[q]The interim SDWA MCL was revoked for this chemical (56 *FR* 3526, January 30, 1991; effective July 30, 1992) and a secondary MCL established instead (see Table 2).

[r]This is a proposed MCL/MCLG only (55 *FR* 30370, July 25, 1990). EPA has deferred setting a final MCL/MCLG for sulfate pending further study (57 *FR* 31776, July 17, 1992).

[s]Total trihalomethanes refers to the sum of the concentration of chloroform, bromodichloromethane, dibromochloromethane, and bromoform.

NA = not available.

The TDEC Office of Superfund has issued draft groundwater classification rules, which classify groundwater as: Class A—current or future sources of drinking water; Class B—not a current or future source of drinking water but protected for other beneficial uses; Class C—not protected for drinking water or other beneficial uses; and Surface Water Recharge groundwater that recharges surface waters. Class A groundwaters are listed by aquifer; two are identified for east Tennessee—the Cambrian-Ordovician Carbonate Aquifer and the Crystalline Rock Aquifer. Final promulgation of this groundwater classification rule is projected for mid-1993 (Moss 1993). Numerical standards for cleanup of groundwater that is classified for drinking water have been proposed [Rules of the TDEC, Chap. 1200-1-13-.08(4)]. These include specific criteria for groundwater found in Rules of the TDEC, Chap. 1200-4-6-.05(2); federal SDWA MCLs and secondary maximum contaminant levels (SMCLs); and naturally occurring background levels. However, the proposed rule provides three approaches to establish cleanup levels: (1) the use of the numerical standards discussed above; (2) the use of the human health and environmental risk assessment approach; or (3) the use of background levels as further defined in 1200-1-13-.08(6) [Rules of the TDEC, Chap. 1200-1-13-.08(3)(a)]. This proposed rule is undergoing revisions based on public comment; it is unclear when it will be promulgated (Binford 1993).

2.1.1 Resource Conservation and Recovery Act

Subtitle C of RCRA lists maximum concentration levels for 14 chemicals; the concentration of these chemicals in groundwater at the plant boundary of a RCRA-permitted treatment, storage, and disposal (TSD) facility may not exceed the stated maximum concentration level [Title 40, *Code of Federal Regulations* (*CFR*), Part 264, §94 (40 *CFR* 264.94)]. In addition, background concentrations or ACLs are established in 40 *CFR* 264.94 as groundwater protection standards. Table 1 lists RCRA MCLs; however, as mentioned above, EPA has specified SDWA MCLs and non-zero MCLGs for cleanup of Class I and II groundwater and site-specific remediation levels for Class III groundwaters. This approach is consistent with the substantive requirements of RCRA MCLs, ACLs, or background limits (53 *FR* 51433). The newly promulgated regulations for municipal landfills (56 *FR* 50978, October 9, 1991) establish all SDWA MCLs by reference, ACLs, or background concentrations as groundwater protection standards (40 *CFR* 258.55). Although not legally applicable to the remedial action sites found at the ORR, these may prove relevant and appropriate for cleanup of groundwater at some of the sites. ACLs may be calculated for chemicals without an MCL using a risk-based approach (56 *FR* 51026).

2.1.2 Safe Drinking Water Act

EPA has promulgated primary and secondary drinking water regulations applicable to public water systems that have at least 15 service connections or serve an average of at least 25 people daily at least 60 days of the year. National Primary Drinking Water Standards (NPDWS) are established in 40 *CFR* 141 and include MCLs and MCLGs. New drinking water standards promulgated for eight synthetic organic chemicals (52 *FR* 25690, July 8, 1987) added a new category of suppliers referred to as noncommunity, nontransient systems that regularly serve at least 25 people for 6 months of the year. Table 1 lists SDWA MCLs and MCLGs. Although sulfate is also included in Table 1, the values listed are proposed, not final, values. EPA has deferred setting a final MCL/MCLG for sulfate pending further study (57 *FR* 31776, July 17, 1992).

MCLs are enforceable standards that take into consideration human health effects, available treatment technologies, and costs of treatment. MCLGs are strictly health-based standards that disregard cost or treatment feasibility and are not legally enforceable. MCLs are legally applicable to water "at the tap" but are not applicable to cleanup of groundwater or surface water. However, they may be considered as relevant and appropriate in situations where groundwater or surface water may be used for drinking water. CERCLA §121(d)(2)(A) specifically mentions that remedial actions must require a level or standard of control that at least attains MCLGs and federal ambient water quality criteria (WQC) where such goals or criteria are relevant and appropriate under the circumstances of the release. Although MCLGs and WQC are nonenforceable guidelines, Congress elevated them to a higher status by specifically mentioning them in CERCLA. Therefore, promulgated MCLGs are listed in Table 1. At present, EPA is planning to use the SDWA MCLs for remedial action compliance for carcinogens that have an MCLG of zero and any nonzero MCLG for remedial action compliance for systemic toxicants (55 *FR* 8752).

EPA has revised its drinking water standards for lead and copper, eliminating the MCL and replacing it with a treatment technology requirement, applicable to community and nontransient, noncommunity water systems. If "action levels" of 15 μg/L and 1300 μg/L, respectively, for lead and copper, are exceeded at the tap, a state is required to analyze source water samples and to decide what treatment levels are necessary to minimize lead or copper levels delivered to users from the affected distribution system. The TDEC has adopted the action levels for lead and copper (TDEC Rules Chap. 1200-5-1-.33). In the instance of contaminated groundwater at ORR, the action levels for lead and copper are neither legally applicable nor relevant and appropriate. Therefore, they have not been included in Table 1. However, the EPA Office of Solid Waste and Emergency Response (OSWER) has recommended that a final cleanup level of 15 μg/L for lead in groundwater usable for drinking water is protective of sensitive populations (OSWER memorandum dated June 21, 1990). This might be considered TBC guidance for remediation of lead-contaminated groundwater. The action levels for lead and copper have also been listed in the proposed TDEC Rule (discussed in Sect. 2.1 above) as cleanup standards for groundwater to be used as a domestic water supply; when promulgated, these cleanup standards would be applicable to groundwater.

Chapter 1200-5-1 of the Rules of the TDEC, as amended in January 1993, lists MCLs for public water systems that are identical to the federal MCLs. Therefore, they are not repeated here.

National Secondary Drinking Water Standards (NSDWS) regulate contaminants that affect the aesthetic qualities related to public acceptance of drinking water and are implemented in 40 *CFR* 143.3 as SMCLs. These regulations are not federally enforceable, but rather are intended to serve as guidelines for use by states in regulating water supplies. Tennessee has promulgated SMCLs in Chap. 1200-5-1.12 of the Rules of the TDEC (see Table 2). These regulations are designed to provide water to the consumer that is aesthetically pleasing, and they apply to all community water systems and to those noncommunity water systems "as may be deemed necessary" by TDEC. In that context, they would not be legally applicable to cleanup of groundwater or surface water, but may be considered as relevant and appropriate in instances where these media may provide private drinking water sources. EPA proposed NSDWS for ten additional contaminants (54 *FR* 22062, May 22, 1989; 55 *FR* 30370, July 25, 1990), and, when these are promulgated, they will

Table 2. Federal and Tennessee secondary drinking water regulations

Chemical	Federal SMCL[a] (mg/L)	Tennessee SMCL[b] (mg/L)
Aluminum	0.05–0.2[c]	0.2
Chloride	250	250
Color	15[d]	15[d]
Copper	1	1
o-Dichlorobenzene[e]	0.01	
p-Dichlorobenzene[e]	0.005	
Ethylbenzene[e]	0.03	
Fluoride	2.0	2.0
MBAS (methyl blue active substance)		0.5
Hexachlorocyclopentadiene[f]	0.008	
Iron	0.3	0.3
Manganese	0.05	0.05
Odor	3[g]	3[g]
Pentachlorophenol[e]	0.03	
pH	6.5–8.5	6.5–8.5
Silver	0.1	0.1
Styrene[e]	0.01	
Sulfate	250	250
Toluene[e]	0.04	
TDS (total dissolved solids)	500	500
Xylene[e]	0.02	
Zinc	5	5

[a]Final rule [44 *FR* 42198 (July 19, 1979); 51 *FR* 11396 (April 2, 1986); 56 *FR* 3526 (January 30, 1991)]. NSDWS are included in this table for completeness since they will be incorporated into the TDEC secondary drinking water regulations when promulgated.

[b]Chapter 1200-5-1.12 of the Rules of the TDEC, January 1993.

[c]Level recommended to prevent posttreatment precipitation in the distribution system.

[d]Color units.

[e]Proposed NSDWS (54 *FR* 22062, May 22, 1989). The Environmental Protection Agency (EPA) has deferred setting final standards for these chemicals pending further study (56 *FR* 3572, January 30, 1991).

[f]Proposed NSDWS (55 *FR* 30370, July 25, 1990). EPA has deferred setting a final standard for this chemical pending further study (57 *FR* 31776, July 17, 1992).

[g]Threshold odor number.

be incorporated into the TDEC secondary drinking water regulations (Foster 1990). Therefore, they are included in Table 2 for completeness. A final NSDWS for two of these chemicals, aluminum and silver, has appeared (NPRM, 54 *FR* 22062; Final Rule, 56 *FR* 3526, January 30, 1991).

2.1.3 Clean Water Act

CERCLA §121(d)(2)(A) specifically states that remedial actions shall at least attain federal ambient WQC established under the CWA if they are relevant and appropriate. In determining whether any WQC are relevant and appropriate, one must consider the "designated or potential use of the surface or groundwater, the environmental media affected, the purposes for which the criteria were developed, and the latest information available" [CERCLA §121(d)(2)(B)]. Federal WQC are derived for the protection of freshwater aquatic organisms and for the protection of human health from the consumption of contaminated drinking water and/or aquatic organisms.

Table 3 lists ambient WQC for the protection of human health. EPA has derived WQC for ingestion of drinking water and aquatic organisms and for the ingestion of aquatic organisms alone. The EPA Region IV Water Quality Standards Unit has adjusted WQC for human health based on recent human toxicity information [reference doses (RfDs) and carcinogen slope factors (CSFs)] obtained from the EPA *Integrated Risk Information System (IRIS)*. The values presented in Table 3 reflect the EPA Region IV revised WQC and are current as of December 1992 (EPA 1992). They are intended to supersede all previous WQC. Criteria for certain toxic pollutants were withdrawn and others revised in the "National Toxics Rule" (57 *FR* 60848, December 22, 1992), and EPA Region IV has subsequently removed or revised these WQC in its criteria charts. Table 3 notes these changes.

As part of the federal requirement for a triennial review of state water quality standards, the TDEC Division of Water Pollution Control has promulgated amendments to Chaps. 1200-4-3 and 1200-4-4 of the Rules of the TDEC. TDEC has revised its water quality standards and promulgated the SDWA MCLs as WQC for domestic water supplies (effective date August 30, 1991). Included in this revision are criteria for protection of recreational uses. These criteria are human health criteria derived to protect the consumer from consumption of contaminated fish. These criteria are similar to the federal WQC for the protection of human health from consumption of fish alone (see Table 3). However, the TDEC WQC for carcinogens are based on a risk of 10^{-5} rather than the 10^{-6} risk on which the federal WQC are based.

Chapter 1200-4-3 of the Rules of the TDEC lists seven use-designation categories for Tennessee's surface waters. Specific water quality standards are promulgated for each use category. Under the Tennessee Water Quality Control Act, the Tennessee Water Quality Control Board has classified the Clinch River for domestic water supply, industrial water supply, fish and aquatic life, recreation, irrigation, and livestock watering and wildlife uses (Chap. 1200-4-4 of the Rules of the TDEC). The tributaries to the Clinch River have various use classifications, which will be analyzed on a site-specific basis. The standards also state that "all other streams, named and unnamed, which have not been specifically noted shall be classified for fish and aquatic life, recreation, irrigation, and livestock watering and wildlife uses." The TDEC has promulgated a change in the use classification that adds recreation as a category for all segments of rivers and streams that are not currently classified as such (effective August 1991).

Table 4 lists federal WQC for the protection of freshwater aquatic life. EPA Region IV has also revised these WQC based on current toxicity and bioaccumulation data for aquatic organisms, and these appear in Table 4. When the designated use classification requires

Table 3. Federal and state ambient water quality criteria (WQC) for the protection of human health (μg/L)

Chemical	WQC for aquatic organisms and drinking water[a]	WQC for aquatic organisms alone[a]	TDEC WQC for aquatic organisms alone[b]
Acenaphthene	1,200 (org)[c,d]	2,700	0.3
Acrolein	320	780	780
Acrylonitrile	0 (0.059)	0 (0.66)	6.7
Aldrin	0 (1.3E-04)[e]	0 (1.4E-04)	0.0014
Anthracene	9,600	110,000	0.03
Antimony	14	4,300	4,310
Arsenic	0 (0.018)	0 (0.14)	
Asbestos	0 (7,000,000 fibers/L)[d]	NA	
Benzene	0 (1.2)	0 (71)	710
Benzidine	0 (1.2E-04)	0 (5.4E-04)	
Benz(a)anthracene	0 (4.4E-03)	0 (0.049)	0.3
Benzo(a)pyrene	0 (4.4E-03)	0 (0.049)	0.3
Benzo(k)fluoranthene	0 (4.4E-03)	0 (0.049)	0.3
3,4-Benzo(b)fluoranthene	0 (4.4E-03)	0 (0.049)	0.3
Beryllium	NA[f]	NA[f]	1.3
Bromoform	0 (4.3)	0 (360)	4,700
Cadmium	NA[f]	NA[f]	
Carbon tetrachloride	0 (0.25)	0 (4.4)	44
Chlordane	0 (5.7E-04)	0 (5.9E-04)	0.006
Chlorinated benzenes			
Monochlorobenzene	680 (org)[d]	21,000[d]	
1,2-Dichlorobenzene	2,700	17,000	17,000
1,3-Dichlorobenzene	400	2,600	2,600
1,4-Dichlorobenzene	400	2,600	2,600
1,2,4,5-Tetrachlorobenzene	38	48	
Pentachlorobenzene	74	85	
Hexachlorobenzene	0 (7.5E-04)	0 (7.7E-04)	0.007
Chlorinated ethanes			
1,2-Dichloroethane	0 (0.38)	0 (99)	990
1,1-Dichloroethylene	0 (0.057)	0 (3.2)	32
1,2-trans-Dichloroethylene	700[d]	NA[d]	
1,1,1-Trichloroethane	NA[f]	NA[f]	170,000
1,1,2-Trichloroethane	0 (0.60)	0 (42)	420
1,1,2,2-Tetrachloroethane	0 (0.17)	0 (11)	110
Hexachloroethane	0 (1.9)	0 (8.9)	89
Chlorinated phenols			
2-Chlorophenol	120 (org)[d]	400[d]	
2,4-Dichlorophenol	93 (org)[d]	790[d]	
2,4,5-Trichlorophenol	1.0 (org)	NA	
2,4,6-Trichlorophenol	0 (2.1)	0 (6.5)	6.5
Pentachlorophenol	0 (0.28)	0 (8.2)	
3-Methyl-4-chlorophenol	NA[f]	NA	
Chloroalkyl ethers			
bis-(Chloromethyl) ether	0 (1.59E-04)	0 (0.0777)	
bis-(2-Chloroethyl) ether	0 (0.031)	0 (1.4)	14
bis-(2-Chloroisopropyl) ether	1,400	170,000	
Chlorodibromomethane	0 (0.41)	0 (34)	
Chloroform	0 (5.7)	0 (470)	4,700
Chloronaphthalene	1,700	4,300	

Table 3 (continued)

Chemical	WQC for aquatic organisms and drinking water[a]	WQC for aquatic organisms alone[a]	TDEC WQC for aquatic organisms alone[b]
Chromium (III)	NA[f]	NA[f]	670,000
Chromium (VI)	NA[f]	NA[f]	
Chrysene	0 (4.4E-03)	0 (0.049)	0.03
Copper	1,300 (org)[d]	NA	
Cyanide	700	220,000	
DDD	0 (8.3E-04)	0 (8.4E-04)	0.008
DDE	0 (5.9E-04)	0 (5.9E-04)	0.006
DDT	0 (5.9E-04)	0 (5.9E-04)	0.006
Dibenz(a,h)anthracene	0 (4.4E-03)	0 (0.049)	
3,3'-Dichlorobenzidine	0 (0.04)	0 (0.077)	
Dichlorobromomethane	0 (0.27)	0 (22)	4,700
Dichlorodifluoromethane	0 (5.67)	0 (470.8)	
1,1-Dichloroethylene	0 (0.057)	0 (3.2)	32
Dichloropropanes/Dichloropropenes			
1,2-Dichloropropane	0.52[d]	39[d]	
cis-1,3-Dichloropropene	10	1,700	1,700
trans-1,3-Dichloropropene	10	1,700	1,700
Dieldrin	0 (1.4E-04)	0 (1.4E-04)	0.0014
2,4-Dimethylphenol	540 (org)[d]	2,300[d]	
2,4-Dinitrotoluene	0 (0.11)	0 (9.1)	42
1,2-Diphenylhydrazine	0 (0.040)	0 (0.54)	
Endosulfan (*a*-,*b*-)	74	159	2
Endosulfan sulfate	74	159	
Endrin	0.76	0.81	
Endrin aldehyde	0.76	0.81	
Ethylbenzene	3,100	29,000	29,000
Fluoranthene	300	370	54
Fluorene	1,300	14,000	0.03
Halomethanes	0 (5.7)	0 (470)	
Heptachlor	0 (2.1E-04)	0 (2.1E-04)	0.002
Heptachlor epoxide	0 (1.0E-04)	0 (1.1E-04)	0.001
Hexachlorobutadiene	0 (0.44)	0 (50)	500
Hexachlorocyclohexanes (HCCH)			
Alpha-HCCH	0 (3.9E-03)	0 (0.013)	
Beta-HCCH	0 (0.014)	0 (0.046)	
Gamma-HCCH	0 (0.019)	0 (0.063)	0.63
Hexachlorocyclopentadiene	240 (org)	17,000	
Indeno(1,2,3-cd)pyrene	0 (4.4E-03)	0 (0.049)	
Isophorone	0 (36)	0 (2,600)	
Lead	NA[f]	NA[f]	
Manganese	30	NA	
Mercury	0.14	0.15	0.15
Methyl bromide	48	4,000	
Methyl chloride	NA[f]	NA[f]	4,700
Methylene chloride	0 (4.7)	0 (1,600)	16,000
Nickel	610	4,600	4,600
Nitrobenzene	17	1,900	1,900
Nitrophenols			
2,4-Dinitrophenol	70	14,000	14,000
2,Methyl-4,6-dinitrophenol	13.4	765	765

Table 3 (continued)

Chemical	WQC for aquatic organisms and drinking water[a]	WQC for aquatic organisms alone[a]	TDEC WQC for aquatic organisms alone[b]
Nitrosamines			
n-Nitrosodimethylamine	0 (6.9E-04)	0 (8.1)	
n-Nitrosodiphenylamine	0 (5.0)	0 (16)	
n-Nitrosodi-n-propylamine	0.005[d]	1.4[d]	
n-Nitrosopyrrolidine	0 (0.016)	0 (91.9)	
Pentachlorobenzene	74	85	
Phenanthrene	NA	NA	0.03
Phenol	21,000 (org)	4,600,000	
Phthalate esters			
Butylbenzyl phthalate	3,000[d]	5,200[d]	
Diethylphthalate	23,000	120,000	120,000
Dimethylphthalate	313,000	2,900,000	2,900,000
Di-*n*-butylphthalate	2,700	12,000	12,000
Bis-2-ethylhexylphthalate	0 (1.8)	0 (5.9)	59
Polychlorinated biphenyls (PCBs) (1016, 1221, 1232, 1242, 1248, 1254, 1260)	0 (4.4E-05)	0 (4.5E-05)	0.001[g]
Polynuclear aromatic hydrocarbons (PAHs)	0 (4.4E-03)	0 (0.049)	
Pyrene	960	11,000	0.03
Selenium	NA[f]	NA[f]	
Silver	NA[f]	NA[f]	
2,3,7,8-Tetrachlorodibenzo-*p*-dioxin	0 (1.3E-08)	0 (1.4E-08)	1.0E-06
1,2,4,5-Tetrachlorobenzene	38	48	
Tetrachloroethylene	0 (0.8)	0 (8.85)	88
Thallium	1.7	6.3	
Toluene	6,800	200,000	300,000
Toxaphene	0 (7.3E-04)	0 (7.5E-04)	0.008
Trichloroethylene	0 (2.7)	0 (81)	807
Trichlorofluoromethane	0 (5.67)	0 (470.8)	
Vinyl chloride	0 (2)	0 (525)	5,250
Zinc	NA	NA	

[a]The criterion value of zero for all potential carcinogens is listed in the table. Concentrations in parentheses for potential carcinogens correspond to a risk of 10^{-6}.

[b]WQC for the protection of humans from consumption of aquatic organisms during recreational use (TDEC Rules, Chap. 1200-4-4). TDEC has adopted the federal WQC based on a risk of 10^{-5} rather than 10^{-6} for all carcinogens.

[c]Criteria designated as organoleptic are based on taste and odor effects, not human health effects. Health-based WQC are not available for these chemicals.

[d]New WQC published in the National Toxics Rule [57 *FR* 60848 (December 22, 1992)].

[e]Read as 1.3×10^{-4}.

[f]WQC withdrawn in the National Toxics Rule [57 *FR* 60848 (December 22, 1992)].

[g]Criterion is for total PCBs; criterion for each individually is 5.0E-04.

NA = not available.

Source: EPA 1992 (EPA Region IV Criteria Charts).

Table 4. Federal and state ambient water quality criteria for the protection of freshwater organisms (μg/L)

Chemical	Maximum[a]	24-h[b]
Aldrin	3	NA
Aluminum	750[c]	87[c]
Ammonia	Concentrations are temperature and pH dependent	
Arsenic (III)	360	190
Boron	NA	750[d]
Cadmium	1.79[e]	0.66[e]
Chlordane	2.4	4.3E-03[f,g]
Chloride	860,000	230,000
Chlorine	19	11
Chlorpyrifos	0.083	0.041
Chromium (VI)	16	11
Chromium (III)	984.32[e]	117.32[e]
Copper	9.22[e]	6.54[e]
Cyanide	22	5.2
Dichlorodiphenyl-trichloroethane (DDT)	1.1	1.0E-03[h]
Demeton	NA	0.1
Dieldrin	2.5	1.9E-03[g]
Endosulfan	0.22	0.056
Endrin	0.18	2.3E-03[g]
Guthion	NA	0.01
Heptachlor	0.52	3.8E-03[g]
Heptachlor epoxide	0.52	3.8E-03[g]
Hexachlorocyclohexanes (HCCH) gamma-HCCH (Lindane)	2	0.08
Hydrogen sulfide	NA	2
Iron	NA	1,000
Lead	33.78[e]	1.32[e]
Malathion	NA	0.1
Mercury	2.40	0.012[g]
Methoxychlor	NA	0.03
Mirex	NA	1.0E-03
Nickel	789.00[e]	87.71[e]
Parathion	0.065	0.013
Pentachlorophenol	20[i]	13[i]
pH	NA	6.5-9
Polychlorinated biphenyls (PCBs)	NA	0.014[g]
Selenium (inorganic selenite)	20.00	5.00[g]
Silver	1.23[e]	NA
Sulfides	NA	2
Toxaphene	0.73	2.0E-04[g]
Zinc	65.04[e]	58.91[e]

[a]One-hour average concentration not to be exceeded more than once every 3 years.
[b]Four-day average concentration not to be exceeded more than once every 3 years.
[c]pH 6.5–9.0.
[d]Minimum standard for long-term irrigation of sensitive crops.
[e]Water hardness dependent criteria (50 mg/L as $CaCO_3$).
[f]Read as 4.3×10^{-3}.
[g]Based on marketability of fish.
[h]Final residue value based on wildlife feeding study.
[i]pH dependent criteria.
NA = not available.

Sources: EPA 1992 (Region IV Criteria Chart); Chapter 1200–4–3 of the Rules of the Tennessee Department of Environment and Conservation.

protection of aquatic life or when environmental factors are being considered at a remedial action site, a WQC for the protection of aquatic life that is more stringent than the SDWA MCL may be relevant and appropriate (55 *FR* 8754) for CERCLA cleanup. TDEC has promulgated WQC for the protection of aquatic organisms, effective August 30, 1991; these are identical to the federal WQC listed in Table 4.

2.2 AIR

Primary National Ambient Air Quality Standards (NAAQS) for six chemicals appear in 40 *CFR* 50; these standards are based on the direct health effects of those chemicals to sensitive groups, with no economic factors considered. The NAAQS take into consideration all sources of exposure to a given chemical and establish ceilings that are not to be exceeded in the United States. Only major new sources, or major modifications to existing sources, must attain NAAQS. Although ORR is in a Tennessee state "attainment" area, it is unlikely that any emissions from CERCLA cleanup will be considered a "major" source under present federal law. However, EPA has listed "site remediation" as a major source category under §112(c) of the CAA (57 *FR* 31576, July 16, 1992) and issued a draft regulatory schedule in September 1992 (57 *FR* 44147) for promulgating emission standards under 40 *CFR* 63 for the newly listed major source categories (final schedule due October 1993) (Houlberg et al. 1993). A preliminary draft timetable calls for emission standards for site remediation by November 15, 2000.

NAAQS are established as the criteria state and local governments must plan to achieve and thus are not directly enforceable. Under §110 of the CAA, states are required to implement regulations to achieve the NAAQS. The ambient air quality standards established by the TDEC Division of Air Pollution Control appear in Chap. 1200-3-3 of the Rules of the TDEC and are identical to the federal primary NAAQS (see Table 1). The ambient standards of 1200-3-3 are translated into source-specific emission limitations (Rules of the TDEC, Chaps. 1200-3-4 to 1200-3-21) that must be considered ARARs if they apply to any of the remedial alternatives selected. Tennessee state air emission standards are considered "hybrid" ARARs and will be summarized as action-specific ARARs in Sect. 5.2; they will be analyzed on a site-specific basis following selection of remedial alternatives.

National Emission Standards for Hazardous Air Pollutants (NESHAPs) for various industrial sources that emit one of several pollutants are established in 40 *CFR* 61. Most of the NESHAPs are generally neither applicable nor relevant and appropriate to cleanup at CERCLA sites because they regulate particular types of sources that would not be expected to be found at a CERCLA site. However, the NESHAPs will be considered as potential "hybrid" ARARs on a site-specific basis during the selection of remedial alternatives; in particular, the NESHAPs for asbestos, vinyl chloride, and radionuclides will be reviewed.

The CAA Amendments of 1990 expanded to 189 the list of hazardous air pollutants regulated under 40 *CFR* 61 for which technology-based standards must be promulgated. These standards will be applicable to categories of emission sources rather than to the substances emitted.

2.3 SOIL

Very little legislation or guidance is available governing cleanup criteria for contaminated soils at CERCLA sites. RCRA has addressed land disposal of treated hazardous wastes in its land disposal restrictions (LDR) (40 *CFR* 268), and these are addressed as "hybrid" ARARs in Sect. 5. If a site is identified as a RCRA Sect. 3004(u) Solid Waste Management Unit (SWMU), or if RCRA-characteristic or RCRA-listed hazardous waste as defined in 40 *CFR* 261 is present at the site, it is subject to RCRA corrective action regulations. The proposed RCRA corrective action regulations address risk-based cleanup standards for soils (55 *FR* 30798); these are briefly discussed in Sect. 5.1.3. Treatment standards for contaminated soil and debris at CERCLA sites are discussed in Sect. 5.1.2.

TDEC has proposed a rule, *Hazardous Substance Site Remedial Action* (Rules of the TDEC, Chap. 1200-1-13), that is currently undergoing revisions based on public comments; it is unclear when this rule will be promulgated (Binford 1993). This rule states that, where numerical standards are not available for cleanup of soils at hazardous waste sites, soil cleanup levels shall be developed based on methods approved or determined by TDEC or by utilizing a site-specific risk assessment approved by TDEC.

The regulations found in the Toxic Substances Control Act (TSCA) contain storage, disposal, and cleanup requirements for materials contaminated with PCBs. These regulations limit concentrations of PCBs disposed of in soil to 50 ppm and require that any soils containing concentrations of PCBs greater than 50 ppm (40 *CFR* 761.60) be incinerated (40 *CFR* 761.70) or stored in a chemical waste landfill (40 *CFR* 761.75). TSCA also specifies requirements that must be achieved for PCBs disposed of by incineration (40 *CFR* 761.70), in a chemical waste landfill (40 *CFR* 761.75), or by other disposal methods [40 *CFR* 761.60(a)(5)(iii)].

2.4 OTHER "TO-BE-CONSIDERED" GUIDANCE

EPA has suggested cleanup values for lead in soils based on studies of levels of lead in the blood of children. The EPA OSWER Directive 9355.4-02 (dated September 7, 1989) recommends a cleanup level for soils of 500 to 1000 ppm lead. However, EPA has distributed a draft memorandum (dated June 1992) recommending a cleanup level for lead in soil of 500 ppm, based on a new lead uptake/biokinetic model. This threshold level could be revised based on site-specific information (DOE 1993).

Although not an ARAR, EPA has published a TSCA PCB spill cleanup policy (52 *FR* 10688) which recommends cleanup standards for PCBs of 25–50 ppm for sites with restricted access; a 10-ppm cleanup level is recommended for residential and unrestricted access rural areas. In this latter case, a 10-in. cap of clean soil must cover the site. In the EPA guidance report for remedial actions at Superfund sites containing PCBs, preliminary remediation goals are set at 1 ppm for residential land use (a risk of 10^{-5}) and between 10 and 25 ppm for industrial and/or remote areas (a risk of 10^{-4}) (EPA 1990). Alternatives should reduce concentrations to these levels, or limit exposures. EPA also presents an approach to deriving cleanup levels of PCBs in sediments (EPA 1990). This approach results in a "sediment quality criteria" as a function of organic carbon concentrations, and is meant to protect wildlife consumers of freshwater benthic species. These values are considered TBC guidance, not ARARs.

In the absence of federally or state-promulgated ARARs, or in the case where ARARs are not adequately protective, EPA states a preference for RfDs or reference concentrations (RfCs) for systemic toxicants, and CSFs for carcinogens or Office of Drinking Water (ODW) Health Advisories (HAs) (EPA 1988) for drinking water contaminants. The RfDs, RfCs, and CSFs are available through *IRIS* (EPA 1991a) and the EPA *Health Effects Assessment Summary Tables* (EPA 1991b).

The EPA ODW has developed nonregulatory drinking water HAs for concentrations of noncarcinogenic contaminants in drinking water at which no adverse health effects would be expected to occur. One-day, ten-day, and longer-term (several months to several years) HAs for a child weighing 10 kg are available. These advisories have been developed as guidance values for short-term exposure situations such as spills or accidents and are not intended for use in estimating acceptable lifetime intakes (50 *FR* 46936). Longer-term and lifetime advisory levels for a 70-kg adult are also provided by the ODW.

EPA uses the lifetime HA (for noncarcinogens only) to develop MCLs and MCLGs; HAs will most likely represent future MCL proposals. However, these values assume that 20% of a person's exposure to a compound is via the drinking water pathway. Therefore, if site-specific information indicates that there are no other sources of exposure to a particular compound, the lifetime HA may be increased by a factor of 5. This will be considered as site-specific exposure pathways are developed. The EPA ODW has also determined the concentration of specific carcinogens in drinking water that will result in one excess cancer in one million people (a risk of 10^{-6}) following a lifetime exposure.

3. RADIATION PROTECTION STANDARDS

Very few applicable standards are available for the cleanup of radioactively contaminated CERCLA sites. The Atomic Energy Act of 1954 (AEA) and its amendments delegated authority for control of nuclear energy to DOE, the U.S. Nuclear Regulatory Commission (NRC), and EPA. In addition, certain states have regulatory authority and programs for radioactive waste. EPA's regulations are derived from several other statutes as well and cover many types of activities and all types of radioactive materials, including naturally occurring and accelerator-produced radioactive material (NARM). The NRC licenses the possession and use of various types of radioactive materials at certain types of facilities. Tennessee is an NRC-Agreement state and, as such, has its own authority and licensing regulations. In addition, Tennessee enforces NARM standards.

DOE is authorized to control all types of nuclear materials at sites under its jurisdiction and is exempt from the NRC licensing and regulatory requirements. Therefore, NRC regulations are not generally considered to be ARARs for CERCLA cleanup at DOE facilities. The DOE regulations for handling and cleanup of radioactive materials are outlined in a series of internal DOE Orders that are legally binding to DOE contractors but are not considered by EPA to be ARARs. The DOE Orders, however, are functionally equivalent to the NRC requirements and include all "appropriate" requirements from the NRC regulations. For the purposes of the development of ARARs, DOE Orders will be treated as TBC guidance rather than the NRC regulations. Sections of the NRC regulations may supply ARARs or TBC guidance in situations where the DOE Orders do not adequately address a specific situation at a site. Therefore, a brief summary of the general content of NRC regulations will be presented here.

Since a complete characterization of the source and identity of radioactive waste at ORR has not been completed, all of the available EPA regulations will be presented here. The proper definition of "mixed low-level radioactive and hazardous waste" has caused considerable debate with regard to dual jurisdiction by EPA and NRC. However, EPA has published a clarification of the problem (53 *FR* 37045, September 23, 1988), as did DOE previously [52 *FR* 15937, May 1, 1987, and DOE Order 5400.3 (*Hazardous and Radioactive Mixed Waste Program*, dated February 22, 1989)]. In effect, mixed wastes are those containing a RCRA hazardous waste as defined in 40 *CFR* 261 and a radioactive waste subject to the AEA. RCRA regulations apply to the hazardous component of the waste, and AEA regulations apply to the radioactive component. When the application of both standards is conflicting or inconsistent, RCRA yields to the AEA. Tennessee received final authorization to regulate radioactive mixed waste on July 3, 1986 (53 *FR* 37045, September 23, 1988); however, the state has not implemented any regulations or guidance related to the handling of mixed waste (West 1991).

On May 26, 1992, EPA published a notice in the *Federal Register* (57 *FR* 22024) proposing to find that DOE has made all but one of the demonstrations required in its application, under RCRA rules in 40 *CFR* 268.5, for a 1-year, case-by-case extension of the May 8, 1992, effective date of the LDR applicable to certain mixed wastes generated or stored at the Oak Ridge K-25 Site (K-25), the Oak Ridge Y-12 Plant (Y-12), and Oak Ridge National Laboratory (ORNL), as well as 28 other DOE facilities. Comments were due back to EPA by July 27, 1992, and no official final action has been taken on this proposal. In June

1992, EPA and DOE signed a Federal Facilities Compliance Agreement (FFCA) to bring mixed waste generation and storage facilities on the reservation into compliance with environmental law (hereafter called the mixed-waste FFCA). Under the agreement, effective immediately, the DOE Oak Ridge Operations Office will submit plans that will include treatment and storage options for LDR-mixed wastes to meet the requirements of RCRA. The plans, to be prepared by DOE, will include proposals for waste minimization, treatment studies, technology development, facility construction, and schedules for future treatment. The mixed-waste FFCA allows DOE ORR facilities to continue to generate and store mixed wastes while addressing LDR mixed waste compliance issues. The mixed wastes covered under the mixed-waste FFCA include flammable and corrosive liquids, solvents, paint waste, waste oils and organics, and solid mixed wastes.

In addition, the FFCA of 1992 (Public Law 102-386, October 6, 1992) amends §6001 of RCRA to waive immunity of the United States with respect to substantive and procedural requirements regarding control, abatement, or management of solid or hazardous waste. This waiver of immunity includes injunctive relief, administrative order, or civil or administrative penalties or fines and subjects the federal government to the full range of available enforcement tools to penalize isolated, intermittent, or continuing violations. A delayed effective date of 3 years from enactment of the FFCA of 1992 is applied to the waiver of sovereign immunity for mixed waste regulated under RCRA §3004(j) so long as that waste is managed in accordance with other applicable requirements. Further, DOE is expressly exempt from the 3-year effective date for mixed waste in violation of RCRA §3004(j) so long as DOE has in effect a plan that has been submitted and approved pursuant to RCRA §3021(b), and an order requiring compliance with such a plan has been issued pursuant to RCRA §3021(b).

3.1 EPA REGULATIONS

EPA has promulgated MCLs for radionuclides in community water systems (see Table 5). These MCLs appear in two forms—concentration limits for certain alpha-emitting radionuclides (40 CFR 141.15) and an annual dose limit for the ingestion of certain beta- and gamma-emitting radionuclides (40 *CFR* 141.16). MCLs and MCLGs were proposed for radon and uranium and reproposed for ^{226}Ra and ^{228}Ra and beta and photon emitters on July 18, 1991, and are included in Table 5. Final promulgation of the concentration limits is not expected until December 1993. As with the chemical-specific MCLs, these may be relevant and appropriate for cleanup of contaminated groundwater at ORR. Table 6 lists EPA and DOE radiation protection standards that are described below.

Subpart H of 40 *CFR* 61 addresses atmospheric radionuclide emissions from DOE facilities and may be applicable to airborne emissions during cleanup of ORR. EPA has issued a final NESHAP rule (54 *FR* 51654, December 15, 1989) that limits emissions of radionuclides to the ambient air from DOE facilities to amounts that would not cause any member of the public to receive an effective dose equivalent of 10 mrem/year (40 *CFR* 61.92).

Environmental protection standards for the management, storage, and disposal of spent nuclear fuel, high-level wastes, and transuranic wastes are found in 40 *CFR* 191. Management and storage shall be conducted so as to provide a reasonable assurance that no member of the public in the general environment shall receive a combined annual equivalent

Table 5. Radionuclide-specific ARARs for groundwater and surface water contamination at the Oak Ridge Reservation

Radionuclide	Current SDWA MCLs[a]	Proposed SDWA MCLs[b]
Radium,[c] pCi/L	5	20
Gross alpha,[d] pCi/L	15	15
Gross beta, mrem/year	4	4
Strontium-90, pCi/L[e]	8	42
Tritium, pCi/L[e]	20,000	60,900
Natural uranium, μg/L[f]		20
Radon-222, pCi/L		300
All other manmade radionuclides, mrem/year[g]	4	4

[a]SDWA MCL = Safe Drinking Water Act maximum contaminant level.
[b]Proposed rule, July 18, 1991 (56 *FR* 33050); final rule delayed until 1994.
[c]The present MCL applies to combined ^{226}Ra and ^{228}Ra; the proposed MCL applies to each separately.
[d]The present MCL excludes radon and uranium but includes ^{226}Ra; the proposed MCL excludes all three radionuclides.
[e]These values are not MCLs; they are concentrations that result in the effective dose equivalent of 4 mrem/year, the MCL for gross beta emissions.
[f]Approximately equal to 30 pCi/L.
[g]If two or more radionuclides are present, the sum of their annual dose equivalent to the total body or to any organ shall not exceed 4 mrem/year.

of greater than 25 mrem to the whole body and 75 mrem to any organ (40 *CFR* 191.03). The standards for disposal systems, originally listed in Subparts A and B of 40 *CFR* 191, were vacated by a federal appeals court decision in 1987; however, Subpart A was reinstated. The Waste Isolation Pilot Plant Land Withdrawal Act (WIPP LWA) was enacted on October 30, 1992 (Public Law 102-579); this act reinstated the Subpart B disposal standards except for the specific parts remanded by the court decision (§191.15 and §191.16). The WIPP LWA required EPA to issue final disposal standards by April 30, 1993. Accordingly, EPA proposed new environmental radiation protection standards for §191.15 as well as a new Subpart C to address groundwater protection requirements (58 *FR* 7924, February 10, 1993). The original §191.04, which has been reinstated, established alternative standards for DOE facilities if EPA determines that such standards prevent any member of the public from receiving a continuous exposure of more than 100 mrem/year effective dose equivalent or an infrequent exposure of more than 500 mrem/year effective dose equivalent from all sources, excluding natural background and medical exposures.

Proposed §191.15 requires that "disposal systems for waste and any associated radioactive material shall be designed so that, for 10,000 years after disposal, undisturbed performance of the disposal system shall not cause the annual committed effective dose, received through all potential pathways from the disposal system, to any member of the public in the accessible

Table 6. Radiation protection standards that may be ARAR for the Oak Ridge Reservation

Regulation	Applicability	Exposure conditions	Standard
40 *CFR* 61	National Emission Standards for Hazardous Air Pollutants for DOE facilities	Public exposure, airborne emissions	10 mrem/year
40 *CFR* 141	Drinking water maximum contaminant levels	Community water systems, gross beta	4 mrem/year
40 *CFR* 191	Spent nuclear fuel, high-level and transuranic wastes	Public exposure, all sources	25 mrem/year (total body); 75 mrem/year (thyroid)
40 *CFR* 192	Uranium and mill tailings	Radium-226	5 pCi/g over background in the first 15 cm; 15 pCi/g below the top 15 cm
DOE Order 5400.5[a]	Radiation Protection of the Public and the Environment	Public exposure, all sources	100 mrem/year
		Temporary exemption, maximum limit	500 mrem/year
		Aquatic organism exposure, absorbed dose	1 rad/d
		Radium-226, radium-228, thorium-230, thorium-232	5 pCi/g over background in the first 15 cm; 15 pCi/g below the top 15 cm
DOE Order 5820.2A	Radioactive Waste Management	Public exposure, all sources, excluding air	25 mrem/year
		Public exposure, atmospheric releases	10 mrem/year
DOE Order 5480.11[b]	Radiation Protection for Occupational Workers	Worker exposure limits, continuous exposure	5 rem/year, cancer effects; 50 rem/year, noncancer effects, any organ or tissue
		Public exposures, controlled areas, effective dose equivalent	100 mrem/year

[a]Proposed for codification at 10 *CFR* 834 (58 *FR* 16268, March 25, 1993); final rule expected March 1994.
[b]Proposed for codification at 10 *CFR* 835 (56 *FR* 64334, December 9, 1991); final rule expected July 1993.

environment, to exceed 15 mrem." The proposed §191.24 ("Subpart C—Environmental Standards for Groundwater Protection") states that "disposal systems for waste and any associated radioactive material shall be designed so that 10,000 years of undisturbed performance after disposal shall not cause the levels of radioactivity in any underground source of drinking water, in the accessible environment, to exceed the limits specified in 40 *CFR* 141." Because of the many inherent problems with compliance assessments performed for such large time periods, EPA intends to develop criteria for certifying compliance with the 40 *CFR* 191 standards (58 *FR* 8029, February 11, 1993). The WIPP LWA requires that EPA issue proposed criteria by October 30, 1993, with final criteria by October 30, 1994.

The provisions of the Uranium Mill Tailings Radiation Control Act (40 *CFR* 192) are designed to regulate the stabilization, disposal, and control of uranium and thorium mill tailings. However, these regulations may be relevant and appropriate to cleanup of contaminated sites at ORR if they contain materials similar to tailings (i.e., radium components of copper, zinc, aluminum and other ore-processing residues, contaminated soil, or any other waste containing more than 5 pCi/g of ^{226}Ra). Final groundwater protection standards for inactive uranium tailing sites are delayed pending review by the Office of Management and Budget and the NRC (Houlberg et al. 1993).

EPA intends to develop environmental radiation protection standards for the disposal of low-level waste (LLW) (possibly including NARM) under 40 *CFR* 193 and 764. The intent of these standards will be to protect the public health and general environment from potential adverse effects from LLW disposal. These proposed regulations may provide TBC guidance for cleanup of ORR and, when promulgated, will be considered as ARARs (see Table 5). This proposed rule is expected by December 1993; final rule is expected December 1994 (Houlberg et al. 1993).

In addition, EPA is developing public health and environmental radiation protection criteria for cleanup of residual radioactive materials at decommissioned DOE, Department of Defense, and NRC-licensed sites, as well as others. These criteria may provide useful TBC guidance for remedial response at ORR. A proposed rule is expected in May 1994 (Houlberg et al. 1993).

3.2 NRC REGULATIONS

As mentioned previously, DOE is not regulated by the NRC; however, NRC technical requirements for land disposal facilities might be relevant and appropriate or provide some TBC guidance for the cleanup of radioactive wastes in instances where the NRC standards are more stringent than those found in the DOE Orders. Thus, the regulations of 10 *CFR* 61 (*Licensing Requirements for Land Disposal of Radioactive Waste*), Subpart D, are briefly discussed here. Part 61 contains procedural requirements and performance standards applicable to any method of land disposal, with specific technical requirements for near-surface disposal of radioactive waste. Section 61.52 gives requirements for land disposal facility operation and disposal site closure. Packaging requirements include minimizing and filling void spaces during packaging and maintaining package integrity during emplacement, with filling of void spaces between packages to reduce future subsidence within the fill. Site-specific circumstances must be addressed with regard to the requirements of the DOE Orders to determine if there are any more stringent requirements contained in 10 *CFR* 61.

3.3 DOE ORDERS

DOE Orders are not promulgated regulations and thus are not considered to be ARARs by EPA. They are, however, binding between DOE and Martin Marietta Energy Systems, Inc., because of contractual agreements. The radiation exposure limits for the general public defined in DOE Order 5400.5 ("Radiation Protection of the Public and the Environment," February 8, 1990) are an effective dose equivalent to 100 mrem/year from all exposure pathways and all DOE sources of radiation and a dose of <500 mrem/year as a temporary maximum exemption under specially permitted and DOE-approved circumstances (see Table 6). In addition, effluent releases to surface water must not result in exposures to aquatic organisms exceeding an absorbed dose of 1 rad/d. The overriding principle of the DOE Order is that all releases of radioactive material shall be as low as reasonably achievable (ALARA). Table 7 summarizes the contents of DOE Order 5400.5 with regard to remedial actions.

Supplemental limits and exceptions may be established for a site as described in Chap. IV.7. An exception may be made in instances where residual radioactive material is inaccessible, such as under hard-surfaced public roads and sidewalks, around public sewer lines, or in fence post foundations.

DOE Order 5400.5 lists derived concentration guides (DCGs) for radionuclide isotopes, which are based on a committed effective dose equivalent to 100 mrem/year for ingestion of air or water. For liquid wastes containing radionuclides, which are discharged to surface waters, the best available technology (BAT) must be used if the receiving water, at the point of discharge, would receive radioactive material at a concentration greater than the DCG. Guidelines for selecting the BAT are given. Implementation of the BAT process is not required if annual releases to surface water are below the DCG. In the case of releases of multiple radionuclides, the sum of the fractional DCGs must not exceed unity. In addition, effluent releases to surface water must not result in exposures to aquatic organisms that exceed an absorbed dose of 1 rad/d.

DOE Order 5400.5, Chap. IV, presents guidelines for cleanup of residual radioactive material and management of sites with residual radioactivity above the specified guidelines. The basic dose limits and guidelines for residual radioactivity are listed in Table 7. Also listed are criteria for interim storage and interim and long-term management of properties where residual radioactivity is left in place above the guidelines. Information on the application of the guidelines and requirements presented in the order, including procedures for deriving specific property guidelines for allowable levels of residual radioactive material from basic dose limits, is contained in DOE/CH/8901, *A Manual for Implementing Residual Radioactive Material Guidelines*, issued in June 1989 as a supplement to DOE guidelines for residual radioactive material at FUSRAP and SFMP sites [as referenced in DOE Order 5400.5(IV.2)]. In these situations, administrative controls with an effective life of 25 years are required for interim management. Control and stabilization features for long-term management of areas containing uranium, thorium, and their decay products above the guidelines must be designed to provide, to the extent reasonably achievable, an effective life of 1000 years, with a minimum life of at least 200 years. Administrative and physical controls to limit access to these properties should be effective for at least 200 years.

Table 7. DOE Order 5400.5, "Radiation Protection of the Public and the Environment"

Action	Requirement	Chapter
Planning and performance of all DOE activities	DOE will carry out all DOE activities to ensure that radiation doses to individuals will be as low as reasonably achievable (ALARA)	I.4
Routine DOE activities including remedial action	DOE must comply with all legally applicable requirements of 40 CFR 61 (NESHAPs[a] for DOE Facilities) and 40 CFR 191 (Spent Nuclear Fuel, High-level, and Transuranic Wastes)	I
	Exposures to members of the public from all radiation sources shall not cause an effective dose equivalent to be greater than 100 mrem (1 mSv) per year	II.1a
	Exposures to members of the public from all radiation sources released into the atmosphere shall not cause an effective dose equivalent to be greater than 10 mrem (0.1 mSv) per year	II.1b
Management and storage of spent nuclear fuel, high-level or transuranic waste at a disposal facility that is not regulated by the NRC[b]	Members of the public shall not receive an effective dose equivalent greater than 25 mrem (0.25 mSv) to the whole body or 75 mrem (0.75 mSv) to a single organ per year	II.1c
	Radioactive materials released into public drinking water supplies shall not cause an effective dose equivalent to be greater than 4 mrem (0.4 mSv) to an individual per year. Gross alpha activity shall not exceed 1.5×10^{-8} μCi/mL	II.1d
	Liquid effluents shall not cause private or public drinking water systems downstream of the facility to exceed the MCL(s) of 40 CFR 141	II.1d(3)
Discharge of liquid waste containing radionuclides to surface water	Implementation of best available technology (BAT) treatment required if discharge is at an annual average concentration greater than the derived concentration guide (DCG) level	II.3a(1)
	Discharge of liquid waste containing radionuclides to surface water at an annual average concentration less than the DCG level does not require the implementation of BAT treatment	II.3a(2)

Table 7 (continued)

Action	Requirement	Chapter
Discharge of liquid waste containing radionuclides to surface water (continued)	The absorbed dose to native aquatic animal organisms shall not exceed 1 rad/d from exposure to liquid wastes discharged to natural waterways	II.3a(5)
	Liquid wastes containing concentrations of radioactive materials greater than 5 times the DCG(s) may be discharged to a federal sanitary sewerage system which provides liquid waste treatment prior to discharge to surface water according to II.3a(1). ALARA process considerations are required	II.3d(3)
	If a waste stream contains multiple radionuclides, then the DCG shall be the sum of the fractional DCG values	II.3a(3)
Management of low-level radioactive solid waste	Design, operational, and monitoring requirements are found in DOE Order 5820.2A (Radioactive Waste Management)	II.4
Demonstration of compliance with the dose limits	DOE shall make appropriate documentation containing information about compliance with dose limits for members of the public in the immediate vicinity and within 80 km of the site	II.6
Conduct of radiological environmental protection programs	DCG(s) for water ingestion, air inhalation, and immersion in a gaseous cloud are provided as reference values. These DCG(s) are based on a committed effective dose equivalent of 100 mrem for the radionuclide taken into the body by ingestion or inhalation during one year	III.2
	The DCG values apply to only one mode of exposure (i.e., either ingestion *-or-* inhalation)	III.2a
	For known mixtures of radionuclides the sum of the ratios of the observed concentration of each radionuclides to its corresponding DCG must not exceed 1.0	III.2c

Table 7 (continued)

Action	Requirement	Chapter
Cleanup of residual radioactive material and management of resulting wastes or residues	DOE facilities shall develop plans and protocols for the implementation of this guidance	IV.1 & 2
	These guidelines are for levels of residual radioactive material that is acceptable for public use of property without restrictions because of residual radioactive material	IV.2c
	Generic guidelines are taken from existing radiation protection standards	IV.2c(1)
	Authorized limits are levels of residual radioactive material that shall not be exceeded if the remedial action is to be considered completed and the property is to be released without restrictions on use	IV.2d
	Monitoring, cleanup, and control of residual radioactive material are subject to the ALARA policy	IV.2e
	The basic dose limits for exposure to residual radioactive material is 100 mrem (1 mSv) annually	IV.3a
	Under unusual circumstances, the dose limit for exposure to residual radioactive material is increased from 100 mrem (1 mSv) to 500 mrem (5 mSv) annually	IV.3b
	Residual radioactive material in soil are those concentrations in excess of background concentrations averaged over an area of 100 m^2. These derivations are obtained by means of environmental pathway analysis and basic dose limits	IV.4a
	Generic surface contamination guidelines are given which are applicable to interior equipment and building components that are potentially salvageable or recoverable scrap	IV.4d
	Residual concentrations of radionuclides in the air and water shall not exceed 100 mrem (1 mSv) per year	IV.4e

Table 7 (continued)

Action	Requirement	Chapter
Cleanup of residual radioactive material and management of resulting wastes or residues (continued)	Limits for hot spots shall be developed in cases where the average concentration in any surface or below surface area equal to or less than 25 m^2 exceeds the limit or guidelines by a factor of $(100/A)^{0.5}$. Reasonable effort must be made to remove any radionuclide source that exceeds 30 times the limit	IV.4a(1)
	The generic guidelines for ^{226}Ra, ^{228}Ra, ^{230}Th, and ^{232}Th are 5 pCi/g averaged over the first 15 cm of soil or 15 pCi/g averaged over 15-cm-thick layers of soil below the first 15 cm	IV.4a(2)
Management of residual radioactivity above the guidelines specified in IV.1-4		
Interim storage	Interim storage control and stabilization features shall be planned to have a minimum life of 25 years and, if reasonably achievable, an effective life of 50 years	IV.6b(1)
	Control features must be designed so that radionuclide concentration in the groundwater shall not exceed applicable federal and state standards	IV.6b(3)
	Access to property and use of onsite material contaminated with residual radioactive material should be controlled through appropriate administrative and physical controls; these control features should be designed to provide, to the extent reasonable, an effective life of at least 25 years	
Interim management	If residual radioactive material is in inaccessible locations and would be unreasonably costly to remove and when residual radioactive material exceeds guideline values, an interim management plan may be arranged to maintain the property	IV.6c(1)

Table 7 (continued)

Action	Requirement	Chapter
Management of residual radioactivity above the guidelines specified in IV.1-4 (continued)	Administrative controls shall include (but are not limited to): - periodic monitoring as appropriate - appropriate shielding - physical barriers to prevent access - appropriate radiological safety measures	IV.6c(2)
Long-term management	Control and stabilization for uranium, thorium, and their decay products must be designed to last at a minimum of 200 years and, if reasonably achievable, have an effective life of 1000 years	IV.6d(1)(a)
	In accordance with legally applicable federal and state standards, DOE facilities shall protect groundwater	IV.6d(1)(d)
	Use of and access to residual radioactive material shall be controlled through appropriate administrative and physical controls	IV.6d(1)(e)
	Long-term management of other radionuclides shall be controlled by applicable requirements in Chapters II, III, and IV of DOE 5820.2A	IV.6d(2)

[a]NESHAPs = National Emission Standards for Hazardous Air Pollutants.
[b]NRC = Nuclear Regulatory Commission.

DOE has proposed these radiation protection standards for the public and the environment for codification at 10 *CFR* 834 (58 *FR* 16268, March 25, 1993). When final, these standards will be legally applicable for cleanup at DOE sites.

DOE Order 5820.2A ("Radioactive Waste Management," September 9, 1988) states that the management of low-level radioactive waste must ensure that external exposure to the waste and concentrations of radioactive material that may be released into surface water and soil does not exceed 25 mrem/year to any member of the public. Releases to the atmosphere shall not exceed 10 mrem/year (Table 6). Reasonable effort should be made to maintain releases to the environment to ALARA levels. The order pertains to the management of radioactive waste and contains closure and postclosure care requirements. Table 8 summarizes the substantive requirements of this order.

DOE plans to revise DOE Order 5820.2A in order to consolidate all waste management requirements for the Office of Environmental Restoration and Waste Management (EM). Revisions are expected to be complete by 1994 and will cover all categories of wastes, including radioactive, hazardous, and sanitary waste (RDPW 1992).

DOE Order 5480.11 ("Radiation Protection for Occupational Workers") contains guidelines for worker protection from both internal and external sources for continuous exposures; that is, 5 rem/year and 50 rem/year annual effective dose equivalent for stochastic (cancer) and nonstochastic (systemic) effects, respectively. Also included in the order are standards for the general public when entering a controlled area. Exposures to the public are limited to an effective dose equivalent of 100 mrem/year (Table 6). As with the other DOE Orders, the ALARA principle prevails. Remediation of radionuclide-contaminated soils must ensure that exposures to on-site workers or public intruders will not exceed these standards. DOE has proposed for codification in 10 *CFR* 835 the primary standards for radiation protection of occupational workers from normal operation of DOE facilities (56 *FR* 64334, December 9, 1991). A final rule is expected July 1993; when promulgated, these standards will then be legally applicable for CERCLA cleanup at DOE sites.

3.4 TBC GUIDANCE FOR RADIOLOGICAL RISK ASSESSMENT

The EPA Office of Radiation Programs has derived slope and unit risk factors for radionuclides of concern at remedial sites for each of three major exposure pathways (inhalation, ingestion, and external exposure to contaminated soil). These are available in the EPA *Health Effects Assessment Summary Tables* (EPA 1991b).

Table 8. DOE Order 5820.2A, "Radioactive Waste Management"

Action	Requirement	Chapter
Management of low-level radioactive waste	Development of site-specific comprehensive closure plans shall address – Disposal site closure after the site has been filled for 5 years and – National Environmental Policy Act (NEPA) requirements	III.3j(1)
	Residual radioactivity levels for surface soil will comply with DOE decommissioning guidelines (DOE Order 5400.5)	III.3j(2)
	The Oak Ridge Reservation must correct problems that could jeopardize the attainment of this order's performance objectives	III.3j(3)
	All disposal sites and units shall be maintained to conform with RCRA,[a] CERCLA,[b] and SARA[c] standards	III.3j(4)
	An appropriate field organization shall review and approve any closure plans for new and existing low-level waste disposal sites	III.3j(5)
	An analysis of site performance will be the basis for terminating the monitoring and maintenance activity at closed facilities or sites at the end of the institutional control period	III.3j(6)
Management of buried transuranic waste	All disposal sites and units shall be maintained to conform with CERCLA and SARA standards	II.1
	Transuranic waste shall be managed to protect the health and safety of the public and the workers at the site	II.2
	Each DOE facility will develop a site closure plan which will include – NEPA requirements – Applicable federal, state, and local regulations – Permits required – Selected closure strategy and justification – Postclosure monitoring and control	II.3i(4)

[a]RCRA = Resource Conservation and Recovery Act.
[b]CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act.
[c]SARA = Superfund Amendments and Reauthorization Act.

4. LOCATION-SPECIFIC ARARs

Location-specific requirements "set restrictions upon the concentration of hazardous substances or the conduct of activities solely because they are in special locations" (53 *FR* 51394). In determining the use of location-specific ARARs for selection of remedial actions at CERCLA sites, one must investigate the jurisdictional prerequisites of each of the regulations. Basic definitions, exemptions, etc., should be analyzed on a site-specific basis to confirm the correct application of the requirements.

Table 9 lists the major federal and state location-specific ARARs that might be pertinent to remedial actions at ORR. Much of the information regarding characteristics of ORR was provided by ORNL, K-25, Y-12, and state environmental staff.

4.1 CAVES, SALT-DOME FORMATIONS, SALT-BED FORMATIONS, AND UNDERGROUND MINES

ORR, located in the Valley and Ridge Physiographic Province of eastern Tennessee, is characterized by gently to moderately sloping ridges and valleys (Rogers et al. 1989). A variety of geologic formations of sedimentary origin underlie ORR. The most important formations are the Rome Formation and the Conasauga, Knox, and Chicamauga groups. The bedrock consists of highly faulted and folded sedimentary units with ridges underlain by limestones, siltstones, sandstones, and solostones. Shales and carbonate formations underlie the valleys (Energy Systems 1990). Both the Y-12 and K-25 sites have areas underlain by the Knox Group limestones, which are subject to cave formation and sinkhole development and trends of groundwater movement that could cause problems for site modifications (Lee 1991). There are no indications of salt-dome formations, salt-bed formations, or underground mines on or near the ORNL, K-25, or Y-12 sites (Lee 1991). However, there is evidence of sinkholes above the ridge near the K-25 K-1070-A contaminated burial ground (Lee 1991).

If any caves are located in areas where remedial activities may occur, the regulations found in RCRA [40 *CFR* 264.18(c)], which prohibit the placement of noncontainerized or bulk liquid hazardous waste in caves, might be ARAR (Table 9).

4.2 FAULTS

The White Oak Mountain and Copper Creek thrust faults transect ORR (Ketelle 1991). These faults extend from the surface to the geologic basement at ~426 m. The White Oak Mountain Fault, a complex branching fault, lies southeast of K-25 with a branch extending across the eastern part of the plant (Ketelle 1991). The Copper Creek Fault is a single fault that transects the ORNL reservation. ORNL is located ~1.5 km southeast of the southeast dip of the Copper Creek Thrust (Davis et al. 1984). Although no faults occur directly in the Bear Creek Valley near Y-12, the White Oak Mountain Fault has induced some minor folding and major jointing and fracturing of the bedrock near the site (Ketelle 1991). Minor seismic activity has been recorded in the region, but no surface rupturing associated with any of the faults within ORR has been recorded (Chance 1986). The faults on ORR are ancient (pre-Holocene) and are stable (Ketelle 1991). The possibility of fault movement is considered extremely unlikely (Chance 1986).

Table 9. Tentative location-specific ARARs for the Oak Ridge Reservation

Location characteristic(s)	Requirement(s)	Operating condition(s)	Citation(s)
Faults			
With displacement in Holocene time	Portions of new facilities must not be within 61 meters (200 ft) of such fault.	New treatment, storage or disposal facility RCRA[a]-defined listed or characteristic hazardous waste (40 *CFR* 261) *-or-* RCRA-permitted facility	40 *CFR* 264.18(a)
Salt-dome formations, salt-bed formations, underground mines or caves	Placement of noncontainerized or bulk liquid hazardous waste in these locations is prohibited.	RCRA-defined listed or characteristic hazardous waste (40 *CFR* 261) *-or-* RCRA-permitted facility	40 *CFR* 264.18(c)
Wetlands			
Presence of wetlands as defined in Executive Order 11990 §7(c) and 40 *CFR* 6, Appendix A §4(j)	Whenever possible, actions must avoid or minimize adverse impacts on wetlands and act to preserve and enhance their natural and beneficial values. New construction in wetlands areas should be particularly avoided unless there are no practicable alternatives. Wetlands protection considerations shall be incorporated into planning, regulating, and decision-making processes.	Agency action which involves: - acquiring, managing, and disposing of lands and facilities - providing federally undertaken, financed, or assisted construction and improvements - conducting federal activities and programs affecting land use	Executive Order 11990 40 *CFR* 6.302(a) 40 *CFR* 6, Appendix A 10 *CFR* 1022
Presence of wetlands as defined in 40 *CFR* 230.3(t) and 33 *CFR* 328.3(b)	Action to avoid degradation or destruction of wetlands must be taken to the extent possible. Discharges for which there is a practicable alternative with less adverse impacts or those which would cause or contribute to significant degradation are prohibited. If adverse impacts are unavoidable, action must be taken to enhance, restore, or create alternative wetlands.	Action involving discharge of dredge or fill material into wetlands	Clean Water Act §404 40 *CFR* 230 33 *CFR* 323

Table 9 (continued)

Location characteristic(s)	Requirement(s)	Operating condition(s)	Citation(s)
Floodplains			
Within 100-year floodplain	Facility must be designed, constructed, operated, and maintained to prevent washout of any hazardous waste by 100-year flood.	Treatment, storage, or disposal facility RCRA-defined listed or characteristic hazardous waste (40 *CFR* 261) *-or-* RCRA-permitted facility	40 *CFR* 264.18(b)
Within "lowland and relatively flat areas adjoining inland and coastal waters and other floodprone areas such as offshore islands, including at a minimum, that area subject to a one percent or greater chance of flooding in any given year." [Executive Order 11988 §6(c) and 40 *CFR* 6, Appendix A §4(d)]	Action shall be taken to reduce the risk of flood loss, minimize the impact of floods on human safety, health and welfare, and restore and preserve the natural and beneficial values of floodplains. The potential effects of actions in floodplains shall be evaluated and consideration of flood hazards and floodplain management ensured. If action is taken in floodplains, alternatives that avoid adverse effects and incompatible development and minimize potential harms shall be considered.	Action which involves: - acquiring, managing, and disposing of lands and facilities - providing federally undertaken, financed, or assisted construction and improvements - conducting federal activities and programs affecting land use	Executive Order (EO) 11988 40 *CFR* 6.302(b) 40 *CFR* 6 (Appendix A) 10 *CFR* 1022
Aquatic resources			
Within area encompassing or affecting waters of the state of Tennessee as defined in TCA[b] 69-3-103(32) and the presence of wildlife or aquatic life	Discharge of "substances" that "will result or will likely result in harm, potential harm or detriment to the health of animals, birds, fish, or aquatic life" is prohibited.	Action involving the discharge of any pollutants into the waters of the state [see TCA 69-3-103(18) and (21) for noninclusive list]	Tennessee Water Quality Control Act of 1977 (TCA 69-3-101 *et seq.*) Stream Use Classifications (TDEC[c] Rules, Chap. 1200-4-4)
Within an area affecting a stream or river	Must comply with the substantive requirements of the aquatic resource alteration permitting process.	Action involving aquatic resource alterations	TDEC Rules, Chap. 1200-4-7

Table 9 (continued)

Location characteristic(s)	Requirement(s)	Operating condition(s)	Citation(s)
Within area affecting stream or river *-and-* presence of fish or wildlife resources	The effects of water-related projects on fish and wildlife resources must be considered. Action must be taken to prevent, mitigate, or compensate for project-related damages or losses to fish and wildlife resources. Off-site actions that alter a resource require consultation with the FWS,[d] NMFS,[e] and/or appropriate state agency. Consultation is also strongly recommended for on-site actions.	Action which results in the control or structural modification of a natural stream or body of water	Fish and Wildlife Coordination Act (16 USC 661 *et seq.*) 40 *CFR* 6.302(g)
Location encompassing aquatic ecosystem with dependent fish, wildlife, other aquatic life, or habitat	Degradation or destruction of aquatic ecosystems must be avoided to the extent possible. Discharges that cause or contribute to significant degradation of the water of such ecosystems are prohibited.	Action involving the discharge of dredge or fill material into aquatic ecosystem	Clean Water Act §404 40 *CFR* 230 33 *CFR* 323
Location encompassing a state-designated natural area	The scientific, scenic, recreational, and educational values of these areas must be preserved and steps taken to prevent impairment thereof.	Action which is likely to impact or adversely modify designated natural areas	TCA 11-14-101 *et seq.*
Endangered, Threatened, or Rare Species			
Presence of endangered or threatened species *-or-* critical habitat of such species as designated in 50 *CFR* 17, 50 *CFR* 226, or 50 *CFR* 227	Actions that jeopardize species/habitat must be avoided or appropriate mitigation measures taken. Off-site actions that affect species/habitat require consultation with DOI,[f] FWS, NMFS, and/or state agencies, as appropriate, to ensure that proposed actions do not jeopardize the continued existence of the species or adversely modify or destroy critical habitat. Consultation is also strongly recommended for on-site actions.	Action which is likely to jeopardize species or destroy or adversely modify critical habitat	Endangered Species Act of 1973 (16 USC 1531 *et seq.*) 50 *CFR* 402 40 *CFR* 6.302(h) Fish and Wildlife Coordination Act (16 USC 661 *et seq.*)

Table 9 (continued)

Location characteristic(s)	Requirement(s)	Operating condition(s)	Citation(s)
Presence of endangered or threatened species or critical habitat (see above citation) of same within an aquatic ecosystem as defined in 40 *CFR* 230.3(c)	Dredge or fill material shall not be discharged into an aquatic ecosystem if it would jeopardize such species or would likely result in the destruction or adverse modification of a critical habitat of the species.	Action involving discharge of dredge or fill material into aquatic ecosystem	Clean Water Act §404 40 *CFR* 230.10(b)
Presence of Tennessee state-listed endangered or threatened animal species as created and amended pursuant to TCA 70-8-105	Protected species may not be taken, possessed, transported, exported, processed, sold, offered for sale, or shipped. Certain exceptions may be allowed for reasons such as education, science, etc., or where necessary to alleviate property damage or protect human health or safety. These exceptions require a permit if the remedial action or its attendant effects are off site.	Action impacting such species	Tennessee Nongame and Endangered or Threatened Wildlife Species Conservation Act of 1974 (TCA 70-8-101 *et seq.*)
Presence of Tennessee state-listed species "in need of management"	No person may knowingly destroy the habitat of such species.	Action impacting such species	Tennessee Wildlife Resources Commission Proclamation 86-29 (1991)
Archaeologic and Historic Resources			
Presence of archaeological resources on public land	Steps must be taken to protect archaeological resources and sites.	Action which would impact resource	Archaeological Resources Recovery Act of 1979 (16 USC 470aa-ll) 43 *CFR* 7
Presence of archaeologic or historic resources	The Secretary of Interior must be advised of the presence of the data. A survey of affected areas for resources and data must be conducted and steps taken to recover, protect, and preserve data therefrom or request that DOI do so.	Action involving dam construction or other alteration of terrain which might cause irreparable loss or destruction of significant scientific, prehistoric, historic, or archaeologic data	Archaeological and Historic Preservation Act (16 USC 469a-c) 40 *CFR* 6.301

Table 9 (continued)

Location characteristic(s)	Requirement(s)	Operating condition(s)	Citation(s)
Presence of federally owned, administered, or controlled prehistoric or historic resources *-or-* the likelihood of undiscovered resources	Cultural resources included on or eligible for inclusion on the National Register of Historic Places (36 *CFR* 60) or National Historic Landmark Program (36 *CFR* 65) must be identified. Action(s) that will affect such resources must be identified and alternatives to the action(s) examined and considered. When alteration or destruction of the resource is unavoidable, steps must be taken to minimize or mitigate the impacts and to preserve records and data of the resource. When all or part of a remedial action is off site, the consultation requirements of 16 USC 470f must be completed. Consultation is also strongly recommended for on-site actions.	Action which will impact such resources	National Historic Preservation Act (16 USC 470a-w) Executive Order 11593 40 *CFR* 6.301 36 *CFR* 800
Cemetery located on property within Tennessee	Destruction or degradation of property in a graveyard or cemetery is prohibited.	Action which would alter or destroy property in a cemetery	Tennessee General Cemetery Act of 1968 (TCA 46-1-101 *et seq.*)

[a]RCRA = Resource Conservation and Recovery Act; definitions appear at 40 *CFR* 260.10.
[b]TCA = Tennessee Code Annotated.
[c]TDEC = Tennessee Department of Environment and Conservation.
[d]FWS = Fish and Wildlife Service.
[e]NMFS = National Marine Fisheries Service.
[f]DOI = Department of Interior.

The DOE ORR is exempted from compliance with the RCRA seismic requirements of 40 *CFR* 264.18 since 40 *CFR* 264.18(a) stipulates that all facilities that are located within political jurisdictions other than those listed in Appendix VI are assumed to be in compliance for location of new TSD. Tennessee is not listed in the appendix. However, EPA intends to propose additional seismic restrictions for location of TSD facilities (NPRM, February 1994; final rule, February 1995), and these restrictions will be incorporated into the TDEC Hazardous Waste Management regulations (Hinch 1989). At that time, the TDEC seismic regulations may be ARARs for remedial actions at ORR.

4.3 WETLANDS AND FLOODPLAINS

ORR is located within the Clinch River drainage basin and is bounded on the south and west by the Clinch River. Each of the three DOE facilities is located in a different sub-basin of the Clinch River. Gullies as well as seasonal and permanent streams drain into White Oak Creek (ORNL), Bear Creek (Y-12) East Fork Poplar Creek (Y-12) Poplar Creek (K-25) and the Clinch River (K-25). Creek flow is interrupted by settling basins and/or retention ponds. The latter includes White Oak Lake at ORNL and Lake Reality at Y-12; K-25 also has holding ponds. Portions of ORNL, K-25, and Y-12 are located within 100- and 500-year floodplains. Many wetland areas occur on the ORR.

If any remedial alternatives are selected that would impact floodplains, the requirements found in EO 11988, 40 *CFR* 264.18(b), 40 *CFR* 6.302(b), 40 *CFR* 6 (Appendix A), and 10 *CFR* 1022 would provide ARARs for ORR. If wetlands are affected, consideration should be given to EO 11990, 40 *CFR* 6.302(a), 40 *CFR* 6 (Appendix A), 10 *CFR* 1022, the CWA §404, and 40 *CFR* 230 for applicable requirements (see Table 9). In addition, EPA intends to propose additional floodplain restrictions for the location of TSD facilities (NPRM, February 1994; final rule, February 1995), and these restrictions will be incorporated into the TDEC Hazardous Waste Management regulations (Hinch 1989). At that time, the TDEC floodplain regulations may be ARARs for remedial actions at ORR.

4.4 AQUATIC RESOURCES

There are no known designated wilderness areas, wildlife refuges, or scenic rivers on ORR or within range of the reservation such that remedial action would likely impact these resources. However, a variety of wooded and open areas, as well as extensive edge communities, create favorable habitat for a wide variety of mammalian, fish, and avian species (DOE 1980, Kitchings and Story 1984). There are a number of aquatic habitats on the reservation, and many of these species are, or may be, associated with the water resources on ORR (Loar 1984). Therefore, if any remedial actions result in the control or structural modification of a natural stream or water body, the provisions found in the Fish and Wildlife Coordination Act [16 U.S. Code (USC) 661 *et seq.*] and 40 *CFR* 6.302(g) may be applicable. If any action involves the discharge of dredge or fill material into an aquatic system, the CWA §404 and 40 *CFR* 230 may also be implicated.

As noted, there are a number of water resources on ORR, some natural and some man-made (Loar 1984). Many of these would fall within the definition of "waters of Tennessee" as found in the Tennessee Water Quality Control Act [Tennessee Code Annotated (TCA) 69-3-103(32)]. At ORNL, seasonal streams and tributaries flow into White Oak Creek before

discharge into the Clinch River (Loar 1984). Drainage from Y-12 enters Bear Creek and East Fork Poplar Creek, both of which flow into Poplar Creek. Surface water and the storm-water drainage system at K-25 drain primarily into Poplar Creek shortly before its confluence with the Clinch River. The Clinch River itself forms part of the western and southern boundaries of ORR. Melton Hill Reservoir also forms part of the southern boundary. The Clinch River, Poplar Creek with its various tributaries and forks, and White Oak Creek have all been classified by TDEC for a variety of uses, including fish and aquatic life and wildlife. It is therefore possible that the provisions of the Tennessee Water Quality Control Act (TCA 69-3-101 *et seq.*) would provide ARARs should any remedial actions at ORR cause, or be likely to cause, harm to wildlife or aquatic life in these waters.

Slightly over 5000 acres of ORR have been designated as a DOE National Environmental Research Park (NERP), which also includes Research Areas (RSAs) located both within and outside of the NERP. The NERP was established by DOE to "provide protected land areas for research and education in the environmental sciences and to demonstrate the environmental compatibility of energy technology and use." RSAs are designated when a specific area is being used to collect monitoring, baseline, or effect data and therefore require protection from disturbance. Portions of the NERP come to within at least 2-3 km of K-25, ORNL, and Y-12. There are also RSAs in close vicinity to all three facilities. RSA No. 51, K-1700 stream monitoring, is <0.05 km from K-25. Several RSAs are within this distance from ORNL, including RSA No. 25, carbon monoxide monitoring, and RSA No. 37, biomass demonstration plots. Both RSA No. 27, Bear Creek characterization and monitoring, and RSA No. 28, East Fork Poplar Creek, are in close proximity to Y-12 (Parr and Pounds 1987).

In addition to the NERP and its associated RSAs, DOE has also designated areas on ORR as DOE-NERP Reference Areas (RAs) and DOE-NERP Natural Areas (NAs). RAs are those areas that are "representative of the vegetational communities of the southern Appalachian region or that possess unique biotic features" and are used exclusively for non-manipulative research. These are important for establishing baseline information for long-term observations. The RAs are located in various sites on ORR, with several in close proximity to the reservation facilities. Specifically, RA17, McKinney Ridge hemlocks; RA18, Blackoak Ridge white pines; and RA23, Poplar Creek rookery, are within ~1 km of K-25, while RA14, Fanny Knob white oak area, is within 1 km of Y-12. NAs have been established to protect rare plant and animal species. Like RAs, these are located in various places within the reservation, some within a few kilometers of facilities on ORR. For example, NA1, Campbell Bend bluffs and forest, is located ~1-2 km west of K-25, adjacent to the Clinch River. Eight of the RAs and NAs have also been registered by Tennessee as State Natural Areas (SNAs). Three of these, No. 1, Campbell Bend river bluff, and Nos. 2 and 3, Poplar Creek hemlock bluffs, are located within a few kilometers of K-25 (Parr and Pounds 1987).

Because of the unique purposes and goals in establishing the NERP, the uses and restrictions that apply to these resources should be considered TBC guidance if remedial actions appear likely to impact the designated areas. Guidance regarding the permitted uses and restrictions of the various locations can be obtained from the NERP Project Manager at ORNL. For a general overview, please refer to Volume 23 of *The Resource Management Plan for the Oak Ridge Reservation* (Parr and Pounds 1987). In addition, should areas that are also designated SNAs by the state of Tennessee be affected, the provisions of the Tennessee Natural Areas Preservation Act of 1971 (TCA 11-14-101 *et seq.*) may be applicable.

4.5 RARE, THREATENED, OR ENDANGERED SPECIES

From a compilation of a number of surveys of the rare plants conducted on the reservation, 14 plant species occurring on the ORR are listed as endangered, threatened, or of special concern by the state of Tennessee (Parr 1992). Three of these plants, spreading false-foxglove (*Aureolaria patula*), Appalachian bugbane (*Cimicifuga rubifolia*), and tall larkspur (*Delphinum exaltatum*), are also candidates for federal listing; and three species that were previously candidates, ginseng (*Panax quinquifolius*), purple fringeless orchid (*Platanthera peramoena*), and Carey saxifrage (*Saxifraga careyana*), are no longer being considered for federal listing. In addition, the pink lady-slipper (*Cypripedium acuale*) is listed as endangered in Tennessee because of commercial exploitation.

Ten state-listed species also occur near ORR and may be present on the reservation (Parr 1992). One of these, the earleaf false-foxglove (*Tomanthera auriculata*), is a candidate for federal listing. This species inhabits cedar barrens that are common on ORR and characteristically support prairie species more commonly found in the Midwest. There are also 13 listed species that, although not identified on the reservation to date, occur in east Tennessee in habitat types found on ORR. Since the recent survey was not exhaustive, the site of any proposed remedial activity should first be carefully surveyed for the presence of federal- or state-listed endangered, threatened, or rare species as well as those of special concern. A list of endangered, threatened, and special concern species provided by the state of Tennessee also includes the sedge (*Carex oxylepis var. pubescens*), the mountain witch alder (*Fothergilla major*), the Michigan lily (*Lilium michiganese*), and the southern rein orchid (*Platanthera flava var. flava*) as threatened or special concern species on ORR (Tennessee Wildlife Resources Commission Proclamation 86-30). Information regarding the presence of these species is not available.

In addition to the plants, a number of federal- and state-listed endangered or threatened animal species are known to occur in east Tennessee (Kroodsma 1987; 50 *CFR* 17). However, none of the listed mollusks, fishes, amphibians, or reptiles have been documented to occur on ORR, although suitable habitat may exist on the reservation for the yellowfin madtom (*Noturus flavipinnis*) (Kroodsma 1987). Additionally, suitable habitat exists for the state-listed threatened blue sucker (*Cycleptus elongatus*) in the riverine tailwaters of Melton Hill Reservoir down to upper Watts Bar Lake (Etnier 1990). A more in-depth discussion of these species appears in Volume No. 24 of *The Resource Management Plan of the Oak Ridge Reservation* (Kroodsma 1987). The list of rare and endangered species for the ORR, provided by the state of Tennessee, also includes 24 federal- and state-listed endangered clams (Tennessee Wildlife Resources Commission Proclamation 86-30, 1991); these species are not mentioned in the various data for the reservation and therefore either have not been documented during surveys or no information is available.

Three federal-listed bird species are known to occur in east Tennessee: the bald eagle (*Haliaeetus leucocephalus*), the peregrine falcon (*Falco peregrinus anatum*), and the red-cockaded woodpecker (*Picoides borealis*) (Kroodsma 1987). Although there have been sightings of the bald eagle, and more rarely the peregrine falcon, there are no documented nestings of either species on ORR itself (Kroodsma 1987). Indeed, neither the peregrine falcon nor the red-cockaded woodpecker are likely to nest on the reservation, or use it extensively, without development of suitable habitat (Kroodsma 1987). There may, however, be suitable habitat for bald eagles (Kroodsma 1987). Recently young eagles from northern nests have been introduced into east and central Tennessee (Owen 1991). On May 31, 1991,

the first baby bald eagle in east Tennessee fledged (Owen 1991). It is unknown whether this activity will lead to nesting on ORR in the future.

In addition to the federal-listed species, there are also a number of state-listed endangered bird species documented in the areas surrounding ORR. The osprey (*Pandion haliaetus*) is listed as endangered in Tennessee. Like the bald eagle, this species has been re-introduced in this area (Owen 1991). There are 24 known nests this year on Watts Bar Lake, and two nests have been sighted on Melton Hill Lake (Owen 1991). Bachman's sparrow (*Aimophila aestivalis bachmani*) is also a state-listed endangered species for which there is apparently suitable habitat on ORR (Kroodsma 1987). However, there has not been a breeding pair documented on the reservation since 1975, although two males were spotted in 1982 (Kroodsma 1987).

There are a number of bird species in this region that are listed as threatened by Tennessee. The northern harrier (*Circus cyaneus*) has been spotted flying over the reservation and may be a winter visitor (Kroodsma 1987). There is also apparently suitable habitat for the Cooper's hawk (*Accipiter cooperi*) and the sharp-shinned hawk (*Accipiter striatus*) (Kroodsma 1987). The former has been spotted recently on the reservation, and a sharp-shinned hawk nest was documented in 1989 at the Clinch River Breeder Reactor site ~2 miles southwest of ORNL (Kroodsma 1991). Finally, the grasshopper sparrow (*Ammodramus savannarum*) has been noted during breeding season in the pastures between Y-12 and Bethel Valley Road (Kroodsma 1987).

Turning to mammalian species, the gray bat (*Myotis grisescens*) and the Indiana bat (*Myotis sodalis*) are both federal- and state-listed endangered species that have been reported in east Tennessee. Neither of these species has been documented on ORR, nor have there been any surveys to ascertain their presence (Kroodsma 1987). White Oak Blowhole Cave, located about 10 miles southeast of ORR in Blount County, has been designated as critical habitat for the Indiana bat [50 *CFR* 17.95(a)]. There is some possibility that habitat may exist for this species on ORR and/or that maternity colonies are present (Kroodsma 1987). Additionally, the reservation may have appropriate habitat for another endangered mammal, the eastern cougar (*Felis concolor*) (Kroodsma 1987). However, this species no longer has a known surviving population in Tennessee (Kroodsma 1987). Finally, the river otter (*Lutra canadensis*) is listed as threatened in the state of Tennessee and has occasionally been reported in nearby counties (Kroodsma 1987). However, the species is not documented on the reservation, nor is there likely to be suitable habitat thereon (Kroodsma 1987).

The state of Tennessee has designated ~80 species as "in need of management," and some of those occur in the area including ORR (Tennessee Wildlife Resources Commission Proclamation 86-29). Pursuant to TCA 70-8-104(b), it is unlawful for any person to knowingly destroy the habitat of "wildlife in need of management." Of the species listed in Proclamation 86-29, the Tennessee dace (*Phoxinus tennesseensis*) has been collected in Bear Creek and other small tributaries to East Fork Poplar Creek, as well as in Ish Creek, a tributary to the Clinch River west of ORNL (Ryon 1990, Ryon and Loar 1988). An amphibian, the hellbender (*Cryptobranchus a. alleganiensis*) and the six-lined racerunner (*Cnemidophorus sexlineatus*) have been collected on the reservation (Kline 1989). The hellbender species is also occasionally taken by anglers in Melton Hill Reservoir (Etnier 1990). Also listed are the green salamander (*Aneides aeneus*) and the southeastern shrew (*Sorex longirostris*). Information pertaining to the actual presence of these species on the reservation is not available.

Should any remedial actions at ORR impact any federal-listed endangered or threatened species, the provisions found in the Endangered Species Act of 1973 (16 USC 1531 *et seq.*), 50 *CFR* 492, 40 *CFR* 6.302(h), and the Fish and Wildlife Coordination Act (16 USC 661 *et seq.*) may be implicated as ARARs. Additionally, if the remedial actions involve the discharge of dredge or fill material, the CWA §404 and 40 *CFR* 230.10(b) may be applicable. If any proposed actions impact state-listed endangered or threatened animal species, the Tennessee Non-Game and Endangered or Threatened Wildlife Species Conservation Act of 1974 (TCA 70-8-101 *et seq.*) may provide ARARs. The prohibitions of the Tennessee Rare Plant Protection and Conservation Act of 1985 (TCA 11-26-201 *et seq.*) do not apply to a landowner, lessee, or other person entitled to possession of the land on which the species is located (TCA 11-26-209). This also includes managers in the case of publicly owned land and those with written permission of the landowner or manager (TCA 11-26-209). These exclusions would apparently apply to ORR. However, the purpose of the statute, which is to protect and preserve rare plants, should be considered TBC guidance for any remedial actions on the reservation.

4.6 HISTORIC SITES AND ARCHAEOLOGICAL FINDINGS

The ORR, as well as the surrounding region, is rich in both archaeological and historic resources (Sanders 1984). The east Tennessee region has been inhabited for ~10,000 years. Although there have not been complete and exhaustive archaeological or historical surveys of the reservation, there have been a number of studies over the years, all indicating the presence of abundant resources on and around the reservation. These surveys were summarized in Volume 3 of the *Resource Management Plan for the U. S. Department of Energy Oak Ridge Reservation* (Sanders 1984), which also includes a list and descriptions of most of the documented sites. Since the location and description of all of the various sites is beyond the scope of this report, Volume 3 would be an invaluable source of information. However, none of the surveys are recent, nor have they covered all of the specific sites where remedial action may be planned or contemplated. Several laws require that such information be obtained and documented if there is ample reason to suspect the presence of these resources [Archaeological and Historic Preservation Act (16 USC 469a-c); Archaeological Resources Recovery Act of 1979 (16 USC 470aa-ll)].

The National Register of Historic Places lists a number of sites in the five-county area (Anderson, Knox, Loudon, Morgan, and Roane) surrounding ORR [Department of Interior (DOI) 1991]. Only one site, the Graphite Reactor at ORNL, lies within the boundary of ORR (DOI 1991). Freels Cabin, located near the Scarboro Facility (formerly known as the Comparative Animal Research Laboratory), was just placed on the National Register on May 6, 1992.

In 1977, a historic sites reconnaissance of much of ORR was completed (Fielder et al. 1977). A total of 414 sites were recorded during this reconnaissance, although 215 of these did not actually have any physical remains present (Sanders 1984).

In 1974, an archaeological survey of ORR was conducted by the Department of Anthropology of the University of Tennessee, Knoxville (Fielder 1975). Sites of aboriginal occupation that might be affected by future activities on the reservation were located and evaluated. Reconnaissance and testing were done in several different physiographic zones, including the Clinch River and its larger tributary-stream terraces, the interior valleys, selected

forested ridges, and specific facility areas. According to the study, 45 sites of prehistoric aboriginal occupations and several historic Euro-American homestead sites were examined. The sites were distributed along the drainage system of the Clinch River, with the majority on the main river (Fielder 1975). Eight archaeological sites were identified at ORNL (Sanders 1984). Of these eight sites, it was recommended that three (4ORE27, 4ORE101, and 4ORE132) be extensively tested and possibly excavated if threatened by construction activities. Ten archaeological sites were located in the immediate K-25 area, four of which were recommended for excavation if potentially impacted by any construction activities. Similarly, three of ten sites identified near the Scarboro Facility were suggested for further evaluation. No archaeological sites were identified at Y-12.

If any remedial action is taken that would cause irreparable harm, loss, or destruction to any historic or archaeological site, the provisions of the Archaeological Resources Recovery Act (16 USC 470aa-ll), 43 *CFR* 7, the Archaeological and Historic Preservation Act (16 USC 469a-c), and 40 *CFR* 6.301 may be ARAR. In addition, identification of cultural resources eligible for the National Register of Historic Places (36 *CFR* 60) or the National Historic Landmark Program (36 *CFR* 65) is mandated by the National Historic Preservation Act (16 USC 470a-w). The provisions of this latter statute would also apply to the Graphite Reactor and Freels Cabin along with EO 11593, 40 *CFR* 6.301, and 36 *CFR* 800 *et seq.* Lastly, there are a number of cemeteries located on ORR that date to before the property was acquired by the government. Any remedial actions that affect these cemeteries would be subject to the provisions of the Tennessee Cemetery Protection Act (TCA 46-1-101 *et seq.*), which prohibits the destruction or degradation thereof.

5. ACTION-SPECIFIC ARARs

Performance, design, or other action-specific requirements set controls or restrictions on particular kinds of activities related to the management of hazardous waste (52 *FR* 32496). Selection of a particular remedial action at a site will invoke the appropriate action-specific ARARs that may specify particular performance standards or technologies, as well as specific environmental levels for discharged or residual chemicals. Action-specific ARARs are established under RCRA, CAA, CWA, SDWA, and TSCA.

5.1 RESOURCE CONSERVATION AND RECOVERY ACT

RCRA has nine distinct sections (subtitles) that regulate various aspects of hazardous waste. Three of these, Subtitle C "Hazardous Waste Management," Subtitle D "Solid Waste Management," and Subtitle I "Regulation of Underground Storage Tanks" (UST), provide the regulatory guidance for RCRA and will be considered for ARAR selection for on-site cleanup at ORR. In considering compliance of CERCLA remedial actions with RCRA requirements, the Subtitle C and I regulations will most likely be applicable or relevant and appropriate. Although the Subtitle D regulations will not be legally applicable, they may prove relevant and appropriate to remediation of sites at the ORR.

Minimum national standards for acceptable management of hazardous waste appear in RCRA, although Tennessee has been authorized by EPA to administer and enforce its own standards in lieu of the federal RCRA regulations. Federally authorized state RCRA programs relate only to RCRA standards prior to the Hazardous and Solid Waste Amendments (HSWA) of 1984.

Tennessee's promulgated RCRA requirements supersede federal regulations as ARARs. However, Tennessee's substantive RCRA regulations are identical for the most part to the federal RCRA regulations (Coutant and Heckman 1987). New regulations imposed in 1984 by HSWA, which have not been adopted by TDEC, are applicable under federal law until TDEC promulgates its own HSWA-related standards. The Tennessee Solid Waste Disposal Control Board has promulgated certain of the HSWA regulations, which EPA has authorized.

Under the present RCRA Subtitle C hazardous waste identification regulations, solid wastes ("solid wastes," as defined under RCRA, can be solid, liquid, semisolid, or contain gaseous material) generated during remedial actions would be subject to RCRA regulation under the following conditions: if they are identified as RCRA-listed or RCRA-characteristic hazardous wastes pursuant to 40 *CFR* Part 261; if they are a "mixture" of solid waste and listed hazardous waste "derived from" a listed hazardous waste; or if they have a listed hazardous waste "contained in" the waste (40 *CFR* 261 3). Wastes are "characteristically hazardous" under RCRA if they exhibit any of four characteristics (ignitability, corrosivity, reactivity, and toxicity), if they meet certain toxicity criteria, or if they contain certain toxic constituents (40 *CFR* 261.10-24). Currently, listed wastes remain hazardous unless they are "delisted" according to procedures set forth in 40 *CFR* 260.20 and 260.22.

In an attempt to address instances where regulation of listed hazardous waste under the jurisdiction of RCRA Subtitle C would cease without the need for a delisting petition, EPA

proposed two alternative approaches for identifying a waste as a RCRA hazardous waste. However, this proposed rule was withdrawn because of a large number of policy and technical issues. Congress has charged EPA with promulgating rules to address the "derived from" and "mixture" issues by October 1994 (Houlberg et al. 1993).

5.1.1 RCRA Subtitle C Regulations

RCRA Subtitle C regulates the generation, transportation, treatment, storage, and disposal of hazardous waste. Standards for the management of hazardous waste at RCRA-permitted TSD facilities were promulgated July 26, 1982, and appear as 40 *CFR* 264. Standards for interim TSD facilities are found in 40 *CFR* 265.

The Subtitle C Part 264 standards will be considered first as ARARs, and the interim standards will be considered only if Part 264 does not address a particular issue. In general, this text will address the Part 264 rather than the Part 265 standards as they are the more stringent. Table 10 lists the pertinent subparts of the permitted and interim standards and the equivalent section of the TDEC hazardous waste management regulations.

The administrative requirements of RCRA (e.g., permitting, reporting, and record-keeping) are not required for on-site remedial actions [CERCLA §121(e) and FFA §XXII(A)]. However, under CERCLA §121(d)(3) and FFA §XXII(B), any removal or remedial action involving the off-site transfer of hazardous substances, pollutants, or contaminants must involve a facility in compliance with all RCRA substantive and administrative requirements. CERCLA response actions will be coordinated with, and supplement, the corrective measures required and conducted by DOE under its current RCRA permit [FFA §IV(A)].

The RCRA Part 264 regulations apply to particular waste management processes (e.g., capping or incineration) or to general procedures (e.g., treatment, disposal, or closure), and it may be necessary to combine the two types of categories in order to adequately address the action-specific ARARs for a selected remedial action. These issues will be addressed on a site-specific basis following selection of remedial alternatives.

On-site wastewater-treatment units that are part of a wastewater treatment facility that is subject to regulation under §402 or §307(b) of the CWA [i.e., are National Pollutant Discharge Elimination System (NPDES) permitted] are exempt from the requirements of RCRA Subtitle C standards for all tank systems, conveyance systems, and ancillary equipment (40 *CFR* 260.10; 40 *CFR* 270.1(c)(2); 53 *FR* 34079, September 2, 1988).

5.1.2 Land Disposal Restrictions

For each hazardous waste, EPA has established treatment standards that are protective of human health and the environment when the wastes are disposed of on land. Land disposal includes placement in a landfill, surface impoundment, waste pile, land treatment facility, etc. In the final NCP, EPA reaffirms that movement of waste within a unit does not constitute "land disposal" for purposes of application of the RCRA LDR; however, waste consolidation from different units at a CERCLA site are subject to the restrictions (55 *FR* 8759).

Table 10. RCRA[a] Subtitle C—standards for the treatment, storage, and disposal of hazardous waste

Federal	Tennessee	Category
40 *CFR* Part 264	1200-1-11-.06[b]	
Subpart I	Section 9	Containers
Subpart J	Section 10	Tanks
Subpart K	Section 11	Surface impoundments
Subpart L	Section 12	Waste piles
Subpart M	Section 13	Land treatment
Subpart N	Section 14	Landfills
Subpart O	Section 15	Incinerators
Subpart X	Section 19	Miscellaneous treatment units
Subpart DD	Not promulgated	Containment buildings
40 *CFR* Part 265	1200-1-11-.05	
Subparts I-O	Sections 9-15	As listed above
Subpart P	Section 16	Thermal treatment
Subpart Q	Section 17	Chemical, physical, and biological treatment
Subpart DD	Not promulgated	Containment buildings

[a]RCRA = Resource Conservation and Recovery Act.
[b]Rule 1200 of the Tennessee Department of Environment and Conservation Hazardous Waste Management Regulations.

These LDR apply only to RCRA hazardous waste placed after the effective prohibition date. Wastes may be disposed of on land if they have been treated with the best demonstrated available technology (BDAT) set by EPA and if they meet the treatment standards. A final rule listing provisions for specific treatment standards and prohibiting land disposal of the following wastes has appeared. Table 11 lists the waste categories for which LDR have been promulgated, the *Federal Register* citation, and the corresponding section in 40 *CFR* 268. Tennessee Rule 1200-1-11-.10 contains the state LDR, which are similar to the RCRA LDR.

EPA has determined that the RCRA treatment standards are generally inappropriate or infeasible when applied to contaminated soil or debris (55 *FR* 8760). Therefore, EPA proposed separate rulemakings to establish treatment standards for the disposal of such contaminated soil and debris. The Notice of Proposed Rulemaking (NPRM) for debris appeared January 9, 1992 (57 *FR* 958); final rule, August 18, 1992 (57 *FR* 37194). A case-by-case capacity variance of the LDR effective date for management of certain hazardous debris was issued (57 *FR* 20766, May 15, 1992), and a 1-year extension of the variance to May 8, 1994, was granted (58 FR 28506, May 14, 1993). The revised standards (40 *CFR* 268.45) require contaminated debris to be treated before land disposal using extraction, destruction, or immobilization technologies. However, since immobilization does not remove contaminants, immobilized debris must still be disposed of on land as hazardous waste (i.e., at a Subtitle C

Table 11. Federal RCRA[a] land disposal regulations

Waste category	Citation	40 *CFR* Part
Spent-solvent and dioxin-containing wastes	51 *FR* 40572 (November 7, 1986)	268.30 268.31
"California List" wastes	52 *FR* 25760 (July 8, 1987)	268.32
First Third wastes[b]	54 *FR* 31138 (August 17, 1988)	268.33
Second Third wastes[b]	54 *FR* 26594 (June 23, 1989)	268.34
Final Third wastes[b]	55 *FR* 22520 (June 1, 1990)	268.35

[a]RCRA = Resource Conservation and Recovery Act.
[b]All listed hazardous wastes identified under 40 *CFR* 261.

facility). EPA identifies six categories of debris as well as other miscellaneous types of debris contaminated with PCBs, asbestos, or radionuclides. Hazardous debris that is also contaminated with waste PCBs must comply with both the applicable PCB requirements and the contaminated debris requirements. Disposal of debris and materials resulting from the cleanup of PCB spills must also comply with the PCB spill cleanup policy of 40 *CFR* 761.125.

The rule includes treatment standards for debris that contains asbestos, which is also regulated under OSHA and the CAA (see other sections in this report). These debris standards for asbestos are a subset of those required for other types of contaminated debris and include water washing and spraying, vapor phase solvent extraction, biodegradation, chemical oxidation or reduction, and microencapsulation (see preamble to the rule, 57 *FR* 37238).

As with mixed waste, debris contaminated with both hazardous and radioactive waste must comply with the treatability standards for contaminated debris as well as those under the AEA. Disposal of treated debris and resultant wastes is discussed in the rule. A 2-year national capacity variance for mixed RCRA/radioactive wastewaters and nonwastewaters contaminated with newly listed wastes was granted in the rule.

Finally, in the debris rule, EPA established a new treatment unit for treating contaminated debris. A "containment building" has been added to the definitions of 40 *CFR* 260.10 to provide for storage and treatment of contaminated debris that does not contain free liquids and is not amenable to treatment in tanks or containers (57 *FR* 979, January 9, 1992). Performance standards for the design and operation of such containment buildings are promulgated for a new Subpart DD to 40 *CFR* 264 and 265 for permitted facilities and interim status facilities, respectively. All containment buildings, permitted or unpermitted, must comply with the same level of performance. These standards would be legally applicable to any remedial activities involving dismantlement of structures and subsequent decontamination in a building. Physical extraction technologies such as abrasive blasting or spalling used

to treat debris in place, which are intended for discard (e.g., treatment of a contaminated building before demolition), are subject to the permit standards of 40 *CFR* 264, Subpart X, for miscellaneous units or the interim status standards for chemical, physical, or biological treatment in 40 *CFR* 265, Subpart Q (preamble to the final debris rule).

The Advance NPRM for soil appeared October 24, 1991 (56 *FR* 55160); an NPRM is expected in August 1993, and a final rule is expected in August 1994 (Houlberg et al. 1993). The rule will be analyzed as ARAR or TBC when available. Under 40 *CFR* 268.5, EPA has granted an interim case-by-case extension of the LDR effective date to May 8, 1993, applicable to all persons disposing of soils contaminated with radioactive mixed waste or RCRA hazardous soils whose BDAT is incineration, retorting, or vitrification (57 *FR* 47772, October 20, 1992). The EPA administration has not yet extended or reinstated this extension (Houlberg et al. 1993). In the interim, EPA has developed guidance for obtaining and complying with a treatability variance for soil and debris that are contaminated with RCRA hazardous wastes for which treatment standards have already been set (OSWER Directive 9347.3-06FS, July 1989). Alternate treatment levels are presented for structural functional groups of organics and for ten inorganics based on actual treatment of soil and best management practices for debris. These will be considered as TBC guidance when remedial alternatives are selected and more information becomes available on waste types.

5.1.3 Corrective Action Requirements

Several sections of RCRA require promulgation of corrective action regulations; when finalized, these requirements will most likely be ARARs for CERCLA remedial actions. The 40 *CFR* 264 Subpart F regulations on groundwater protection at RCRA-regulated units are potential ARARs to CERCLA corrective actions within facility boundaries, and these include groundwater protection standards (40 *CFR* 264.92 and 264.94, see Sect. 2.1.1) and groundwater monitoring requirements (40 *CFR* 264.97). The corrective action standards developed under RCRA §3004(u) will be applicable to any CERCLA cleanup site that is also an active or a formerly active RCRA facility with an active SWMU; thus, the standards will also be applicable to a CERCLA site where disposal is currently occurring. In addition, RCRA §3004(v) authorizes cleanup beyond facility boundaries.

Requirements for corrective action for SWMUs have been proposed as a new Subpart S of 40 *CFR* 264 (55 *FR* 30798, July 27, 1990). EPA proposed a risk-based approach to establish media cleanup standards for surface water, groundwater, soil, and air. These standards are to be established at concentrations that ensure protection of human health and the environment and are to be set for each media of concern during the remedy selection process. Target cleanup levels may initially be set at the RCRA action levels but modified as appropriate to reflect site-specific exposure assumptions (55 *FR* 30826).

A portion of the proposed Subpart S was promulgated as a final rule for corrective action at Corrective Action Management Units (CAMUs) and Temporary Units (TUs). This rule establishes two new sections in Subpart S (*Corrective Action for Solid Waste Management Units*): 40 *CFR* 264.552 (CAMUs) and 40 *CFR* 264.553 (TUs) (58 *FR* 8658, February 16, 1993). Both of these units function solely to manage wastes that are generated at a RCRA facility for the purpose of implementing remedial actions (i.e., remediation wastes). As a result of this rule, regulatory requirements for remediation wastes will differ from those for "as-generated" wastes regulated under Subtitle C, particularly the LDR and minimum technology requirements (MTRs). The CAMU or TU designations must be made by the EPA Regional

Administrator or the authorized state, and such designations would be subject to the public review and comment process as part of a remedy selection. These designations would be incorporated into permit modifications for a facility and would include specifications of applicable design, operating, and closure requirements that may be less stringent than the appropriate 40 *CFR* 264 standards.

Under the CAMU provisions, movement and consolidation of remediation wastes within a designated CAMU will not be subject to LDR or other hazardous waste land-disposal requirements. CAMUs would also not be subject to the MTR, since they are not classified as landfills, surface impoundments, or waste piles. Placement of remediation wastes into a CAMU from an area at a facility but outside the CAMU, or from one CAMU into another CAMU, will not trigger LDR or MTRs, nor will excavation, treatment outside the CAMU, and replacement back in the CAMU. However, movement of wastes from a CAMU to another area in a facility not designated a CAMU would trigger the appropriate LDR or MTRs.

In addition, the EPA Regional Administrator may designate tanks and container storage units used for treatment or storage of remediation wastes as TUs. Permit specifications for TUs must include design, operating, and closure requirements; these may be less stringent than the 40 *CFR* 264 requirements so long as they are protective of human health and the environment and comply with statutory requirements. There is a 1-year time limit for the operation of TUs, subject to a 1-year extension by the Regional Administrator.

The substantive requirements of this rule are expected to be ARARs for remediation of CERCLA sites that involve the management of RCRA hazardous waste. In this context, CAMU designations would be incorporated into CERCLA decision documents.

5.1.4 RCRA Subtitle I Regulations

RCRA §9003 requires promulgation of regulations pertaining to detection, prevention, and correction of releases from USTs. Implementing regulations appear in 40 *CFR* 280.50 ("Release Reporting, Investigation, and Confirmation"), 280.60 ("Release Response and Corrective Action for UST Systems Containing Petroleum or Hazardous Substances"), and 280.70 ("Out-of-Service UST Systems and Closure") and will be considered as ARARs for cleanup of USTs at ORR. In 40 *CFR* 280.66 it is specified that corrective action plans designed to protect human health and the environment must be submitted to the "implementing agency" (TDEC UST Division) for approval. The state must be notified of permanent closure plans not taken in response to corrective action (40 *CFR* 280.71). Suggested cleaning and closure procedures are recommended in 40 *CFR* 280.71 and may be considered TBC guidance for closure of tanks at ORR.

The Tennessee UST Board promulgated regulations for release response and corrective action for USTs on April 15, 1990; these are found in the Rules of the TDEC, Chaps. 1200-1-15-.05 to 1200-1-15-.07. The regulations closely parallel the federal 40 *CFR* 280 regulations, although the state regulations only apply to USTs containing petroleum products. Chapter 1200-1-15-.06(6) addresses investigations for groundwater cleanup. Chapter 1200-1-15-.06(7)(e)(1) mandates that groundwater contaminated by benzene or total petroleum hydrocarbons (TPH) from USTs must be cleaned up to meet levels listed in Appendix 3 of the rule; the levels vary depending on whether the water is classified as "drinking water supply" or "nondrinking water supply."

Chapter 1200-1-15-.06(7)(e)(2) of the regulations mandates cleanup of contaminated soils to the levels listed in Appendix 4 of the rule. Soil cleanup levels may vary depending on the permeability of the soil and whether the groundwater below the site is a "drinking water supply" or "nondrinking water supply." These variable cleanup levels are listed for benzene, toluene, and xylene (BTX) and TPH. The rule also outlines the steps for investigations and confirmation of a release from USTs and delineates requirements for corrective action and closure of the USTs.

5.1.5 RCRA Subtitle D Regulations

The EPA has promulgated a final rule establishing a new 40 *CFR* Part 258, which sets forth revised minimum federal criteria for municipal solid waste landfills (56 *FR* 50978, October 9, 1991). These include closure and postclosure care requirements (40 *CFR* 258.60 and 258.61). Although not legally applicable to remedial action sites found at the ORR, they may prove relevant and appropriate for closure of some of the sites. These regulations will be analyzed as site-specific ARARs are addressed.

In addition, the Tennessee state (Rules of the TDEC 1200-1-7) and federal RCRA regulations governing solid waste management facilities may be relevant and appropriate. Specifically, 40 *CFR* 257.3-3 prohibits nonpoint source contamination of surface waters from solid waste management facilities. 40 *CFR* 257.3-3 also prohibits point source discharges of pollutants into surface waters that are in violation of the requirements of the NPDES. Contamination of an underground drinking water source above SDWA MCLs is prohibited by 40 *CFR* 257.3-4.

5.2 CLEAN AIR ACT

Chapter 25, "Air Pollution Control," of the TCA provides for the purity of the air resources of the state "consistent with the protection of normal health, general welfare and physical property of the people, maximum employment and the full industrial development of the state." Implementing these objectives are the Tennessee ambient air quality standards established by the TDEC Division of Air Pollution Control, which appear in Chap. 1200-3-3 of the Rules of the TDEC and are identical to the federal primary NAAQS (see Sect. 2.2.1 and Table 1). The ambient standards of 1200-3-3 are translated into source-specific emission limitations (Rules of the TDEC, Chaps. 1200-3-4 to 1200-3-21) that must be considered ARARs if they apply to any of the remedial alternatives selected. Table 12 lists sections of the Tennessee state air emission standards that will be analyzed on a site-specific basis following selection of remedial alternatives. The procedural and administrative requirements of the TDEC air pollution control regulations are generally not considered to be ARARs for on-site CERCLA cleanup activities; however, they will be analyzed on a site-specific basis if it is determined that permitting, etc. is required for off-site releases.

The CAA (§111) requires EPA to promulgate standards for new sources of air emissions. This requirement has been implemented in 40 *CFR* 60 through the New Source Performance Standards (NSPS) that are based on the best demonstrated technology (BDT) and set minimum federal emission limitations on classes of facilities. The NSPS are probably not legally applicable to cleanup of CERCLA sites, but will be considered as potentially relevant and appropriate for cleanup at ORR on a site-specific basis. NESHAPs have been discussed

Table 12. Rules of the TDEC[a] Bureau of Environment, Division of Air Pollution Control

Chapter	Subject
1200-3-1	General provisions
1200-3-2	Definitions
1200-3-4	Open burning
1200-3-5	Visible emissions
1200-3-6	Nonprocess emission standards
1200-3-7	Process emission standards
1200-3-8	Fugitive dust
1200-3-11	Hazardous air contaminants
1200-3-14	Control of sulfur dioxide emissions
1200-3-16	New source performance standards
1200-3-18	Volatile organic compounds
1200-3-21	General alternate emission standards
1200-3-22	Lead emission standards
1200-3-23	Visibility protection
1200-3-24	Stack height regulations

[a]TDEC = Tennessee Department of Environment and Conservation.

as potential "hybrid" ARARs (see Sects. 2.2.1 and 3.1), which will be considered as remedial alternatives are selected.

5.3 CLEAN WATER ACT

The regulatory aspects of the CWA include site-specific pollutant limitations and performance standards designed to restore and maintain the chemical, physical, and biological integrity of the nation's surface waters. The NPDES permit program includes applicable effluent standards, monitoring requirements, and conditions for discharge. Tennessee has an EPA-authorized state program that is equivalent to the federal program. Although NPDES permits are not necessary for on-site discharges from CERCLA sites, the substantive CWA NPDES requirements must be complied with. Various NPDES permits regulate discharges from ORR to the Clinch River and its tributaries. The effluent limitations and monitoring requirements found in the NPDES permits will be analyzed on a site-specific basis for cleanup at ORR.

TDEC issues general permits for the alteration of aquatic resources. These Aquatic Resource Alteration Permits (ARAPs) include alteration of wet weather conveyances, minor road crossings, utility line crossings, bank stabilization, sand and gravel dredging, and debris removal. Individual permits may be required for other activities. The substantive requirements are that no activities be located in wetlands; no activities be located in any waterway that has been identified by TDEC as having contaminated sediments; and no portion of the activity

be located in a known habitat of federal- or state-listed threatened or endangered species (TDEC Rules, Chapter 1200-4-7 *et seq.*).

Storm-water discharges from activities at industrial sites involving construction operations that result in the disturbance of 5 acres or more have been included in the final rule for NPDES permits for storm-water discharges (40 *CFR* 122). Consultation with TDEC is required to ensure compliance with the substantive requirements of the NPDES permitting process for storm-water discharges during construction activities (Chap. 1200-4-10-.05 of the Rules of the TDEC). In particular, implementation of good site planning and best management practices to control storm-water discharges is required.

TDEC also has an NPDES permit requirement for storm-water discharges during industrial activity (Chap. 1200-4-10-.04). The substantive requirements of this permitting process will be applicable to discharges following closure of a site. The monitoring parameters and reporting levels are listed in Chap. 1200-4-10-.04(e) for biological oxygen demand, chemical oxygen demand, total suspended solids, ammonia as nitrogen, oil and grease, pH, floating material, color, sheen, and priority pollutants.

Direct discharge of dredge and fill material into navigable waters is regulated under CWA §404 and implemented through 33 *CFR* 320–330 and 40 *CFR* 230. CERCLA remedial actions that may be considered dredge and fill activities include dredging sediments from contaminated water bodies, disposing of contaminated soil or materials in surface water, capping a site, building berms and levees to contain wastes, excavating for the containment of effluent, and dewatering a site to obtain adequate flow (EPA 1988). The Tennessee Valley Authority Act §26A approval application for streambed sediment removal also may be necessary for remedial actions occurring off site.

The Corps of Engineers (COE) requires permits for structures or work in or affecting navigable waters of the United States under §10 of the Rivers and Harbors Act. In addition, the discharge of dredged or fill material into waters of the United States or navigable waters is regulated under CWA §404 and implemented through 33 *CFR* 320–330 and 40 *CFR* 230. "Waters of the United States" is defined in 33 *CFR* §§322.2 and 328 as those waters of the United States that are subject to the ebb and flow of the tide toward the mean high-water mark and which have been at any time, or may be, used for interstate commerce. This definition includes all impoundments of such waters [40 *CFR* 328.3(a)(4)]. The COE has established the ordinary high-water mark for impoundments to be the normal summer pool elevation (elevation 741 for the Watts Bar impoundment), which includes any slack-water areas. Any activity above this elevation would not require approval pursuant to §10 of the Rivers and Harbors Act. The COE published a public notice (ORNOR-F, 86-23), dated May 8, 1986, of all "navigable waters" in the area; Poplar Creek from its mouth to River Mile 18.3 has been designated a navigable water. However, no tributaries to Poplar Creek have received such a designation (Claud 1992).

Discharge of fill material into adjacent wetland areas may require a CWA §404 permit and would be regulated by the requirements of 40 *CFR* 230 *et seq.*, which are designed to prevent potential impacts on aquatic ecosystems. These requirements are discussed in Sect. 4.3.

5.4 SAFE DRINKING WATER ACT

Part C of Title XIV of the SDWA authorizes the establishment of an underground injection control (UIC) permit program designed to prevent contamination of underground sources of drinking water. An underground drinking water source is defined in the UIC regulations (40 *CFR* 146.3) as an aquifer or its portion that supplies drinking water for human consumption, contains a sufficient supply of groundwater to supply a public water system, and contains fewer than 10,000 mg total dissolved solids per liter of water. Tennessee has a UIC program (Chap. 1200-4-6 of the Rules of the Water Control Board) that classifies all groundwater as useful for domestic water supply unless certain exemption criteria apply. Aquifers are exempted for various reasons, including economic or technical impracticality (1) in recovery because of depth or location or (2) in successful treatment of contaminated water for drinking water purposes.

5.5 TOXIC SUBSTANCES CONTROL ACT

Specific TSCA standards exist for incineration or alternate disposal of liquid and nonliquid waste and for articles and soils containing PCBs, and these will be addressed during the site-specific RI/FS process. For mixed waste containing radionuclides and PCBs, the K-25 TSCA Incinerator is the technology of choice. TSCA storage requirements for PCBs (40 *CFR* 761.65) specify that PCBs and PCB-containing items at concentrations of greater than 50 ppm must be disposed of within 1 year after being placed in storage for disposal. Because of the limited disposal options for mixed waste contaminated with PCBs, the K-25 incinerator must store mixed waste for a time period exceeding 1 year. An FFCA (TSCA-FFCA) between DOE and EPA focuses on resolving compliance issues related to the regulation of PCBs under TSCA. It sets committed milestones for the final disposal of various PCB-contaminated materials at the five gaseous diffusion plants operated by DOE. Complete disposal of all waste PCBs must be achieved by December 31, 2015.

5.6 DEPARTMENT OF TRANSPORTATION REGULATIONS

The Department of Transportation (DOT) Regulations for Hazardous Materials lists general requirements for shipping and packaging at 49 *CFR* 172 and 173 and for requirements for carriage by public highway at 49 *CFR* 177. General requirements for the shipping of hazardous materials are defined in 49 *CFR* 172, with specific marking, labeling, and placarding regulations for radioactive materials in 49 *CFR* 172.310, 172.403, and 172.556, respectively. These requirements would be ARARs for any off-site shipments of hazardous waste materials generated during remedial actions, including any transport by public highway from one to another on-site area.

The DOT regulations govern "transportation in commerce of hazardous materials." Government agencies offering hazardous materials for transportation in commerce or transporting hazardous materials in furtherance of commercial enterprise are subject to the regulations. However, the Chief Counsel of the Research and Special Programs Administration under DOT has issued an opinion letter for DOE Headquarters stating that DOE is not required to comply with the Hazardous Materials Transportation Act when it offers or transports hazardous materials in a government vehicle because those DOE activities are presumed to be for a governmental purpose and thus not in commerce (Kaleta 1991). The

DOT requirements would be applicable if DOE does not close off the road to public use during transport, if the transport does not occur in a DOE-operated government vehicle, or if access to the roads is not controlled by the use of gates and guards (Kaleta 1991). However, DOE has stated that it will comply with the DOT transportation requirements; therefore they are briefly summarized here.

In 49 *CFR* 173, Subpart I, requirements for packaging and shipping radioactive materials are listed. General package design requirements are given in 49 *CFR* 173.411, with specific design requirements for Type A and B packaging found in 49 *CFR* 173.412 and 173.413, respectively. Activity limits for normal form radioactive material (termed A_2 limits) are listed in 49 *CFR* 173.435 for various radionuclides. Type A packaging is authorized for shipment if each package does not exceed the A_2 value (49 *CFR* 173.431). If package quantities exceed the A_2 value, Type B packaging is required (49 *CFR* 173.431). In addition, each package of radioactive materials must be designed and prepared for shipment such that under normal conditions, the radiation level does not exceed 200 mrem/h at any external point on the package (49 *CFR* 173 .441). Small quantities of solid radioactive materials are exempt from these packaging and shipping requirements if the materials package limit is $<10^{-3}$ A_2 (49 *CFR* 173.4 and 173.423).

Standards for the packaging and shipment of NRC-licensed material are found in 10 *CFR* 71. These are not legally applicable to DOE activities. However, DOE Order 5480.3 ("Safety Requirements for the Packaging and Transportation of Hazardous Materials, Hazardous Substances, and Hazardous Wastes") specifies the Type A packaging requirements, which are given in 49 *CFR* 173.411 and 412. Type B packages will be in compliance with requirements found in 10 *CFR* 71. Reference is made to 10 *CFR* 71.41, *et seq.* for general standards for all of the packages and special requirements for Type B packages [DOE Order 5480.3(8)].

Regulations governing transportation of hazardous materials by public highway are found in 49 *CFR* 177, and specific loading and unloading requirements for radioactive materials are in 49 *CFR* 177.842. The number of packages in any one motor vehicle must be limited so that the total *transport index number does not exceed 50.* The total transport index is described as the sum of the numbers expressing the maximum radiation level in meter roentgen equivalent man per hour at 1 m (3.3 ft) from the external surface of each package (49 *CFR* 173.403bb).

5.7 FEDERAL INSECTICIDE, FUNGICIDE, AND RODENTICIDE ACT

The Federal Insecticide, Fungicide, and Rodenticide Act delegates authority to EPA to regulate the disposal and storage of excess pesticides and pesticide containers. To that end, EPA has published nonregulatory procedures for disposal of pesticides in 40 *CFR* 165, Subpart C. Although not an ARAR, these recommendations might provide guidance for cleanup of pesticides and pesticide containers at ORR and will be analyzed on a site-specific basis. EPA is currently updating these guidelines to make them consistent with current regulations and technologies. Regulatory initiatives for 40 *CFR* 165 will be published in three phases. An NPRM for Phase I, concerning suspended and canceled pesticides, was published May 5, 1993 (58 *FR* 26856). The NPRM for Phase II, concerning container design, residue removal storage, containment, and excess, is due in August 1993, and the Phase III NPRM is due in 1994 (Houlberg et al. 1993).

5.8 FEDERAL VERSUS STATE REGULATIONS

Table 13 gives a preliminary list of action-specific ARARs established under RCRA and various other statutes discussed above. Action alternatives are listed alphabetically, followed by a summary of the requirements found in the particular statute cited. The prerequisites for applicability are also given; however, the regulations must be related to site-specific conditions to determine whether the regulation cited is legally applicable or relevant and appropriate. This table does not represent a complete listing of action-specific ARARs; analysis of the regulations on a site-specific basis will be necessary to ensure a comprehensive summary.

Table 13. Action-specific ARARs for the Oak Ridge Reservation[a]

Actions[b]	Requirements	Prerequisites[c,d]	Federal citation	Tennessee Code Annotated (TCA)
Air emissions	Use standards for control of emissions of volatile organics (these are based on CAA,[e,f] emission standards found in 40 *CFR* 60.480-60.489)	Applicable to emissions from process vents and equipment leaks at treatment, storage, and disposal (TSD) facilities handling or recycling hazardous waste containing more than 10 ppm by weight volatile organics	40 *CFR* 264.1030; 40 *CFR* 264.1050	
	Use standards for control of emissions of volatile organics	Applicable to emissions of volatile organics from tanks, surface impoundments, containers, and certain miscellaneous treatment units that treat hazardous waste having a volatile organic concentration greater than 500 ppm by weight—*Proposed* rule, not yet ARAR	40 *CFR* 264.1080; 56 *FR* 33490 (July 22, 1991)	
Capping	When a cap is being placed over waste (e.g., closing of a landfill or surface impoundment or closing of a waste pile as a landfill), design and construct a cover to • Provide long-term minimization of migration of liquids through the capped area • Function with minimum maintenance • Promote drainage and minimize erosion or abrasion of the cover • Accommodate settling and subsidence so that the cover's integrity is maintained • Have a permeability less than or equal to the permeability of any bottom liner system or natural subsoils present	Applicable to RCRA[g,h] hazardous waste placed at site after Nov. 19, 1980, or placement of hazardous waste into another unit, which makes requirements applicable when the waste is being covered with a cap for the purpose of leaving it behind after the remedy is completed; capping without such placement does not make requirements applicable, but technical requirements are likely to be relevant and appropriate	40 *CFR* 264.228(a)(2)(iii) (Surface impoundments) 40 *CFR* 264.310(a) (Landfills)	1200-1-11-.06(11)(i) 1200-1-11-.06(14)(k)

Table 13 (continued)

Actions[b]	Requirements	Prerequisites[c,d]	Federal citation	Tennessee Code Annotated (TCA)
Clean closure (e.g., closure with no postclosure care)	Eliminate need for further maintenance and control; eliminate postclosure escape of hazardous waste, hazardous constituents, leachate, contaminated runoff, or hazardous waste decomposition products to groundwater, surface water, or the atmosphere	Applicable to land-based unit containing RCRA hazardous waste (listed or characteristic) placed at site after Nov. 19, 1980, or placement of hazardous waste into another unit; designed for cleanup that will not require long-term management and that is designed to health-based standards	40 *CFR* 264.110-120 (Subpart G) 40 *CFR* 264.111	1200-1-11-.06-7
	Remove or decontaminate waste residues, contaminated containment system components (e.g., liners and dikes), contaminated subsoils, and structures and equipment contaminated with waste and leachate, and manage them as hazardous waste in accordance with 40 *CFR* 262	Applicable to clean closure of containers, tank systems, surface impoundments, and waste piles containing RCRA hazardous waste	40 *CFR* 264.114 40 *CFR* 264.178 40 *CFR* 264.197 40 *CFR* 264.228 40 *CFR* 264.258	1200-1-11-.06-7(e) 1200-1-11-.06-9(i) 1200-1-11-.06-10(h) 1200-1-11-.06-11(i) 1200-1-11-.06-12(i)
	Protect human health and the environment		40 *CFR* 264.111(b)	1200-1-11-.06-7(b)
Closure with waste in place	Eliminate free liquids by removal or solidification	Applicable to surface impoundment containing RCRA hazardous waste	40 *CFR* 264.228(a)(2) (Surface impoundments)	1200-1-11-.06-11(i)
	Stabilize remaining waste and waste residues to support cover			
	Install final cover to provide long-term minimization of infiltration (see "capping" for further restrictions)	Applicable to final closure of RCRA landfill or surface impoundment	40 *CFR* 264.228(a)(2)(iii) (Surface impoundments)	1200-1-11-.06-11(i)
	Provide postclosure care and monitor groundwater[i] (see "Postclosure care")		40 *CFR* 264.310(a) (Landfills)	1200-1-11-.06-14(k)

Table 13 (continued)

Actions[b]	Requirements	Prerequisites[c,d]	Federal citation	Tennessee Code Annotated (TCA)
Consolidation between units	Land disposal requirements and restrictions are triggered if waste is placed on or in land outside unit boundary or area of contamination	Applicable to placement of RCRA hazardous wastes subject to land disposal restrictions and to movement of hazardous waste (listed or characteristic) from one unit or area of contamination into another; consolidation within a unit or area of contamination does not trigger applicability[j]	40 *CFR* 268 (Subpart D)	
	Neither land disposal restrictions of 40 *CFR* 268 nor applicable minimum technology requirements are triggered if remediation wastes are moved and consolidated within or between designated "Corrective Action Management Units" (CAMUs)	Applicable to placement of RCRA hazardous waste generated during remediation activities into a designated CAMU	40 *CFR* 264.552 (58 *FR* 8658, Feb. 16, 1993)	
Container storage (on site)	Ensure that containers of hazardous waste are	Applicable to storage of RCRA hazardous waste (listed or characteristic) not meeting small quantity generator criteria held for a temporary period before treatment, disposal, or storage elsewhere, in a container (i.e., any portable device in which a material is stored, transported, disposed of, or handled); a generator who accumulates or stores hazardous waste on site for 90 days or less in compliance with 40 *CFR* 262.34 (a)(1-4) is not subject to full RCRA storage requirements		
	• Maintained in good condition		40 *CFR* 264.171	1200-1-11-.06(9)(b)
	• Compatible with hazardous waste to be stored		40 *CFR* 264.172	1200-1-11-.06(9)(c)
	• Closed during storage (except to add or remove waste)		40 *CFR* 264.173	1200-1-11-.06(9)(d)
	Inspect container storage areas weekly for deterioration		40 *CFR* 264.174	1200-1-11-.06(9)(e)
	Comply with less stringent minimum technology requirements that may be applied to containers designated as "temporary units" (TUs); protection of human health and the environment must be ensured	Applicable to container storage units used for storage of RCRA or CERCLA remediation wastes and designated as TUs	40 *CFR* 264.553	

Table 13 (continued)

Actions[b]	Requirements	Prerequisites[c,d]	Federal citation	Tennessee Code Annotated (TCA)
Container storage (on site) (continued)	Place containers on a sloped, crackfree base, and protect from contact with accumulated liquid; provide containment system with a capacity of 10% of the volume of containers; remove spilled or leaked waste in a timely manner to prevent overflow to the containment system		40 *CFR* 264.175	1200-1-11-.06(9)(f)
	Keep containers of ignitable or reactive waste at least 50 ft from the facility's property line		40 *CFR* 264.176	1200-1-11-.06(9)(g)
	Keep incompatible materials separate; separate incompatible materials stored near each other by a dike or other barrier		40 *CFR* 264.177	1200-1-11-.06(9)(h)
	At closure, remove all hazardous waste and residues from the containment system, and decontaminate or remove all containers, liners, bases, or soils		40 *CFR* 264.178	1200-1-11-.06(9)(i)
	Store banned wastes in accordance with 40 *CFR* 268; when such storage occurs beyond 1 year, the owner/operator bears the burden of proving that such storage is solely for the purpose of accumulating sufficient quantities to allow for proper recovery, treatment, and disposal		40 *CFR* 268.50	1200-1-11-.10(1)(e)
Construction of new landfill on site	**Minimum Technology Requirements**			
	Install two liners or more: a top liner that prevents waste migration into the liner and a bottom liner that prevents waste migration through the liner[k]	Applicable to RCRA hazardous waste (listed or characteristic) currently being disposed of at a new, replacement, or expanded landfill	40 *CFR* 264.301	1200-1-11-.06(14)(b)

Table 13 (continued)

Actions[b]	Requirements	Prerequisites[c,d]	Federal citation	Tennessee Code Annotated (TCA)
Construction of new landfill on site (continued)	Install leachate collection systems above and between the liners		40 *CFR* 264.301	1200-1-11-.06(14)(b)
	Construct run-on and run-off control systems capable of handling the peak discharge of a 25-year storm		40 *CFR* 264.301	1200-1-11-.06(14)(b)
	Control wind dispersal of particulates		40 *CFR* 264.301	1200-1-11-.06(14)(b)
	Inspect liners and covers during and after installation		40 *CFR* 264.303	1200-1-11-.06(14)(d)
	Inspect facility weekly and after storms to detect malfunction of control systems or the presence of liquids in the leachate collection and leak detection systems		40 *CFR* 264.303	1200-1-11-.06(14)(d)
	Maintain records of the exact location, dimensions, and contents of waste cells		40 *CFR* 264.304	1200-1-11-.06(14)(e)
	Close each cell with a final cover after the last waste has been received (see closure with waste in place)		40 *CFR* 264.310	1200-1-11-.06(14)(k)
	Do not dispose of bulk or noncontainerized liquid hazardous waste or hazardous waste containing free liquids in landfills		40 *CFR* 264.314	1200-1-11-.06(14)(o)
	Do not place containers holding free liquids in a landfill unless the liquid is mixed with an absorbent or solidified		40 *CFR* 264.314	1200-1-11-.06(14)(o)

Table 13 (continued)

Actions[b]	Requirements	Prerequisites[c,d]	Federal citation	Tennessee Code Annotated (TCA)
Construction of new landfill on site (continued)	**Groundwater Monitoring**			
	Establish a detection, a compliance, and a corrective action monitoring program when required by 40 *CFR* 264.91	Applicable to creation of a new landfill to treat, store, or dispose of RCRA hazardous wastes as part of a remedial action	40 *CFR* 264.91-100	1200-1-11-.06(6)(b)-(k)
	Ensure that all monitoring programs meet RCRA general groundwater monitoring requirements		40 *CFR* 264.97	1200-1-11-.06(6)(h)
	Treatment with Best Demonstrated Available Technology (BDAT) before placement	Applicable to placement of RCRA hazardous waste subject to land disposal restrictions	40 *CFR* 268	1200-1-11-.10
Construction of new surface impoundment on site	**Minimum Technology Requirements**			
	Use two liners: a top liner that prevents waste migration into the liner and a bottom liner that prevents waste migration through the liner throughout the postclosure period	Applicable to RCRA hazardous (listed or characteristic) currently being placed in a new surface impoundment or to use of replacement or lateral extension of existing surface impoundments	40 *CFR* 264.220	1200-1-11-.06(11)(a)
	Design liners to prevent failure because of pressure gradients, contact with the waste, climatic conditions, and the stress of installation and daily operation		40 *CFR* 264.221	1200-1-11-.06(11)(b)
	Provide leachate collection system between the two liners		40 *CFR* 264.221	1200-1-11-.06(11)(b)
	Use leak detection system that will detect leaks at the earliest possible time		40 *CFR* 264.221	1200-1-11-.06(11)(b)
	Use closure and postclosure care requirements (see "Closure with waste in place" and "Postclosure care")		40 *CFR* 228	1200-1-11-.06(11)

Table 13 (continued)

Actions[b]	Requirements	Prerequisites[c,d]	Federal citation	Tennessee Code Annotated (TCA)
Construction of new surface impoundment on site (continued)	**Groundwater Monitoring**			
	Establish a detection, a compliance, and a corrective action monitoring program when required by 40 *CFR* 264.91	Applicable to creation of a new landfill to treat, store, or dispose of RCRA hazardous wastes as part of a remedial action	40 *CFR* 264.91-100	1200-1-11-.06(6)(b-k)
	Ensure that all monitoring programs meet RCRA general groundwater monitoring requirements		40 *CFR* 264.97	1200-1-11-.06(6)(h)
Dike stabilization	Design and operate facility to prevent overtopping from overfilling; wind and wave action; rainfall; run-on; malfunctions of level controllers, alarms, and other equipment; and human error	Applicable to existing surface impoundment containing hazardous waste, or creation of new surface impoundment	40 *CFR* 264.221	1200-1-11-.06(11)(b)
	Construct dikes with sufficient strength to prevent massive failure		40 *CFR* 264.221	1200-1-11-.06(11)(b)
	Inspect liners and cover system during and after construction		40 *CFR* 264.226	1200-1-11-.06(11)(g)
	Inspect weekly for proper operation and integrity of the containment devices		40 *CFR* 264.226	1200-1-11-.06(11)(g)
	Remove surface impoundment from operation if the dike leaks or if there is a sudden drop in liquid level		40 *CFR* 264.227	1200-1-11-.06(11)(h)
	At closure, remove or decontaminate all waste residues and contaminated materials; otherwise, free liquids must be removed, the remaining wastes stabilized, and the facility closed in the same manner as a landfill		40 *CFR* 264.228	1200-1-11-.06(11)(i)
	Manage ignitable or reactive waste so that it is protected from materials or conditions that may cause it to ignite or react		40 *CFR* 264.227	1200-1-11-.06(11)(h)

Table 13 (continued)

Actions[b]	Requirements	Prerequisites[c,d]	Federal citation	Tennessee Code Annotated (TCA)
Direct discharge of treatment system effluent	**National Pollutant Discharge Elimination System (NPDES) Permitting Program**			
	Use best available technology economically achievable to control toxic and nonconventional pollutants (required); use best conventional pollutant control technology to control conventional pollutants (required) (technology-based limitations may be determined on a case-by-case basis)	Applicable to point source discharge to waters of the United States[l,m]	40 *CFR* 122.44(a) (Clean Water Act)[n]	1200-4-5
	Ensure that discharge complies with applicable federal water quality requirements and more stringent state requirements under the Clean Water Act (CWA)[o]		40 *CFR* 122.44(d) and state regulations approved under 40 *CFR* 131	1200-4-3-.03
	Ensure that discharge is consistent with the requirements of a Water Quality Management plan approved by EPA under CWA §208(b)		40 *CFR* 122.44(d)	
	Ensure that discharge limitations are established for all toxic pollutants that are or may be discharged at levels greater than that which can be achieved by technology-based standards		40 *CFR* 122.44(e)	
	Develop and implement a best management practice (BMP) program and incorporate in the NPDES permit to prevent the release of toxic constituents to surface waters		40 *CFR* 125.100	

Table 13 (continued)

Actions[b]	Requirements	Prerequisites[c,d]	Federal citation	Tennessee Code Annotated (TCA)
Direct discharge of treatment system effluent (continued)	**Criteria and standards for NPDES**		40 *CFR* 125	1200-4-5
	Ensure that the BMP program • Establishes specific objectives and BMP for the control of toxic and hazardous pollutants • Includes a prediction of direction, rate of flow, and total quantity of toxic pollutants where experience indicates a reasonable potential for equipment failure • Includes proper management of solid and hazardous waste in accordance with regulations promulgated under RCRA	Applicable to discharge to waters of the United States[m]	40 *CFR* 125.104	
	To ensure compliance, monitor discharge for • The mass of each pollutant • The volume of effluent • Frequency of discharge and other measurements as appropriate		40 *CFR* 122.44(i)	
	Follow approved test methods for monitored waste constituents; detailed requirements for analytical procedures and quality control are provided		40 *CFR* 136.1-136.3(e)	
	Comply with additional permit conditions such as • Duty to mitigate any adverse effects of any discharge • Proper operation and maintenance of treatment systems	Applicable to off-site discharges	40 *CFR* 122.41(d,e)	
	All tank systems, conveyance systems, and ancillary equipment are exempt from the requirements of RCRA Subtitle C standards	Applicable to on-site wastewater treatment unit, part of a wastewater treatment facility that is subject to regulation under §402 or §307(b) of the CWA (NPDES permitted)	40 *CFR* 260.10; 40 *CFR* 270.1(c)(2); 53 *FR* 34079 (Sept. 2, 1988)	

Table 13 (continued)

Actions[b]	Requirements	Prerequisites[c,d]	Federal citation	Tennessee Code Annotated (TCA)
Discharge to publicly owned treatment works (POTW)	Pollutants that pass through the POTW without treatment, interfere with POTW without operation, or contaminate POTW sludge are prohibited	Applicable to off-site discharge;[e] the same regulations apply regardless of whether the waste is discharged into a sewer or trucked to a POTW	40 *CFR* 403.5 (Clean Water Act)	
	Discharge of pollutants to POTWs is prohibited if they • Create a fire or explosion hazard in the POTW • Are corrosive (pH < 5.0) • Obstruct flow, resulting in interference • Are discharged at a flow rate and/or concentration that will result in interference • Increase the temperature of wastewater entering the treatment plant which would result in interference, but in no case raise the POTW temperature above 104°F (40°C)		40 *CFR* 403.5(b)	
	Discharge must comply with local POTW pretreatment program		40 *CFR* 403.5(d)	
	Comply with RCRA permit-by-rule requirements for discharges of RCRA hazardous wastes to POTWs by truck, rail, or dedicated pipe		40 *CFR* 270.60(c)	1200-1-11-.07(1)(c)

Table 13 (continued)

Actions[b]	Requirements	Prerequisites[c,d]	Federal citation	Tennessee Code Annotated (TCA)
Discharge of dredge and fill material to navigable waters	Satisfy the following four conditions before dredge and fill is an allowable alternative: • There must be no practible alternative • Discharge of dredge or fill material must not cause a violation of state water quality standards, violate any applicable toxic effluent standards, jeopardize an endangered species, or injure a marine sanctuary • Discharge must not cause or contribute to significant degradation of the water • Appropriate steps to minimize adverse effects must be taken	Applicable to discharge of dredge or fill material to "Waters of the United States"	40 *CFR* 230.10 (Marine Protection, Research, and Sanctuaries Act)	
	Determine long- and short-term effects on physical, chemical, and biological components of the aquatic ecosystems		33 *CFR* 320-330 (Clean Water Act)	
	Comply with additional substantive conditions such as • Duty to mitigate any adverse effects of any discharge • Proper operation and maintenance of treatment systems		40 *CFR* 122.41(i)	
	Monitor and report results as required by permit (minimum of at least annually)	Applicable to off-site discharges	40 *CFR* 122.44(i)	
Excavation	Area from which materials are excavated may require cleanup to levels established by closure requirements	Applicable to RCRA hazardous waste placed at site after Nov. 19, 1980, or movement of hazardous waste from one unit, area of contamination, or location into another unit or area of contamination	See closure requirements	

Table 13 (continued)

Actions[b]	Requirements	Prerequisites[c,d]	Federal citation	Tennessee Code Annotated (TCA)
Excavation (continued)	Shore site excavations or slope them in accordance with Subpart P of 29 *CFR* 1926 to prevent accidental collapse	Applicable to excavations at a hazardous waste site by workers subject to Occupational Safety and Health Act (OSHA) regulations	29 *CFR* 1926 54 *FR* 9294 (March 3, 1989)	
	Movement of excavated materials to new location and placement in or on land will trigger land disposal restrictions for the excavated waste or closure requirements for the unit in which the waste is placed	Placement of materials containing RCRA hazardous wastes subject to land disposal restrictions in another unit	40 *CFR* 268 (Subpart D)	1200-1-11-.10(3)
Fugitive dust emissions	Take reasonable precautions to prevent particulate matter from becoming airborne; no visible emissions are permitted beyond property boundary lines for more than 5 min/h or 20 min/day	Applicable to emissions from construction activities		1200-3-8-.010
Gas collection	Follow standards for control of emissions of volatile organics, which are based on CAA emission standards found in 40 *CFR* 60.480-60.489	Applicable to emissions from process vents and equipment leaks at TSD facilities handling or recycling hazardous waste containing more than 10 ppm by weight volatile organics	40 *CFR* 264.1030; 40 *CFR* 264.1050	
Groundwater diversion	Excavation of soil for construction of slurry wall, grout curtain, or other hydraulic containment structure may trigger closure or land disposal restrictions	Applicable to materials containing RCRA hazardous waste subject to land disposal restrictions if waste is moved to another unit	40 *CFR* 268 (Subpart D)	1200-1-11-.10(3)
	Shore site excavations or slope them in accordance with Subpart P of 29 *CFR* 1926 to prevent accidental collapse	Applicable to excavations at a hazardous waste site by workers subject to OSHA regulations	29 *CFR* 1926; 54 *FR* 9294 (March 3, 1989)	
Incineration (on site)	Analyze the waste feed	Applicable to RCRA hazardous waste	40 *CFR* 264.341	1200-1-11-.06(15)(b)
	Dispose of all hazardous waste and residues, including ash, scrubber water, and scrubber sludge			

Table 13 (continued)

Actions[b]	Requirements	Prerequisites[c,d]	Federal citation	Tennessee Code Annotated (TCA)
Incineration (on site) (continued)	No further requirements apply (1) to incinerators that only burn wastes listed as hazardous solely by virtue of combination and (2) if the waste analysis shows that no Appendix VIII constituent is present that might reasonably be expected to be present			
	Follow these performance standards for incinerators:			
	• Achieve a destruction and removal efficiency of 99.99% for each principal organic hazardous constituent in the waste feed and 99.999% for dioxins		40 *CFR* 264.343(a)	1200-1-11-.06(15)(d)
	• Reduce hydrogen chloride emissions to 1.8 kg/h or 1% of the HCl in the stack gases before entering any pollution control devices		40 *CFR* 264.343(b)	1200-1-11-.06(15)(d)
	• Limit emissions of particulate matter		40 *CFR* 264.343(c)	1200-1-11-.06(15)(d)
	During operation of the incinerator, monitor for the following parameters (required): • Combustion temperature • Waste feed rate • An indicator of combustion gas velocity • Carbon monoxide		40 *CFR* 264.347	1200-1-11-.06(15)(g)
	Control fugitive emissions either by • Keeping combustion zone sealed or • Maintaining combustion zone pressure lower than atmospheric pressure		40 *CFR* 264.345(d)	1200-1-11-.06(15)(f)
	Utilize automatic cutoff system to stop waste feed when operating conditions deviate		40 *CFR* 264.345(e)	1200-1-11-.06(15)(f)

Table 13 (continued)

Actions[b]	Requirements	Prerequisites[c,d]	Federal citation	Tennessee Code Annotated (TCA)
Incineration (on site) (continued)	Follow special performance standards for incineration of polychlorinated biphenyls		40 *CFR* 761.70(b) (Total Substances Control Act)[e]	
	Follow new source performance standards for incinerators	Applicable to incinerators with a charge rate greater than 45 metric tons per day	40 *CFR* 60.50-60.54 (Clean Air Act)	
Operation and maintenance	Provide 30-year postclosure care to ensure that site is maintained and monitored	Applicable to closure of hazardous waste management units	40 *CFR* 264.117	1200-1-11-.06(7)(h)
Placement of liquid waste in landfill	Do not dispose of bulk or noncontainerized liquid hazardous waste or hazardous waste containing free liquids in landfills	Applicable to placement of a bulk or noncontainerized RCRA waste in a landfill	40 *CFR* 264.314(b)	1200-1-11-.06(14)(o)
	Do not place containers holding free liquid in a landfill unless the liquid is mixed with an absorbent or solidified			
Placement of waste in land disposal unit	Attain land disposal treatment standards to comply with "land ban" restrictions (see Treatment)	Applicable to placement of RCRA hazardous waste in a landfill, surface impoundment, waste pile, injection well, land treatment facility, salt dome formation, salt bed formation, or underground cave or mine	40 *CFR* 268 (Subpart D)	1200-1-11-.10(3)
Postclosure care	Restrict postclosure use of property as necessary to prevent damage to the cover	Applicable to final closure of a RCRA hazardous waste facility with some hazardous materials or residues left in place	40 *CFR* 264.117(c)	1200-1-11-.06-7(h)

Table 13 (continued)

Actions[b]	Requirements	Prerequisites[c,d]	Federal citation	Tennessee Code Annotated (TCA)
Postclosure care (continued)	Ensure that postclosure care includes • maintenance of the integrity and effectiveness of the final cover • maintenance and monitoring of the groundwater monitoring system and compliance with all applicable parts of Subpart F, "Releases from Solid Waste Management Units" • prevention of run-on and run-off from damaging the final cover		40 *CFR* 264.228(b) 40 *CFR* 264.310(b)	1200-1-11-.06-11(i) 1200-1-11-.06-14(k)
	For landfills, ensure that postclosure care also includes • operation of the leachate collection and removal system • protection and maintenance of surveyed benchmarks used to locate waste cells (landfills, waste piles)		40 *CFR* 264.310(b)	1200-1-11-.06(14)(k)
Slurry wall	Excavation of soil for construction of slurry wall may trigger cleanup or land disposal restrictions	Applicable to RCRA hazardous waste placed at site after Nov. 19, 1980, or movement of hazardous waste from one unit into another unit or area of contamination	40 *CFR* 268 (Part D) See also Consolidation, Excavation, and Treatment regulations	1200-1-11-.10(3)
Streambed modifications	Comply with the substantive requirements of the TDEC Aquatic Resources Alteration Permit (ARAP) process	Applicable to streambed modifications that involve alteration of wet weather conveyances, minor road crossings, bank stabilization, sand and gravel dredging, and debris removal, for all of which general permits exist		1200–4–7
Surface water control	Prevent run-on and control and collect run-off from at least the amount of water volume resulting from a 24-h 25-year storm (waste piles, land treatment facilities, landfills)	Applicable to RCRA-permitted land disposal unit	40 *CFR* 264.251(c,d); 40 *CFR* 264.273(c,d); 40 *CFR* 264.301(c,d)	1200-1-11-.06(12)(b) 1200-1-11-.06(13)(d) 1200-1-11-.06(14)(b)
	Prevent over-topping of surface impoundment		40 *CFR* 264.221(c)	1200-1-11-.06(11)(b)

Table 13 (continued)

Actions[b]	Requirements	Prerequisites[c,d]	Federal citation	Tennessee Code Annotated (TCA)
Surface water control (continued)	Use sediment and erosion controls and best management practices to control run-off from construction activities	Applicable to stormwater discharges associated with construction activities at industrial sites that result in a disturbance of greater than 5 acres of total land area	40 *CFR* 122	1200-4-10-.05
	Obtain NPDES permit (required); monitor to ensure compliance with state water quality standards	Applicable to storm water runoff from industrial sites	40 *CFR* 122	1200-4-10-.04
Tank storage (on site)	Ensure that existing and new tanks have sufficient structural strength that is compatible with the waste to prevent collapse or rupture	Applicable to storage of RCRA hazardous waste (listed or characteristic) not meeting small quantity generator criteria held for a temporary period greater than 90 days before treatment, disposal, or storage elsewhere, in a tank (i.e., any portable device in which a material is stored, transported, disposed of, or handled); a generator who accumulates or stores hazardous waste on site for 90 days or less in compliance with 40 *CFR* 262.34 (a)(1-4) is not subject to full RCRA storage requirements	40 *CFR* 264.191-192	1200-1-11-.06(10)(b)-(c)
	Ensure that waste is compatible with the tank material unless the tank is protected by a liner or by other means		40 *CFR* 264.191	1200-1-11-.06(10)(b)
	Provide tanks with secondary containment and controls to prevent overfilling, and maintain sufficient freeboard in open tanks to prevent overtopping by wave action or precipitation		40 *CFR* 264.193-194	1200-1-11-.06(10)(d)-(e)

Table 13 (continued)

Actions[b]	Requirements	Prerequisites[c,d]	Federal citation	Tennessee Code Annotated (TCA)
Tank storage (on site) (continued)	Less stringent minimum technology requirements may be applied to tanks designated as TUs; protection of human health and the environment must be ensured	Applicable to tank units used for management of RCRA or CERCLA remediation wastes and designated as TUs	40 *CFR* 264.553	
	Inspect the following: overfilling control, control equipment, monitoring data, waste level (for uncovered tanks), tank condition, above-ground portions of tanks (to assess their structural integrity), and the area surrounding the tank (to identify signs of leakage)		40 *CFR* 264.195	1200-1-11-.06(10)(f)
	Repair any corrosion, crack, or leak		40 *CFR* 264.196	1200-1-11-.06(10)(g)
	At closure, remove all hazardous waste and hazardous waste residues from tanks, discharge control equipment, and discharge confinement structures		40 *CFR* 264.197(a)	1200-1-11-.06(10)(h)
	If all contaminated contents cannot be removed, consider the tank system a landfill and close in accordance with the landfill closure requirements of 40 *CFR* 264.310		40 *CFR* 264.197(b)	1200-1-11-.06(10)(h)
	Store ignitable and reactive waste so as to prevent the waste from igniting or reacting; ignitable or reactive wastes in covered tanks must comply with buffer zone requirements in "Flammable and Combustible Liquids Code," Tables 2-1 through 2-6 (National Fire Protection Association 1976, 1981)		40 *CFR* 264.198	1200-1-11-.06(10)(i)

Table 13 (continued)

Actions[b]	Requirements	Prerequisites[c,d]	Federal citation	Tennessee Code Annotated (TCA)
Tank storage (on site) (continued)	Store banned wastes in accordance with 40 *CFR* 268; when such storage exceeds 1 year, the owner/operator bears the burden of proving that the storage is solely for the purpose of accumulating sufficient quantities to allow for proper recovery, treatment, and disposal		40 *CFR* 268.50	1200-1-11-.10(4)(a)
Treatment	For treatment of wastes subject to ban on land disposal, attain levels achievable by BDAT for each hazardous constituent in each listed waste if residual is to be land disposed; if residual is to be further treated, initial treatment and any subsequent treatment that produces residual to be treated need not be BDAT if it does not exceed the value in the Constituent Concentration in Waste Extract Table for each applicable wastewater	Applicable to the following: • Wastes that have been prohibited from land disposal without treatment – Spent solvent wastes and dioxin-containing wastes –"California List" wastes • All ranked and listed hazardous wastes identified under 40 *CFR* Part 261: – First third – Second third – Final third, and mixed radioactive hazardous waste • Newly listed wastes and contaminated debris	40 *CFR* 268 (Part D) 40 *CFR* 268.30; 40 *CFR* 268.31 40 *CFR* 268.32 40 *CFR* 268.33 40 *CFR* 268.34 40 *CFR* 268.35 40 *CFR* 268.36; 40 *CFR* 268.45	1200-1-11-.10(3)
	Obtain a no-migration variance for untreated restricted hazardous waste land disposal	*Proposed* ARAR—applicable to land disposal of untreated hazardous waste that has been restricted from land disposal and has no potential to migrate off site	40 *CFR* 268 (Part D) Notice of Proposed Rulemaking (NPRM) August 11, 1992; final rule expected August 1994	
	Follow treatment standards for the disposal of hazardous soil	EPA will propose standards for the land disposal of contaminated soil	40 *CFR* 268 (Part D) NPRM August 1993	

Table 13 (continued)

Actions[b]	Requirements	Prerequisites[c,d]	Federal citation	Tennessee Code Annotated (TCA)
Treatment (chemical, physical, or biological)	Do not place hazardous wastes or treatment reagents in the treatment process or equipment if they could cause the treatment process or equipment to rupture, leak, corrode, or otherwise fail before the end of intended life	Applicable to treatment processes involving RCRA hazardous wastes and treatment reagents	40 *CFR* 265.401	1200-1-11-.05(17)
	Where hazardous waste is continuously fed into a treatment process or equipment, ensure that the process or equipment is equipped with a means to stop the inflow		40 *CFR* 265.401	1200-1-11-.05(17)
	Follow general requirements for ignitable, reactive, or incompatible wastes		40 *CFR* 265.17	1200-1-11-.05(2)
Treatment in a containment building	Owners or operators of containment buildings designed and operated under the requirements of §268.1101 are not subject to the definition of land disposal in RCRA 3004(k) given certain provisions outlined in §268.1100	Applicable to processes involving treatment of RCRA hazardous wastes in a containment building as defined in 40 *CFR* 260.10	40 *CFR* 264.1100	
	Follow design and operating standards, which are intended to ensure containment of managed wastes and to prevent exposure to the elements via precipitation, wind, run-on, etc.		40 *CFR* 264.1101(a)	
	Maintain primary barrier to be free of significant cracks, gaps, corrosion, or other deterioration that could cause release of hazardous substances		40 *CFR* 268.1101(c)(1)	
	Take measures to prevent the tracking of hazardous waste outside of the unit by personnel or equipment			
	Take measures to control fugitive dust emissions			

Table 13 (continued)

Actions[b]	Requirements	Prerequisites[c,d]	Federal citation	Tennessee Code Annotated (TCA)
Treatment in a containment building (continued)	Obtain certification by a qualified registered professional engineer that the building design meets the requirements of §268.1101		40 *CFR* 264.1101(c)(2)	
	Promptly repair in accordance with prescribed procedures any condition that could lead to the release of a hazardous substance		40 *CFR* 264.1101(c)(3)	
	Inspect at least weekly, and keep a log book of the facility's operating record		40 *CFR* 264.1101(c)(4)	
	Follow secondary containment requirements for management of hazardous wastes containing free liquids or treated with free liquids		40 *CFR* 264.1101(b)	
	At closure, remove or decontaminate all waste residues, contaminated containment system components, contaminated subsoils, and structures or equipment contaminated with waste and leachate, and manage them as hazardous waste; the closure plan, etc., must meet all the requirements of 40 *CFR* 264 Subparts G and H		40 *CFR* 264.1102(a)	
	If all contaminated subsoils cannot be removed from the structure, close the structure in accordance with the landfill closure and postclosure requirements of 40 *CFR* 264.310		40 *CFR* 264.1102(b)	
Treatment in a miscellaneous unit	Follow design and operating standards that ensure protection of human health and the environment for units in which hazardous waste is treated	Applicable to processes involving treatment of RCRA hazardous wastes in a miscellaneous unit as defined in 40 *CFR* 260.10	40 *CFR* 264.601	1200-1-11-.06(19)(b)

Table 13 (continued)

Actions[b]	Requirements	Prerequisites[c,d]	Federal citation	Tennessee Code Annotated (TCA)
Treatment in a miscellaneous unit (continued)	Prevent any releases that may have adverse effects on human health or the environment due to migration of waste constituents, specifically preventing adverse effects in			
	• the groundwater or subsurface environment		40 *CFR* 264.601(a)	1200-1-11-.06(19)(b)
	• surface water, or wetlands, or the soil surface		40 *CFR* 264.601(b)	
	• the air		40 *CFR* 264.601(c)	
Underground injection of wastes and treated groundwater	Follow guidelines from the Underground Injection Control (UIC) program, which prohibits	Applicable to all "well injection" activities as defined in 40 *CFR* 144.3	40 *CFR* 144 (Safe Drinking Water Act)[f]	1200-4-6
	• injection activities that allow movement of contaminants into underground sources of drinking water (USDW) and results in violation of MCLs or adversely affects health[g]		40 *CFR* 144.12	1200-4-6-.04
	• subsurface emplacement of waste fluids into groundwater in area of regional rock deformation of the magnitude that occurs in east Tennessee	Applicable to Class I wells		1200-4-6-.10(1)(c)
	• construction of new Class IV wells, and operation and maintenance of existing wells	Excludes Class IV wells used to reinject contaminated groundwater that has been treated if part of a CERCLA or RCRA remedial action	40 *CFR* 144.13	1200-4-6-.13
	Comply with the RCRA Part 264 permitting requirements for all hazardous waste injection wells		40 *CFR* 144.14	
	Use or operation of unpermitted injection wells is prohibited			1200-4-6-.03

Table 13 (continued)

Actions[b]	Requirements	Prerequisites[c,d]	Federal citation	Tennessee Code Annotated (TCA)
Underground injection of wastes and treated groundwater (continued)	**General standards and methods**			
	Owners and operators		40 *CFR* 144.26	1200-4-6-.09
	• Submit inventory information to the director of the UIC program for the state; including hydrogeologic data for wells, construction record, nature or composition of injected fluids, injection rate and pressure, and groundwater monitoring data		40 *CFR* 144.27	1200-4-6-.08(13)(j)
	• Report noncompliance orally within 24 hours	Applicable to Class I wells	40 *CFR* 144.28(b)	1200-4-6-.08(13)(l)
	• Prepare, maintain, and comply with plugging and abandonment plan	Applicable to Class I wells, which are used to inject hazardous waste beneath the lowermost formation containing, within one quarter mile, a USDW	40 *CFR* 144.28(c)	1200-4-6-.09(6)
	• Monitor Class I wells by - frequent analysis of injection fluid - continuous monitoring of injection pressure, flow rate and volume - installation and monitoring of groundwater monitoring wells		40 *CFR* 144.28(g)(1)	1200-4-6-.10(4)(f)
	Applicants for Class I permits			
	• Identify all injection wells within the area of review		40 *CFR* 144.55	1200-4-6-.10(3)(b)
	• Take action as necessary to ensure that such wells are properly sealed, completed, or abandoned to prevent contamination of USDW		40 *CFR* 146.4	1200-4-6-.10(5)
	Determine whether an aquifer may be an exempted aquifer through criteria that include current and future use, yield, and water quality characteristics		40 *CFR* 146.12(a)(b)	

Table 13 (continued)

Actions[b]	Requirements	Prerequisites[c,d]	Federal citation	Tennessee Code Annotated (TCA)
Underground injection of wastes and treated groundwater (continued)	Case and cement all Class I wells to prevent movement of fluids into USDW, taking into consideration well depth, injection pressure, hole size, composition of injected waste, and other factors		40 *CFR* 146.12(a)(b)	1200-4-6-.10(3)(d)(2) 1200-4-6-.10(3)(f)
	Record information in logs and conduct other tests during construction; prepare a descriptive report and submitted it to the UIC program director		40 *CFR* 146.12(d)	1200-4-6-.10(i)
	Do not exceed injection pressure maximum level which is designed to ensure that injection does not initiate new fractures or propagate existing ones and cause the movement of fluids into a USDW		40 *CFR* 146.13(b)	1200-4-6-.10(4)(b)(1) 1200-4-6-.10(4)(b)(2)
	Provide continuous monitoring of injection pressure, flow rate and volume, and annual pressure, if required		40 *CFR* 146.13(a)	1200-4-6-.10(4)(e) 1200-4-6-.10(4)(f) 1200-4-6-.10(4)(g)
	Demonstrate mechanical integrity every 3 years (required)			1200-4-6-.10(4)(e)(6)
	Provide groundwater monitoring (may be required)		40 *CFR* 146.13(b)	1200-4-6-.10(4)(e) 1200-4-6-.10(4)(f)
	Underground injection of hazardous wastes (California list wastes, all other listed wastes) in underground injection wells is prohibited	Applicable to injection into Class I underground injection wells	40 *CFR* 148.10-16	1200-4-6-.10(1)
Underground storage tanks (USTs) Temporary closure	Provide continuous monitoring for leaks; leave vent lines open and functioning; cap and secure all other lines, pumps, manways and ancillary equipment; notify implementing agency of return to service or permanent closure	Pertains to releases of CERCLA hazardous substances from any one or a combination of tanks the volume of which is 10% or more beneath the surface of the ground (including pipes); applicable also to tanks that have been out of service 3–24 months	40 *CFR* Part 280.70(a)(b)	

Table 13 (continued)

Actions[b]	Requirements	Prerequisites[c,d]	Federal citation	Tennessee Code Annotated (TCA)
USTs (continued) Permanent closure	Remove all liquids and sludges from the UST, remove all pipes from the UST, and purge the UST of all hazardous vapors before removal and disposal	Applicable to USTs that are out of service	40 *CFR* Part 280.71	
	Remove all liquids and sludges from the UST, disconnect or cap all pipes, and fill tank system with an inert solid material		40 *CFR* 280.71	
Waste pile	Use liner and leachate collection and removal system	Applicable to RCRA hazardous waste, noncontainerized accumulation of solid, nonflammable hazardous waste that is used for treatment or storage in piles	40 *CFR* 264.251(a)	
	Follow minimum technology requirements for double liners and leachate collection and removal systems		40 *CFR* 264.251(c)	
	Operate and maintain run-on and run-off control systems for at least the amount of water resulting from a 14-h, 25-year storm		40 *CFR* 264.251(g)(h)	1200-1-11-.06(12)(b)
	Manage pile to control wind erosion		40 *CFR* 264.251(j)	1200-1-11-.06(12)(b)
	Monitor and inspect pile		40 *CFR* 264.254	1200-1-11-.06(12)(e)
	Provide closure and postclosure care (required)		40 *CFR* 264.258	1200-1-11-.06(12)(i)
	At closure, remove all hazardous waste and hazardous waste residues from tanks, discharge control equipment, and discharge confinement structures		40 *CFR* 264.258(a)	1200-1-11-.06(12)(i)

Table 13 (continued)

Actions[b]	Requirements	Prerequisites[c,d]	Federal citation	Tennessee Code Annotated (TCA)
Waste pile (continued)	If all contaminated contents cannot be removed, close in accordance with the landfill closure requirements of 40 *CFR* 264.310 (because tank system is considered a landfill)		40 *CFR* 264.258(b)	1200-1-11-.06(12)(i)

[a]Adapted and modified from EPA (1989).

[b]Action alternatives were modified from the Record of Decision keyword index, *FY 1986 Record of Decision Annual Report*, January 1987, Hazardous Site Control Division, EPA.

[c]Requirements have been proposed but not promulgated for various remedial actions. When these regulations are promulgated, they will be included in the matrix.

[d]Some action-specific requirements listed may be relevant and appropriate even if RCRA definitions of storage, disposal, or hazardous waste are not met (40 *CFR* 260.10) or if the waste at the site is similar to but not identifiable as a RCRA hazardous waste.

[e]CAA = Clean Air Act.

[f]Title I of the CAA covers Air Pollution Prevention and Control, and implementing regulations are found in 40 *CFR* Parts 50-99.

[g]RCRA = Resource Conservation and Recovery Act.

[h]Subtitle C of RCRA governs hazardous waste management (§3001-3020). Implementing regulations appear in 40 *CFR* Parts 260-268, 270, 271, 280, and 124.

[i]Regional administrator may revise length of postclosure care period (40 *CFR* 264.117).

[j]In many cases there are no defined "units" at a CERCLA site. Instead, there are areas of contamination with differing concentration levels (including hot spots) of hazardous substances, pollutants, or contaminants. When RCRA hazardous wastes are moved into or out of an area of contamination, RCRA disposal requirements are applicable to the waste being managed and certain treatment, storage, or disposal requirements (such as for closure) are applicable to the area where the waste is received.

[k]Landfill units meeting the requirements of 40 *CFR* 264.301(b) are not subject to RCRA minimum technology requirements.

[l]The term "Waters of the U.S." is defined broadly in 40 *CFR* 122.2 and includes essentially any water body and wetland.

[m]Section 121 of the Superfund Amendments and Reauthorization Act of1986 (SARA) exempts on-site CERCLA activities from obtaining permits. However, the substantive requirements of a law or regulation must be met. In particular, on-site discharges to surface waters are exempt from procedural NPDES permit requirements. Off-site dischargers would be required to apply for and obtain an NPDES permit.

[n]Titles III and IV of the CWA cover Standards and Enforcement, and Permits and Licenses, respectively. Implementing regulations appear in 40 *CFR* Parts 110, 112, 116, 117, 122, 124, 125, 131, and 136. 40 *CFR* Subchapter N sets forth effluent guidelines for various point source categories.

[o]Federal Water Quality Criteria (WQC) may be relevant and appropriate depending on the designated or potential use of the water, the media affected, the purposes of the criteria, and current information [SARA §121(d)(2)(B)(i)]. Federal WQC for the protection of aquatic life will be relevant and appropriate when environmental factors (e.g., protection of aquatic organisms) are being considered (55 *FR* 8755, March 8, 1990).

[p]Discharge to POTWs is considered an off-site activity. Off-site actions must comply with all legally applicable requirements, both substantive and administrative. The concept of "relevant and appropriate" is not available for off-site actions.

[q]Implementing regulations for the Toxic Substance Control Act of importance to cleanup at CERCLA sites are 40 *CFR* Parts 717 and 761.

[r]Title IV of the Safe Drinking Water Act covers Safety of Public Water Systems. Implementing regulations are found in 40 *CFR* Parts 124 and 141-147.

[s]A USDW is a nonexempted aquifer or its portion which: (1) supplies any public water system, or (2) contains sufficient quantity of groundwater to supply a public water system and currently supplies drinking water for human consumption or contains fewer than 10,000 mg/L total dissolved solids (40 *CFR* 144.3).

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