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I. Introduction

Class IV and most Class V wells present the possibility of endangering human health and the environment because they inject fluids into or above underground sources of drinking water (USDWs). Region 5 believes it is necessary to fully assess the potential for this endangerment at some point either before, during, or after closing Class IV or Class V injection wells. Although Class IV wells are banned, the implementation of the Toxicity Characteristic (TC) Rule, published in the Federal Register on March 29, 1990, has caused some Class V wells to be reclassified as Class IV wells. This, along with the recent national shallow-injection well initiative, has focused attention on the issue of closure of those Class V wells which may cause a violation of primary drinking water regulations. Closure, in many cases, is not just ceasing injection into the well, it also may include conducting a site assessment and, if necessary, performing remediation at the site. The goal of conducting site assessment is to determine if contamination of ground water has occurred, and if so, to determine the extent of that contamination. The question that should be answered at the end of a site assessment is whether the injection well should be closed, and if contamination has occurred, whether site remediation should be performed.

The two subcategories of Class V wells that cause the most concern over the possibility of endangering human health and the environment are service station disposal wells (5X28) and industrial waste disposal wells (5W20). Automobile service station wells are a potential hazard because of the presence of hydrocarbons and solvents in the service bay area. Contaminants from spills, washing off automobiles, or disposal of wastes can get into the groundwater via the well at these sites. It is difficult to assess the amount of environmental damage or human health risk that can occur from a 5X28 well due to the variability of the wastestream. Data collected by United States Environmental Protection Agency (USEPA) headquarters of sample analyses taken from 5X28 wastestreams show that up to 36 organic and inorganic contaminants that are listed on the National Primary Drinking Water Standards and/or exhibit a characteristic of toxicity have been injected through a 5X28 well.

For 5W20 wells, the total universe of constituents possibly disposed of via this well type can be quite large. However, the wastestream is usually generated through a consistent industrial process, so the variability of constituents injected into a single well should be less than that for 5X28 wells. Although the variability of constituents may be less, the potential for environmental harm is not lessened. For this reason, 5W20 wells should also be tested to determine the toxicity of the waste being injected in order to evaluate the potential harm that the injection operation may pose to human health and the environment.

As stated above, the TC Rule has caused some Class V wells to be reclassified as Class IV. In addition, chemical sampling and analysis of Class V wells as part of site assessment has shown many wells previously thought to be Class V to be, in actuality, Class IV wells. For example, a preliminary study conducted on 70 5X28 wells nationwide showed that 37% of the sites had sludges that would be characterized as hazardous under the TC Rule and 17% of the sites had liquid that was characterized as hazardous. The data collected to date at Class V wells sampled in Region 5 show similar results. Of the 14 5X28 wells in the Region that were sampled, 21% had hazardous waste or sludge present; likewise, 14% of the 21 5W20 wells were similarly hazardous. Moreover, when comparing the data from these wells to the maximum contaminant levels (MCLs), 64% of the 5X28 and 47% of the 5W20 wells had levels of constituents that exceeded the National Primary Drinking Water standards.

The seriousness of such injection activities may be illustrated using a sample calculation of contaminant transport in a typical aquifer. The derivation of this calculation is elaborated upon in Attachment A. The example chosen is one for a 3.5 mg/l concentration of benzene, a human carcinogen known to cause a higher than normal incidence of leukemia, which was measured in the injectate at a 5X28 well in New York State. Assuming a uniform groundwater flow of 0.002 cm/sec for a typical glacial till aquifer, a concentration of benzene of 0.5 milligrams per liter (mg/l) will be found in the groundwater 0.4 miles down-gradient from the well after one year of injection. This level is still 100 times greater than the health-based MCL for benzene and meets the definition of hazardous waste under the TC Rule. If a water supply well were located within 0.4 miles down gradient of this 5X28 well, there exists the real potential for producing hazardous levels of benzene in the drinking water after only one year of well operation, assuming the generic hydraulic parameters chosen in Attachment A are representative of this site.

This document presents the authorities for the Region to request that a site assessment be performed at Class IV and Class V facilities which may be injecting fluids at concentrations that violate primary drinking water standards and outlines Region 5's guidelines when conducting Class IV and V site assessments. The second part of this document discusses the different levels of site assessment that may be required at a site and the data requirements for each level. Special emphasis is placed on sampling procedures and protocols due to the complexity and wide range of difficulties that may be encountered in conducting a sampling program.

II. Statutory and Regulatory Basis

A. Class IV Wells

The operation of Class IV wells is prohibited under UIC regulations at 40 CFR 144.13(a). In addition, 40 CFR 144.13(b) requires the owner or operator of a Class IV well to comply with Section 144.23 regarding closure of Class IV wells. Section 144.23 provides that for EPA administered programs, the owner or operator of a Class IV well shall plug or otherwise close the well in a manner acceptable to the Regional Administrator. By stating that the well can be

otherwise closed in a manner acceptable to the Regional Administrator, Section 144.23 provides discretionary authority for the Regional Administrator to require actions beyond plugging a well where a Class IV operation has occurred. In addition, under 40 CFR 144.23(b)(2) the owner or operator must submit to the Regional Administrator for approval a plan for plugging or otherwise closing the well. The preamble to the Part 144 regulations promulgated in 1984 elaborates on the discretionary authority available to the Regional Administrator:

> Often, the Agency will want to impose groundwater monitoring requirements prior to closing certain wells to determine whether and to what extent the ground water has been contaminated. Section 144.27 will afford this authority to the Regional Administrator...[I]n some circumstances the Agency will want to require aquifer cleanup. Where ...appropriate, [the Regional Administrator] will require it on a case by case basis pursuant to Section 1431 or other authorities of the Safe Drinking Water Act, and may also draw on the authorities of other statutes such as [CERCLA]. 49 Federal Register 20144, May 11, 1984.

The authority in 40 CFR 144.23 can be read in conjunction with other discretionary authorities available to the Regional Administrator such as the information gathering requirements available under 40 CFR 144.27. This section provides that, for EPA administered programs, the Regional Administrator may require rule-authorized wells (such as Class V or Class IV wells existing at the outset of the UIC program (6/24/84)) to submit information deemed necessary to determine whether the well may be endangering a USDW in violation of 40 CFR 144.12, including chemical analysis, groundwater monitoring and reporting. Failure to submit in a timely fashion any such information requested would result in the loss of authorization of the well in question.

Another discretionary authority is the emergency authority in Section 1431 of the SDWA which provides that upon receipt of information that a contaminant which is present in or is likely to enter a USDW may present an imminent and substantial endangerment to the health of persons, the Administrator (and by delegation the Regional Administrators) may take such actions as deemed necessary to protect the health of persons. This may be done by an administrative order or judicial injunctive relief. The administrative order may be enforced in district court and violations thereof are subject to penalties of $5000 per day of violation. In order to determine whether there is cause for invoking this authority, such as a determination that contaminants which may cause a violation of a primary drinking water regulation are entering the groundwater, it is necessary to perform a site assessment which includes sampling and analysis of the wastestream being injected into the ground.

This emergency authority is reiterated in Underground Injection Control regulations at 40 CFR 144.12(e) which prohibits the abandonment of any injection activity in a manner that allows the

movement of any contaminant into a USDW if such contamination may cause a violation of a primary drinking water regulation or adversely affect the health of persons. While Class IV wells are not specifically mentioned, the authority as it relates to Class V wells may be employed with respect to former Class V wells.

B. Class V Wells

Much of the above discussion regarding Class IV wells, such as the discretionary authority available to the Regional Administrator and the emergency authority in Section 1431, also applies to Class V wells and will not be reiterated here.

In addition to the emergency authority found in Section 1431 and the availability of Section 144.27 to seek information as to the dangers of the injection activity, the enforcement sanctions available in Section 1423 also may be employed for violations of 144.12(a).

Further, subsection (c) of 40 CFR 144.12 provides that if a Class V well may cause a violation of primary drinking water regulations, the Director (Regional Administrator in EPA administered programs) may order such actions as necessary to prevent the violation in accordance with SDWA authorities. Subsection (d) provides that if the Class V well may be otherwise adversely affecting the health of persons, the Director may prescribe actions which may be necessary to prevent the adverse effect, including any action authorized under subsection (c). Neither subsection (c) nor (d) is linked to "an imminent and substantial endangerment." Thus, pursuant to Section 1423 of the SDWA, the prescription of actions for violations of 40 CFR 144.12(a) would include the issuance of an administrative order to comply and to pay penalties of up to $10,000 per day. A civil enforcement action seeking injunctive relief and penalties of up to $25,000 per day would also be available, as well as criminal enforcement.

In summary, if it is determined that there are grounds to believe the operation of an injection activity caused contamination of soils or ground water, the Regional Administrator may require a site assessment, which can include monitoring or sampling, to determine the extent of such contamination under 40 CFR 144.27. Failure to comply with the 144.27 request can be subjected to a Section 1423 compliance order with penalties or referred for judicial action.

Once the extent of the contamination has been established via the site assessment, the Regional Administrator can order the owner/operator to revise the closure plan to include restoration of the aquifer or removal of the contaminated soil in addition to proper plugging of the well under 40 CFR 144.12(a) and (c).

The authorities listed above empower the Regional Administrator to require such actions as necessary to prevent the endangerment of human health and the environment. These actions include requiring the operator to perform some measure of site assessment to determine the magnitude and extent of the groundwater contamination. Based on the nature of the activities occurring at 5X28 and 5W20 sites, the construction of the wells, and the probable constituents of the wastestream, Region 5 feels there is adequate cause to request operators of these sites to perform chemical sampling as part of an initial site assessment to determine if contamination of the drinking water aquifers has occurred. The relevance of sampling at 5X28 and 5W20 sites has been borne out by the results of the preliminary nationwide study described above, which showed that 37% of the sites in the study had hazardous constituents being injected via their wells.

III. Recommendation

It is Region 5's position that, in order to determine whether injection activities have caused endangerment to human health or the environment, at a minimum, first level site assessments should be performed by the owner/operator at all Class IV injection well facilities. Further, site assessments may be required at Class V facilities where it has been determined that injection into the well may cause a violation of drinking water regulations or otherwise adversely affect the health of persons. Such determination may be made based on well type or on a case by case basis.

IV. Elements of a Site Assessment Plan

Site assessments can vary in scope and level of detail. In this document, site assessments have been subdivided into three levels, each level requiring the acquisition of information that is deemed necessary based on the data gathered at the level preceding it. As stated in the recommendation above, all Class IV and most Class V facilities will be required to conduct a first level site assessment. Based on the results of the first level assessment, it may be determined that the site does not warrant further investigation, however, Region 5 reserves the right to require further investigation in the future should it be deemed necessary. If the results of the first level assessment demonstrate that the injection operation may pose harm to human health or the environment, then a second level assessment is required. Likewise, if the second level assessment continues to show the injection operation may pose harm to human health or the environment, then the operator proceeds to a third level assessment. To determine whether a site should undergo level 2 site assessment, Region 5 is using the criteria that if the sampling results obtained under the first level site assessment show the injectate to be classified as hazardous under the TC Rule, then the site will move up to level 2 site assessment. At sites where the injectate does not exhibit a characteristic of toxicity but does exceed a MCL set under the National Primary Drinking Water Standards, Region 5 may request a level 2 site assessment to be performed. Such requests will be made on a site-by-site basis. Should new concentration limits be set for the constituents currently being tested for, or if new information is received showing the limits currently being employed to be too stringent or too lax, then Region 5 will reassess the criteria currently being used to determine when site assessment will move to the second level.

The determination for when to move from level 2 to level 3 will be made based on an evaluation of the proximity of discharge points from the aquifer in question, the volume and mobility of the waste plume, possible subsurface chemical transformations, and other technical considerations. Such determination must be made on a site-by-site basis, hence no set criteria for when to elevate the site assessment from level 2 to level 3 can be given here.

It should be noted that, upon USEPA approval, well closure can be completed, and may be required, at any time during the site assessment. In other words, site assessments up to level three can be initiated and completed before, during and after well closure. The following is a description of the information to be provided for each level of site assessment, including additional detail regarding sampling and analysis.

A. Level 1 Site Assessment

All site assessments submitted by owners/operators of Class IV or V wells should include the following:

1. A description of the injection activity including accurate facility plans and drawings;
2. Diagrams and construction records detailing the construction of the injection well;
3. A Quality Assurance Project Plan (QAPP) that covers data collection, including wastestream sampling, handling and analysis; and
4. The chemical composition of the injectate. Owners/operators of 5X28 wells should analyze their wastes for either the constituents listed in Attachment C of this document or for the constituents listed under 40 CFR 261.24 as exhibiting a characteristic of toxicity. Owners/operators of 5W20 wells should analyze their waste for constituents exhibiting toxicity as described in the TC Rule under 40 CFR 261.24, unless they demonstrate that other chemical analyses can characterize their wastestream more completely than the TC analyses. A step-by-step description of how to determine the appropriate test method(s) is described below.

   Operators should follow the lettered sequence found below when carrying out the sampling and analysis of their shallow injection well waste. Attachment B contains a visual representation of the steps to be followed. Each lettered section below can be treated as a step in the decision-making process necessary to complete a waste characterization. Requirements for a specific well type do not necessarily apply to operators of a differing well type.

   a. Determination of the Presence of Listed Wastes

      Operators of Class V injection wells should be aware that characterization of their wastestream is not wholly dependent upon comprehensive analyte concentration knowledge. Wastes may be hazardous, not only by individual analyte concentration exceedance, but also by matching a specific description of waste(s) found at 40 CFR §261.30-§261.33. Waste codes (F,K,P,U) found in this section

refer to either (1) specific process-generated wastes or (2) listed analytes disposed of on land in a manner for which they were not intended or which do not meet product grade quality standards.

An operator must investigate the possibility that injected waste may meet a definition of hazardous waste as specified in 40 CFR §261-Subpart D. A positive match of waste with the waste codes in this section must be reported to Region 5 UIC staff as soon as it is known. In addition, a positive match may also require some groundwater sampling to determine the nature and extent of the waste contamination. A sampling plan for the site should be approved by Region 5 before sampling is initiated.

b. Operator Knowledge of Characteristically Hazardous Waste

As stated in the March 29, 1990, Federal Register Notice approving the Toxicity Characteristic Leaching Procedure (TCLP) and at 40 CFR 262.11(c)(2), an operator of an injection well may apply knowledge of the waste, the raw materials, and the processes used in its generation to determine if a waste exhibits any characteristic of hazardous waste. Such knowledge must be reported to Region 5 staff as soon as it is known. Any such claim should be supported with relevant documentation, such as Material Safety Data Sheets describing the materials stored or used onsite, a detailed description of the activities or manufacturing processes conducted on site that may contribute to the wastestream, and any management practices employed to prevent wastes from being injected underground.

c. Determining the Sampling Location

The sampling location will vary from site to site depending on well construction and wastestream source and production. The ideal sampling scheme would consist of ground water and soil samples taken at some defined point of compliance, close to the point of injection, in the drainfield or down- gradient from the point of injection. However, designing and implementing this type of sampling program would be time, labor, and cost intensive. For this reason, in a first level site assessment the sampling point may be at the wellhead, oil/water separator, septic tank, or in the dry well, although the operator may elect to conduct a groundwater sampling scheme as described above, if so desired. If the site assessment progresses to level three, then ground water and soil sampling in the drainfield should be conducted.

Sampling at the wellhead is not practical for most 5X28 and 5W20 wells because they do not receive a constant wastestream. For those Class V wells which receive a constant wastestream generated through a uniform, repeated process, sampling should consist of the liquid phase taken at the wellhead or before entering an oil/water separator or septic tank. Sampling a non-constant wastestream at the wellhead is difficult because there is no liquid phase present except during spills

or washing down the site. It is also not representative because, if a sample can be obtained, it will consist of the latest spill or washwater, and will not provide a good indicator of the aggregate wastestream. Therefore, we suggest that if the disposal line is connected to an oil/water separator, liquid and sludge samples be taken from the separator. If a separator is not present and the line empties into a septic tank, then liquid and sludge samples should be taken from the tank. Finally, if there is no separator or septic tank present and the waste is going directly into a dry well, then sludge or sediment samples should be taken from the bottom of the well. If there is a liquid phase present in the well, it should also be sampled.

d. Requirements Specific to 5X28 Injection Wells

Operators of 5X28 wells should submit samples of both their waste sludge and waste water to a laboratory for chemical analysis. A list of 38 waste parameters to be tested for and their approved analytical methods is found in Attachment C. Operators may use this list when selecting a laboratory to perform analytical determinations. This list contains constituents common to the 39 found on the TCLP list, the 75 found on the Maximum Contaminant Level (MCL) list for National Primary Drinking Water standards and the most current database of constituents present in 5X28 wells across the country. Operators have the option of testing their waste using either a test method found in Attachment C or the TCLP method. The operator should notify USEPA which method is to be used prior to sampling. In addition, two characteristic tests are on this list: ignitability and corrosivity. The constituents found in either Attachment C or in the TC rule are those most likely to be of environmental concern in 5X28 wells because sampling data shows that they are the most likely constituents to be found in this well type and they can be present in hazardous concentrations. Quality assurance protocols must be observed as specified in paragraph (f) below.

e. Requirements Specific to 5W20 Injection Wells

Operators of 5W20 wells must submit samples of both their waste sludge and waste water to a laboratory for chemical analysis. The universe of possible individual constituents to be found in any given 5W20 well can be very large, considering the diversity of waste types covered within this well classification. Considering this point, if an operator has not conducted the exercise found under Part IV(A)(4)(b) above, or has found the waste to contain any of the constituents listed under the TC rule, then a complete TCLP analysis is required, along with tests of ignitability and corrosion. A partial TCLP analysis may be required, if upon completion of the exercise in paragraph (b) above, the operator can certify that not all constituents listed in the TC Rule may be present in the wastestream. Quality assurance protocols must be observed as specified in paragraph (f) below.

f. Quality Assurance and Quality Control Requirements

The process of analytical determination is reliable only if standard quality assurance and quality control measures are followed. These items should be described in great detail in a quality assurance project plan (QAPP) submitted to Region 5 for Agency approval prior to implementation of the sampling event(s). A complete QAPP would contain comprehensive descriptions of items 1 through 23 below. Attachment D is a suggested format for QAPP preparation. A complete QAPP would contain the 23 items listed below, presented following the 16 element outline found in Attachment D.

1. Sample description,
2. Sample collector,
3. Sample collection method,
4. Sample collection point,
5. Sample preservation technique,
6. Analytical method for parameter detection/quantification,
7. Anticipated quantification limit for each parameter,
8. Sampling schedule,
9. Equipment cleaning blanks,
10. Trip blanks,
11. Sample replicates,
12. Sample chain-of-custody protocol,
13. Equipment calibration,
14. Data reduction,
15. Data validation,
16. Data reporting,
17. Internal quality control,
18. Performance audits,
19. Systems audits,
20. Laboratory preventative maintenance,
21. Data assessment procedures,
22. Laboratory corrective actions, and
23. Quality assurance reports.

In view of the goal of sampling both 5X28 and 5W20 wells as soon as possible, Region 5 is presently requiring, at a minimum, items 1 through 7 above and all applicable quality assurance/quality control documentation from the laboratory selected. However, Region 5 reserves the right to require additional sampling and analyses, along with a QAPP containing all items above, in the format suggested in Attachment D.

g. Reporting Analytical Results

Operators should submit to Region 5 all documentation sent to them by the laboratory as well as all relevant records maintained by the injection facility. This should be done as soon as possible after the operator receives this information in order that USEPA staff can interpret the results in a timely manner.

B. Level 2 Site Assessment

If the information gathered in the level 1 site assessment shows that injection operations may have introduced contaminants into underground sources of drinking water, then it becomes necessary to determine whether the quantity, location, or toxicity of the contamination poses a threat to human health or the environment. Evaluation of the following information, gathered under a level 2 site assessment, is necessary in order to make such a determination. Well testing, such as slug or pump tests, may be considered in order to gather some of the information requested as part of a level 2 site assessment.

1. A topographic map of the site showing the locations and types of any discharge from or recharge to the injection aquifer, such as public or private water wells, rivers, etc., or other injection wells and septic systems, and the location of any samples taken for chemical analysis, within either a 2 mile radius of the well, or the zone through which the contaminant migrated, calculated using known site-specific hydraulic parameters;
2. The average and maximum rate and cumulative volume of waste injected into the subsurface during the duration of well operation; and
3. A description of the local hydrogeology of the site. This should include, but may not be limited to:
    a. The identification of any aquifer(s) receiving injected waste;
    b. A description and quantification of the groundwater quality of any receiving aquifer and all significant zones of saturation above or immediately below the injection zone;
    c. A description of the ground water flow system, including flow velocity, flow direction, vertical component of flow (if any), and interconnection between the injection zone and any significant zones of saturation located above or below the injection zone;
    d. The depth, thickness, permeability, porosity, water level(s), and lateral variations of the injection zone and any significant zones of saturation located above or below the injection zone; and
    e. The method(s) used to determine all information in parts a. through d. above (e.g. field tests, literature).

C. Level 3 Site Assessment

In moving from level 1 to level 2 site assessment, it was determined that the injection of wastes that are either hazardous or that violate national primary drinking water standards has occurred at the site. In order to move from level 2 to level 3, it should first be determined that the waste plume is in proximity to a point of discharge from the aquifer and that the plume may reach that point of discharge. Therefore, once level 3 is reached, it has already been determined that the injection activity has impacted the environment. The dual goals of level 3 site assessment is to determine whether human health is endangered, and to delineate the extent of the impact on the environment. The information gathered during level 3 site assessment can also be used in planning remediation options, if it has been determined that remediation is necessary.

Upon evaluation of the information submitted in the site assessment under Parts IV(A) and IV(B) of this document, the USEPA may request additional information to be submitted as part of a level 3 site assessment. The information should either demonstrate that the waste plume does not threaten human health or help to determine the extent of the threat. Such information may be in the form of a demonstration that the hazardous constituents in the plume undergo a transformation in the subsurface rendering them non-toxic, or a larger area of review may be searched to demonstrate that the plume will never migrate to a point where it could impact human health. In the event that neither of these options can demonstrate that the waste plume will not threaten human health, it may be necessary for data gathering devices such as a monitoring network be installed at the injection well site.

1. If a groundwater monitoring network is required, the following information should be submitted for approval prior to installation of that network:
    a. The proposed number, location, depth, and construction of detection monitoring wells; and
    b. The techniques, procedures, and analytical equipment to be used for ground water sampling during the assessment, including but not limited to:
        1. Method for measurement of groundwater elevations; and
        2. A quality assurance plan for the installation and operation of a monitoring well network. The plan should conform to the guidelines given in Attachment D.
2. Any additional information may be requested by the Director.

Further information on ground water monitoring can be obtained in RCRA Ground Water Monitoring Technical Enforcement Guidance Document (1986).

The Director may, based on an evaluation of the site, choose to waive any of the elements of a site assessment plan listed above.

V. Attachments

A. Sample Calculation for Contaminant Transport

The governing equations when predicting groundwater contaminant transport can be quite complex, attempting to deal with such elusive variables as contaminant-specific molecular diffusion, physical and chemical isotropy of the medium, and actual direction of groundwater flow. As such, a simplified approach is taken here. The following exercise assumes a one-dimensional particle path, which is directly down the groundwater flow gradient. The aquifer is assumed to have isotropic and homogeneous physical and chemical characteristics. The equation which will predict the velocity of the groundwater flow in the one dimension (x-direction) is

(1) $v_x=(K/n_{ed})(dh/dl)$

Source: Fetter, 2nd ed., 1988

where v_x=velocity in cm/sec

K=permeability in cm/sec
n_{ed}=effective Darcian porosity (%/100)
dh/dl=groundwater gradient (cm/cm)

The equation which governs the transport of a solute in this one-dimensional flow is

(2) $C/C_o=0.5$ [erfc{$(L- v_xt)/(2[sqrt](D_Lt)$}+exp{v_xL/D_L} erfc{$(L+v_xt)/(2[sqrt](D_Lt)$]

Source: Fetter, 2nd ed., 1988

where C=[constituent] at time t (mg/l)
C_o=[constituent] at time t_o (mg/l)
L=distance from well (cm)
t= time (sec)
erfc=complimentary error function
exp=exponential function

Since equation (2) takes the form of $C/C_o=0.5$ (dispersion term + diffusion term), the relative contribution of each term is important. In most cases, the effect of diffusion is orders of magnitude lower than that of dispersion and may be ignored when making an approximation. Hence, equation (2) reduces to

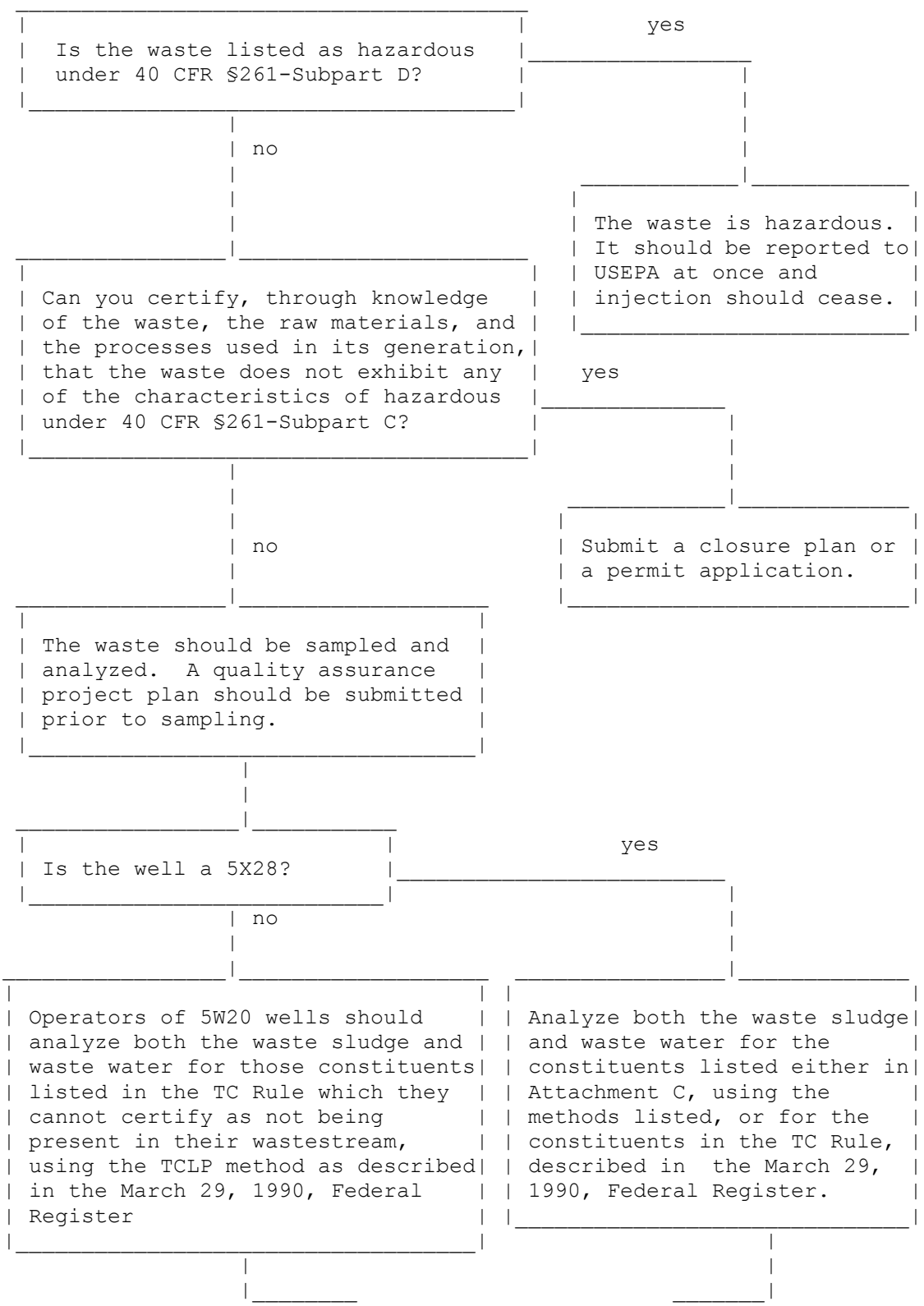
(3) $C/C_o=0.5$ erfc{$(L-v_xt)/(2[sqrt](D_Lt)$}

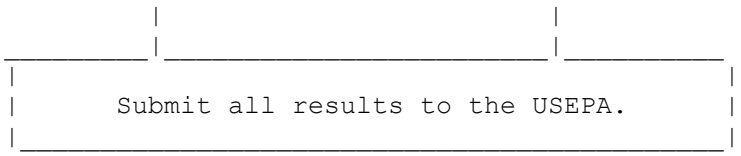
By assigning the measured value of 3.5 mg/l benzene to C_o and defining C to be its TC limit of 0.5 mg/l, we can choose a length of time of injection and calculate the distance at which the hazardous plume front will be found in a linear distance from the well, L. This process is simply done by finding the value of the erfc argument in equation (3) which corresponds to 2.0 C/C_o and then solving for L.

After a year of constant injection, with the input parameters of K=0.1 cm/sec, n_{ed}=0.20, dh/dl=0.01, t=3.15 10^7 sec (1 year), the distance that the hazardous waste plume front will travel is 2136 feet, or roughly 0.4 miles from the well. This calculation is performed using the concentration data from a Class 5X28 well in New York State. The parameters assumed for the hydrogeology are from typical glacial till sand lenses found in Region 5, and are approximations only. It should be noted that site specific values for these parameters are crucial to any such attempt at modeling the extent of plume migration. The extent of contaminant transport is also highly dependent upon such physical factors as topographic relief and water table fluctuations induced by human activity such as water well pumping and aquifer recharge. These factors influence the hydraulic parameters used above. This information, however, is typically not available at many Class V injection well sites.

B. Sampling Flow Chart for 5W20 and 5X28 Operators - Level 1 Site Assessment

ATTACHMENT B
SAMPLING FLOW CHART FOR 5W20 AND 5X28 OPERATORS
LEVEL 1 SITE ASSESSMENT





C. List of Constituents and the Appropriate Test Methods for Class 5X28 Wells

This table was revised September 24, 1999.

INORGANICS		
CONSTITUENT	**PREFERRED METHOD**	**OTHER METHODS**
Arsenic	6010	7060/7061
Barium	6010	7080/7081
Cadmium	6010	7130/7131
Chromium	6010	7190/7191
Lead	6010	7420/7421
Mercury	7470	
Nickel	6010	7520
Selenium	6010	7740/7741
Silver	6010	7760/7761
Ignitability	1010/1020	
Corrosivity	1110	

ORGANICS		
CONSTITUENT	**PREFERRED METHOD**	**OTHER METHODS**
Benzene	8240	8020
Carbon Tetrachloride	8240	8010
Chlorobenzene	8240	8010/8020
Chloroform	8240	8010
1,4-Dichlorobenzene	8250/8270	8010/8020/8120
trans-1,2-Dichloroethene	8240	8010
Dichloromethane (Methylene Chloride)	8240	8010
Ethylbenzene	8240	8020
Hexachlorobenzene	8250/8270	8120
Hexachlorocyclopentadiene	8250/8270	8120
PAHs (Benzo(a)pyrene)	8250/8270	8100

Phthalates	8060	
Tetrachloroethene	8240	8010
Toluene	8240	8020
Trichloroethene	8010	
Vinyl Chloride	8240	8010
Xylenes	8240	8020

PESTICIDES AND HERBICIDES*		
CONSTITUENT	**PREFERRED METHOD**	**OTHER METHODS**
Chlordane	8080	8250
2,4-D	8150	8151
Endrin	8080	8250
Heptachlor	8080	8250
Lindane	8080	8250
Methoxychlor	8080	8270
2,4,5-TP (Silvex)	8150	8151

* Only in agricultural settings.

All test methods are taken from "Test Methods for Evaluating Solid Waste Physical/Chemical Methods, SW-846".

D. Suggested Format for a Quality Assurance Project Plan (QAPP)

SUGGESTED FORMAT FOR A QUALITY ASSURANCE PROJECT PLAN (QAPP)

1. Title Page and QAPP Approval
2. Table of Contents
3. Project Description
4. Project Organization and Responsibility
5. Quality Assurance Objectives for Measurement Data in Terms of Precision, Accuracy, Completeness, Representativeness, and Comparability
6. Sampling Procedures
7. Sample Custody
8. Calibration Procedures and Frequency
9. Analytical Procedures
10. Internal Quality Control Checks
11. Data Reduction, Validation and Reporting
12. Performance and System Audits
13. Preventative Maintenance
14. Specific Routine Procedures Used to Assess Data Precision, Accuracy, and Completeness

15. Corrective Action
16. Quality Assurance Reports to Management

VI. Closure Guidelines

Closure Plan for 1) Septic Systems with Leachfield/Filtration Gallery; or 2) Dry well, Cesspool, or Drainage Well - Prior to commencing any closure activities, the operator must submit an approvable closure plan, in accordance with the guidelines outlined below, and must collect and perform chemical analysis on a representative waste sample in accordance with the methods for the Toxicity Characteristic Leaching Procedure (TCLP) outlined in 40 CFR 261 Appendix II as amended March 29, 1990. Please note that the closure of any well is intended to satisfy Federal requirements and that the operator is further required to ensure that the closure of these wells is in compliance with all applicable State and Local regulations.

1. Locate any floor drains at the facility;
2. Submit a map showing the location of all water wells and surface water bodies within a 100-foot radius of the discharge area;
3. Collect and chemically analyze representative samples from both the liquid and sludge phases of the oil/water separator (if applicable), and the septic tank or dry well, according to procedures specified in an approved Quality Assurance Project Plan (QAPP). All samples must be analyzed according to procedures specified in the QAPP. The QAPP should be prepared by the laboratory and sampling services contractor and must be submitted to Region V for approval;
4. Remove solids from the oil/water separator, septic tank or dry well;
5. Clean and pressure wash all drainage piping leading to the well, fill with clean material and seal;
6. For Septic Systems - Visually inspect the septic tank for integrity and determine if cracks or leaks are present. If none are found, the septic tank can be used for domestic waste. If the septic tank has visible cracks or leaks, it, along with the drainfield and any contaminated soil within the vicinity, must be removed. For Dry Wells - Visually inspect the dry well for integrity and determine if cracks or leaks are present. If the dry well has visible cracks or leaks, it must be removed along with any visibly contaminated soil. Any visibly contaminated soil must be analyzed to determine whether it is hazardous or not, for proper disposal;
7. If the analyses of either the liquid or sludge phases or the surrounding soil indicate that the contents are hazardous (exceeding the regulatory levels under the TC Rule), then the operator must dispose of the waste in accordance with the requirements of 40 CFR Part 262, using a licensed hauler operating in accordance with 40 CFR Part 263 and transporting the waste to an approved RCRA treatment, storage, or disposal facility with authorization under 40 CFR Parts 264 and 265;
8. If the liquid, sludge and soil analyses indicate that none of the contents is hazardous, the operator can contract for removal of the contents through a reputable hauler of domestic wastes;

9. Seal all associated floor drain(s) with concrete or other permanent material unless the floor drain(s) are needed to comply with State or local laws; and
10. If analyses of the liquid, sludge or soil samples indicate the presence of contaminants which may present a threat to human health or the environment, EPA reserves the right to require site assessment to determine the extent of any remediation which may be required.