Appendix F

Corrective Action:
Technologies and Other Alternatives

F.1 TECHNICAL CONDITIONS DETERMINING THE APPLICABILITY OF CORRECTIVE ACTION ALTERNATIVES[a]

Condition	Containment	Withdrawal	Treatment	In-situ Rehabilitation	Management Options
Aquifer Type Unconfined/perched Partially confined Confined Homogeneous Nonhomogeneous	All containment measures designed to limit or halt the lateral migration of contaminants (e.g., slurry walls, sheet pile, geomembrane cutoff, clay cutoff) must be tied into a naturally occurring horizontal stratum of low permeability to be effective. Eaae of construction/excavation will depend on aquifer type and geologic setting.	Effectiveness of methods depends on degree of non-homogeneity, complexity, and in particular, hydraulic contiguity of the aquifer.	Indirect. Conditions determine applicability insofar as before treatment can be applied, groundwater must be withdrawn and transported to a surface treatment unit. (see Withdrawal).	Aquifer type may be major limiting factor if not reconfined/perched and homogeneous. Effectiveness of biological and chemical degradation is dependent on ability to inject, control, and withdraw reagents, which may be difficult or impractical in nonhomogeneous aquifers. Effectiveness of natural process restoration and inter table adjustment is constrained in confined, partially confined, and nonhomogenous aquifers.	Poses no constraint on applicability of methods.
Saturation Conditions Unsaturate zone Saturated zone	Hydraulic barriers are not applicable in unsaturated zone. Clay cutoffs are not commonly applied in saturated zone because de-watering would be required during installation. Otherwise, saturation conditions are not limiting for the use of containment methods.	Pumping and gravity drainage are not applicable in the unsaturated zone. Gas writing is not applicable in the saturated zone. Otherwise, saturation conditions are not limiting for methods.	Indirect. Conditions determine applicability insofar as before treatment can be applied, groundwater must be withdrawn and transported to a surface treatment unit (see Withdrawal). Although removal of unsaturated zone water is not practical by pumping or gravity drainage, soil and unsaturated zone water could be excavated and treated by techniques not requiring the water to be entirely in the liquid phaae (e.g., air and steam stripping, chemical and biological detoxification).	Saturation conditions are unlikely to pose major constraint on applicability of methods. Effectiveness of degradation methods may be restricted to use in the unsaturated zone (e.g. , if deperdent on aerobic coalitions).	Poses no constraint on applicability of methods.

Condition	Containment	Withdrawal	Treatment	In-situ Rehabilitation	Management Options
Flow System Recharge Scorage Discharge	Nature of flew system is important in choice of technologies. Use of methods in recharge areas may require some form of surface water control to prevent the contained area frcm filling and overflowing with recharge water. In discharge areas, underdrainage may be required below liners to dissipate uplift uplift pressures.	Flew system generally poses no major technical constraints on methods. However, water-level fluctuations (e.g., due to seasonal variations) that can change the rate or direction of flew, leakage among layers in multi-layer flow system, and downward migrating flow system pose additional uncertainties.	Indirect. Condition determines applicability insofar as before treatUent can be applied, groundwater must be withdrawn and transported to a surface treatment unit (see Withdrawal).	Flew system is net a major constraint. However, in recharge areas, degradation reagents may be difficult to control after injection; this is of particular concern if reagents are in themselves contaminants. In discharge areas, water table adjustment is typically more difficult; natural processes may bring contaminants to surface water bodies.	Generally poses no constraint on applicability of methods. May be important for monitoring options.
Depth 0-5m up to 20m Over 20m	Depth is major limiting factor for methods, in large part arising from equipment limitations. Practical depths for material tarriers will vary among individual technologies but are generally in the vicinity of 20m. While technically feasible, generally little experience has been @&i at depths greater than 20m (one exception is sheet piles which appear practical to depths of 40m).	Depth poses no major technical constraints unless excavation is required (e.g., gravity drainage, excavation). Excavation costs increase rapidly at depths greater than about 5m and very rapidly greater than about 20m. Applicability of gravity drainage is limited to about 37 m.	Indirect. Condition determines applicability insofar as before treatment can be applied, groundwater must be withdrawn and transported to a surface treatment u-lit (see Withdrawal).	Depth is likely to constrain applicability of degradation techniques; there is limited experience with degradation below about 5m and it is not likely to be practical below 20m because of controllability problem.	Poses no constraint on applicability of methods.
Areal extent <10000 m² up to 0.1 km² up to 10 km² Over 10 km²	While areal extent in itself poses no technical limitations, the use of material barriers tends to be practically restricted to areas less than 1000m²; exceptions include slurry walls (up to 10 km²) and liners (up to 0.1 km²). Experience with other methods tends to be limited to upwards of 0.1 km², except for natural containment which can exceed 10 km² depending on site conditions.	While areal extent in itself poses no technical limitation, little experience has been gained with methods in areas as large as 10 km².	Indirect. Condition determines applicability insofar as before treatment can be applied, groundwater must be withdram and transported to a surface unit (see Withdrawal).	Areal extent is likely to constrain applicability of all methods because of controllability factors (except natural process rehabilitaton) to areas less than 10 km² but little experience available.	Poses m technical constraint on applicability of methods but large areas (e.g., greater than 0.1 km²) may practically restrict use.

Condition	Containment	Withdrawal	Treatment	In-situ Rehabilitation	Management Options
Volume $<35 m^3$ up to $1000\ m^3$ up to $10^6 m^3$ $>10^6 m^3$	While volume of contaminated groundwater in itself poses no technical limitations, the use of methods is practically restricted to volumes less than $1000 m^3$ because of cost considerations. Exception include slurry walls, geomembranes, and liners for which experience has been gained upwards to $10^6 m^3$. Volumes naturally contained will depend on site conditions.	While volume of contaminated groundwater in itself poses no major technical limitations, little experience has been gained with methods for volumes greater than about $10^6 m^3$. An exception is withdrawal enhancement which appears practically applicable for volumes only up to about $1000 m^3$.	Indirect. Condition determines applicability insofar as before treatment can be applied, groundwater must be withdrawn and transported to a surface treatment unit (see Withdrawal). Feasibility of methods is directly related to design flow rates rather than volumes.	While volume of contaminated groundwater in itself should pose no major technical limitations, there is little experience dealingith volumes in excess of about $1000 m^3$ (except for natural process restoration). Higher volumes could lead to controllability problems.	Posea no technical constraint on applicability of methods but large velures (e.g., greater than $1000 m^3$) may practically restrict use.

Condition	Containment	Withdrawal	Treatment	In-situ Rehabilitation	Management Options
Predominant Geologic Setting Sedimentary Crystalline Coarse-grained Fine-grained	Geology is major limiting factor If rocks are sedimentary or crystalline. The presence of rocks, boulders, etc., poses difficult excavation @Area for most methods (exceptions include hydraulic barriers and grouting, the latter also being dependent on fracture ad/or adsorptive characteristics of the rock). Coarse-grained materials generally pose no limitations, except for natural containment. Fine-grained materials restrict use of grouting, hydraulic barriers, and sheet pilea.	Geology is a major limiting factor for certain methods. In general, areas of high transmissivity may render withdrawal options impractical due to high fluid handling requirements. (i) only gravity drainage and gas Writing are generally unconstrained by the presence of sedimentary or crystalline rock; applicability of other methods depends on nature of fracture system and other features of the geologic formation. Excavation la not generally applicable in sedimentary or crystalline rock. (ii) Coarse-grained materials generally pose no limitations except for withdrawal enhancement, which depends on features of the geologic formation. (iii) Unconsolidated, fine-grained materials of low permeability restrict effectiveness of pumping and gravity drainage; only excavation can proceed without major constraint in fine-grained materials.	Indirect. Condition determines applicability insofar as before treatment can be applied, groundwater must be withdrawn and transported to a surface treatment unit (see Withdrawal).	Effectiveness of methods in general will depend on site conditions. Fine-grained materials which constrain flow control and areas of poor drainage or heterogeneity may adversely affect methods. Non-homogeneous areas may not allow for sufficient contact between reagents and contaminated materials.	Poses no constraint on applicability of methods.

Condition	Containment	Withdrawal	Treatment	In-situ Rehabilitation	Management Options
Climate					
Air temperature Below freezing 0° to 20°C Above 20°C	Methods requiring construction/excavation cannot be performed efficiently during periods when the ground is frozen.	Under frozen conditions, pumping and gravity drainage require special surface hsl'riling procedures for fluids in certain cases* Excavation is often not practical.	All treatment facilities must be protected (i.e., heated) in temperatures below freezing. In addition, low temperatures (e.g., 0°-20°C) seriously impair air and stem stripping (volatility reduced) and biological transformations (rate reduced) if water is also allowed to decrease in temperature.	Temperatures below freezing require special handling procedures for injectants end for the protection of piping; water table adjustment may be feasible, depending on aite conditions. Low temperatures reduce rates of chemical and biological transformation.	Poses no constraint on applicability of methods.
Rainfall Evapotranspiration greater than precipitation Predpitation greater than evapotranspiration	Methods requiring construction ad/or excavation require surface water controls if precipitation exceeds evapotranspiration. Run-on and runoff controls and surface seals are essential for slurry wall.	Rainfall is generally net a major limiting factor for methods. Excavation may require surface water controls if precipitation exceeds evapotranspiration.	Indirect. Condition determines applicability insofar as before tree& ment can be applied, groundwater must be withdram and transported to a surface treatment unit (see Withdrawal).	Rainfall is probably not a constraint in general but could be depending on site conditions. Applicability of natural. rehabilitation may be limited if natural recharge is limited.	Poses no constraint on applicability of methods.
special Construction Considerations	Emplacement of tarriers (e.g., membranes and liners) has risks associated with barrier damage during hardling and installation. Specially designed equipment is needed for slurry wall construction using a vibrating bean. There is difficulty in obtaining water-tight interlocks with sheet pilea.	Specially designed equipment and materials are required for withdrawal enhancement.	Equipment size is determined by flow rate and nature and amount of contaminants to be removed. Sophisticated controls are required for ultrafiltration. Semi-permanent equipment is required for air and steam stripping.	Means to inject reagents into the soil is required.	Construction cur siderations vary depending on such factors as availability of alternative sources of tinter, availability of transportation/distribution/delivery system, and nature of the source of contamination.

Condition	Containment	Withdrawal	Treatment	In-situ Rehabilitation	Management Options
Contaminant Type and Castration	Contaminant category poses major constraint on applicability of some methods. Contaminant-specific evaluations will be required to assure compatibility of contaminant (at high concentrations) and physical barrier materials. Aromatic hydrocarbons and other volatiles (e.g., volatile halogens) are least amenable containment method. Generally, if containment use of low concentration, the type of contaminant may not be critical. Hydrodynamic controls & not depend on contaminant type, assuming no contact is made. The handling and disposal of excavated materials could influence the use of this Option.	Limitations posed by contaminant category vary among specific methods. Geochemistry and other associated factors that affect partitioning of contaminants between the soil, rock, and water may affect efficiency of both excavation and pumping methods. Handling and disposal of excavated materials and associated contaminants could constrain the use of this option. Withdrawal enhancement is applicable only to organics. Relatively dilute concentrations become increasingly less cm= fective to pump.	Contaminant category poses major constraint on applicability of methods ~ any method tends to address specific contaminant categories. Treatment is also limited if mixtures of contaminants are present and If concentrations are changing rapidly (discontinuously) over time. No methods are available for some pathologicals (viruses) and rzxMXU- clides (little experience with treatment). Treatment costs are also sensitive to mass and volume of material to be treated. Rate of process is limited by low concentrations.	Limitations posed contaminant category vary among specific methods. All methods generally applicable to organics. Ivesesof hinter table adjustment and natural process relaxation is very specific and could be limited (e.g., if contaminants are strongly adsorbed or in separate fluid phases). Degradation methods best suited when significant contaminants are present. Biological degradation appears applicable only to certain categories of organics and typically is net efficient for low concentrations. No degradation method appears applicable to @m@= No method 1s applicable to radionuclides.	Generally poses no constraint on applicability of methods. Applicability of methods is dependent on public perception about the nature and severity of the problem.

Based on Woodward-Clyde Consultants, Inc. , 1983.

Conversion factors:

.30S x feet to obtain meters (m)

4047 x acres to obtain square meters (m^2)

2.S90 X square miles to obtain square kilometers (km^2)

.02a x cubic feet to obtain cubic meters ( )

Source: Office of Technology Assessment .

F.2 NON-TECHNICAL CONDITIONS DETERMINING THE APPLICABILITY OF CORRECTIVE ACTION ALTERNATIVES[a]

Condition	Containment	Withdrawal	Treatment	In-situ Rehabilitation	Management Options
Environmental/social side-effects	Major potential side-effects are associated with the continued presence and possible leakage of contaminants. Changes to groundwater flow patterns could also have disruptive effects on the environment and other users. Surface disturbances would be caused by methods requiring construction. Noise, air pollution, traffic, etc., may occur during construction/operation. In some cases, effects associated with disposal of excavated materials may be significant.	The purpose of withdrawal is to reduce contaminant concentrations In the subsurface but there could be major potential aide-effects associated with the surface disposal of withdrawn contaminants (or treated residuals). Additional impacts possible from pumping and gravity drainage are related to alteration of groundwater flow patterns (e.g., lowering of the water table and saltwater intrusion). Noise, air pollution, traffic, etc., may occur during construction/operation.	Possible side-effects are related to the transferral of contaminants to the atmosphere. Disposal of treatment byproducts (including solutions from regeneration) could also have adverse effects depending on disposal methods chosen.	Major side-effeas are associated with the potential for reactions between reagents used in degradation methods and the hydrogeologic environment (e. g., resulting in contaminant residues). For water table adjustment, side-effects may result from both raising the water table (e.g., flooding of sewers, leach fields, or basements) and lowering the water table (e.g., kee flow alterations and effects on wells). Natural processes are slow, and the ride exists that contamination will spread further.	Major potential environmental and social side-effects include disruption of normal use patterns, disruption of economic activity, public concern, continued presence of and potential spreading of contaminants, and health risks (e.g., if contaminants are not removed ad/or treated). Possible environmental and social disruption accompany source removal.
Labor considerations	The construction/installation of material tarriers tends to require skilled professionals; operational requirements are minimal (and would relate to performance monitoring). Otter methods require minimal labor, and skill requirements are variable. Only hydrodynamic barriers in this category generally have labor requirements during operation that are in addition to non-labor intensive monitoring and supervision.	Methods are generally labor-intensive and require skilled professionals during construction/installation; operational requirements tend to be non-labor intensive but still require skilled professionals.	Methods are generally labor-intensive and require skilled professionals during construction/installation. Operational requirements are generally non-labor intensive, but skilled professionals are still required. One exception is biological detoxification which has labor-intensive operational requirements.	Degradation methods are generally non-labor intensive but specially trained technical personnel are required for construction/installation. Water table adjustment Is labor intensive In Its construction/installation but non-labor intensive in its operation; skilled personnel are required.	Labor requirements vary by method. Methods are generally non-labor intensive during construction/installation; skilled personnel are often net essential. Operational requirements are often minimal.

Condition	Containment	Withdrawal	Treatment	In-situ Rehabilitation	Management Options
Safety considerations for workers	Processes requiring the removal of contaminated material (e.g., construction activities) require special handling and safety precautions.	Drilling activities produce contaminated materials and require special handling precautions. The handling of contaminated excavated materials poses a serious limitation on the use of excavation. Labor requirements generally increase as the dangers posed by contaminants increase.	Exposure to contaminants can remit from residuals handling, volatization, and other factors. For example, in air stripping, volatiles could be introduced into the atmosphere.	Safety considerations could be significant if the handling of materials that are potentially reactive is required.	Safety considerations vary among options. For example, they could be important for monitoring activities. Concern about workers is usually overshadowed by concern to protect the public more generally.
Time requirements	unforeseen geotechnical conditions, complex hydrogeology, and extent of contamination are major f actors in determining time for construction/installation. Time for design is generally less than two months (grouting and hydraulic barriers may require upwards of six months). Time for construction is generally two to six months for tarrier methods and under two months for otter methods. There are minimal time requirements during operation.	Hydrogeology and extent and nature of contamination are major factors. Time for design and construction/installation are each typically less than six months. Excavation may tske as long as one year depending on areal extent and depth of excavation and existence of structures, e.g., utilities. operation of pumping may take many years, depending on the extent of contamination, hydrogeology, and degree of cleanup to be achieved.	Time for design la typically less than six months. Tine for construction/installation is typically less than six months. Design and vendor delivery are @or time considerations. Tine requirements for operating the system depend on contaminant types, concentration levels, and performance goals.	Degradation methods are possible either to design or construct/install within about one month if contaminants are familiar; otherwise, time requirements could be longer. Water table adjustment design and construction/installation are each on the or&r of six months, but maintenance of the system over the long-term la required.	Time requirements vary by option; they are generally less than six months each for design and construction/installation. Long lead times may be required in safe cases, e.g., for developing alternative supplies and implementing health advisories. Termination/limitation of aquifer use and purchase of alternative supplies are often used for a rapid emergency response. Institutional considerations could constrain timely implementation of many methods.

Condition	Containment	Withdrawal	Treatment	In-situ Rehabilitation	Management Options
Cost considerations	Principal factors determining costs include depth to groundwater contamination, areal extent of contamination to be contained, geotechnical conditions, and type of contaminants. Containment methods are generally capital intensive during construction/installation; operational costs are generally minimal except for natural containment (e.g., analysis) and hydraulic barrier options. Replacement costs are likely to be incurred. The cost of maintaining surface seals used in conjunction with slurry walls is significant.	Principal factors determining costs include depth to groundwater contamination, volume of contaminated groundwater to be pumped, geotechnical conditions, availability of disposal and/or treatment facilities, and hydrogeology. Generally, these methods are capital intensive during construction/installation. System components may need to be selectively replaced depending on length of time of system operation; otherwise, operational costs are generally minimal.	Principal factors determining costs include flew rates and system capacity, concentration and types of contaminants, and plant design. Coats are highly variable among treatment options; the most costly methods include reverse osmosis, ion exchange, and electrodialysis. Home treatment units (at point-of-end use) are also costly.	Principal factors determining costs include: the size of sites and type and concentration of contaminants for degradation methods, and the extent of the system and duration of operation for water table adjustment.	cats vary among options; they could include components related to enforcement, providing public information, and emergency responses.
Performance vis-a-vis the continued presence Of contaminants	Containment results in the continued presence of contaminants in the subsurface with the potential for further migration (e.g., via leakage).	Withdrawal per se results in the continued presence of contaminants which are transferred to other environmental media; however, withdrawal methods are typically used in conjunction with treatment.	Treatment haa the potential to result In the continued presence of contaminants through their possible transfer to other environmental media (e.g., air); additional contaminants may also be introduced (e.g., treatment byproducts). Removal efficiencies of methods are variable.	These methods result in the presence of transformed contaminants in the subsurface together with (spent) transformation agents.	These methods often result in the continued presence of contaminants In the subsurface with the potential for further migration.

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Condition	Containment	Withdrawal	Treatment	In-situ Rehabilitation	Management Options
Design life and operational requirements	Design life of material harrier containment systems is f inite but as yet unknown. Long records of experience are generally lacking but design life tends to be 2040 years for applications not involving contaminants. Replacement may be eventually required unless barriers are coupled with withdrawal/treatment. Hydro- - C techniques must operate perpetually to isolate contaminants, requiring periodic Well/pulp replacement. Techniques for managing surface runoff can require more frequent maintenance than underground Structure.	only excavation is permanent. Design life of other methods will vary and a continuous maintenance/replacement schedule would be required. Fluid withdrawal methods could have lag operation and maintenance periods (e.g., for highly attenuated contaminants).	Typically, design life is 15-30 years for equipment other than membranes (which Is less than 5 years). Exceptions include filtration ard ion exchange which have a design life of 15 yearn but which also require more frequent filter regeneration. Hare units are prone to bacterial growth and require careful maintenance. Data are not available to evaluate ultrafiltration since this method has been operational only about 4-8 years. In general, replacement will be required at the end of design life if contaminants remain.	Design life is not typically a limitation. (use of machinery or semi-permanent construction materials are not generally required.)	Design life is not always a limitation. Exceptions include purchasing of alternative supplies and point-of-end use treatment which both tend to k short-term (less than 5 years). In addition, the performance of point-of-end use treatment units has been known to shift dramatically over time. Developing alternative supplies may have a design life upwards of 50 years. 'l'he design life of municipal treatment facilities la generally on the order of 20-30 years.
Institutional considerations	Institutional considerations include the ease of land across and the presence of facilities and structures at the construction site.	Water @ma issues may restrict the use of pumping. Other considerations include the availability of disposal alternatives for withdrawn contaminants and the ease of land access.	A major consideration involves the availability of alternatives for the disposal of treatment residues.	Regulatory approval may be required for the injection of degradation reagents.	A wide range of institutional considerations may arise depending on the option and includes enforcement, competing uses, access to alternative supplies (e.g., purchasing alternative supplies), and public acceptance.

[a] Based on Woodward-Clyde Consultants, Inc. , 1983.

Source: Office of Technology Assessment.

F.3 APPLICATION OF CORRECTIVE ACTION ALTERNATIVES TO SOURCES

Source Category	Containment	Withdrawal	Treatment	In-situ Rehabilitation	Management Options
Category I (Designed to discharge)					
	Most containment methods[a] are generally applicable to all Category I sources except injection wells because of their depth. Only natural containment appears applicable to injection wells.	All withdrawal methods are applicable to almost all Category I sources. The exception is injection wells which are typically too deep for gravity drainage, gas venting, or excavation methods; in practice, mechanical integrity testing and annular pressure tests are used to detect problems from injection wells in lieu of corrective actions.	N.R.[b]	While all in-situ rehabilitation methods are generally applicable to most Category I sources, site-specific factors (e. g., geology, hydrology, and contaminants) must be evaluated to determine method feasibility. One exception may be injection wells which are typically too deep for degradation methods.	Most management options[c] are generally applicable to all Category I sources. In practice, corrective actions are generally limited to management options for sub-surface percolation.
Category II (Designed to swine, treat, and/or dispose)					
	Most containment methods[a] are generally applicable to all Category II sources. Contaminant-specific evaluations are typically required to assure compatibility of radionuclides and any material tarrier.	All withdrawal methods are generally applicable to all Category II sources. Withdrawal enhancement is not generally applicable to radioactive disposal sites.	N.R.[b]	Applicability of in-situ rehabilitation methods to most Category 11 sources depends on site-specific factors. In particular, tendency for methods to be contaminant-specific may limit use for multiple-contaminant situations. In addition, in-situ rehabilitation methods would generally be Inapplicable to radioactive wastes; natural restoration would be inapplicable to sources containing some typea of hazardous wastes; and degradation would be inapplicable to dredging conditions.	Most management options[c] are generally applicable to all Category II sources.

Source Category	Container	Withdrawal	Treatment	In-situ Rehabilitation	Management Options
Category III (Designed to transport or transmit)					
	Most containment methods[a] are generally applicable to all Category III sources.	All withdrawal methods are generally applicable to all Category III sources.	N.R.[b]	Degradation methods are generally applicable to Category 111 sources, especially if the contaminants involved are petroleum-based. In other cases, site-specific factors must be evaluated to determine feasi-bility of in-situ rehabilitation methods.	Most managment options[c] are generally applicable to all Category III sources.
Category IV (Discharge as a consequence of other activities)					
	Most containment methods[a] are technically applicable to au Category IV sources. However, experience to date la limited in terns of the areal extent and volumes handled; these factors could effectively preclude methods from addressing some Category Iv sources.	All withdrawal methods are tech-nically applicable to almost au Ca-tegory Iv sources. Exceptions in-clude deicing salts application, which is not amenable to withdrawal enhancement methods, and mining and mine drainage which, If the mine is too deep, will not k amenable to gravity drainage or excavation. Volumes and areal extent could effec-tively preclude we of these methods, however, for practical reasons.	N.R.[b]	While in-situ rehabilitation methods are generally applicable to most category IV sources, site-specific factors must be evaluated to determine feasibility. Degradation methods, however, are typically not used for deicing salts.	Most management options[c] are generally applicable to all Category IV sources. Due to the dispersed nature of contaminating activities, and w the high volumes and large areal extent of groundwater affected, corrective actions may be limited to management options in practice.

Source Category	Containment	Withdrawal	Treatment	In-situ Rehabilitation	Management Options
Category V (Provide conduit or induce discharge via altered flow patterns)					
	The applicability of most containment methods[a] to most category v sources depends on well depth. For example, oil wells, geothermal wells, enhanced recovery wells, and solution mining are @ally too deep for any of these methods. Only natural containment would not generally be restricted by depth; limited experience is available using hydraulic barriers for these deep sources. In general, application of any corrective action alternative to Category V sources depends on mechanical condition of wells. Most methods are applicable to construction excavation.	The applicability of some withdrawal methods (e. g., gravity drainage, excavation, and gas venting) to most Category V sources depends on well depth. For example, oil wells, geothermal wells, enhanced recovery wells, and solution mining are typically too deep for these meth- *. Withdrawal enhancement is not applicable to geothermal or water supply wells. only pumping is generally unconstrained in its application to Category V sources. All methods are applicable to construction excavation.	N.R.[b]	The applicability of different in-situ rehabilitation methods varies by source. Site-specific factors must be evaluated to determine the feasibility of natural process restoration. With respect to degradation methods, oil wells and enhanced recovery wells are typically too deep, and geothermal wells have an unfavorable temperature (high) and chemical makeup (brine). Lowering of the water table may be inappropriate for water supply wells.	Most management options[c] are generally applicable to all Category v sources.
Category VI (Naturally-occurring)					
	Most methods[a] are generally applicable to all Category VI sources.	Most methods generally are applicable to all Category VI sources. Constraining factors include depth of the source and areal extent and volume of groundwater affected.	N.R.[b]	Water table adjustment is likely to k applicable to all Category VI sources. Natural process restoration is unlikely to be applicable. Degradation methods are typically not used for asks.	Most ~ * options[c] are generally applicable to all category VI sources.

[a] Neither sheet piles nor cement grout cutof fs have generally performed well in practice for these sources. Performance of all methods involving material tarriers are dependent on compatibility with contaminant s present and geologic conditions.
[b] The source, per se, or contamination la generally not relevant to the choice of treatment technologies except insofar as it indicates which specific contaminants may be present, cent aminant concentration, or the degree of contaminant removal desired.
[c] Source substitution or source removal may not be economically feasible or politically viable for some sources in this category.

Source: Off ice of Technology Assessment