FINAL GUIDANCE ON DESIGNATION OF CLASSIFICATION EXCEPTION AREAS

Regulatory Basis

The New Jersey Ground Water Quality Standards (GWQS), N.J.A.C. 7:9-6, provide the basis for the protection of the ambient ground water quality of the State through the establishment of constituent standards for ground water pollutants. The Standards impact all Site Remediation cases where ground water contamination exceeds the standards applicable to the Classification Area in which the site is located.

The GWQS recognize the different natural utility of ground waters in various parts of New Jersey and classify ground water according to a combination of natural characteristics and actual or potential uses. For each classification area, designated uses that will be protected are specified. The Standards do include a provision for the Department to designate areas of exception to strict application of the GWQS in certain, specific situations. These circumstances are identified under N.J.A.C. 7:9-6.6, which states that the Department may designate a CEA only when constituent standards are not or will not be met due to (1) natural ground water quality; (2) localized effects of a permitted discharge (e.g., effluent limits above the constituent standards with discharge outside the plume/capture zone); (3) part of a pollution remedy conducted pursuant to an ACO or other Department oversight mechanism or program; or (4) an Alternate Concentration Limit approved pursuant to the New Jersey Pollutant Discharge Elimination System (NJPDES).

As stated in the GWQS, a CEA cannot be established for purposes of sanctioning violations of or achieving compliance with the constituent standards for a given aquifer classification. In designating a CEA, the Department does not condone any violation which resulted in pollutant concentrations above applicable GWQS, but does acknowledge that primary aquifer uses based on classification cannot be met within a given area as a result of the permitted discharge or pollution problem. Unless a CEA is established for an area in which ground water quality criteria are (or will be) exceeded in one of the four circumstances identified above, the permitted discharge or approved remediation must meet the constituent standards applicable to the aquifer classification.

Purpose of Establishing CEAs

The Response to Comments document provides insight into the various purposes of establishing CEAs, particularly with respect to the role of the CEA as a public notification mechanism. In the Response to Comments, it is stated that CEAs are established in order to provide notice that the constituent standards for a given aquifer classification are not or will not be met in a localized area due to natural water quality or anthropogenic influences, and that designated aquifer uses are suspended in the affected area for the term of the CEA. The intent of such Departmental action is to ensure that the uses of the aquifer are restricted until standards are achieved.

Cataloguing CEAs as defined areas of non-compliance with GWQS, particularly on the Geographic Information System, will greatly enhance the ability of the Department to conduct regional ground water studies, perform assessments of the cumulative impacts of industrial pollution on ground water and provide the regional data needed to reclassify some currently designated Class IIA aquifers to Class IIB, designate Wellhead Protection Areas, geographically represent the impact of contaminated sites on ground water, and assist in our long-term environmental planning efforts. Mapping the known and expected pathways of contaminant plumes in relation to source areas and potential receptors also can reduce the future number of IEC cases handled by the Department Site Remediation Program (SRP). In addition, the ability to except contaminated portions of an aquifer from application of the GWQS for the term of a cleanup will allow the SRP to move forward with remediation of contaminated sites where immediate compliance with the Standards by a given discharge may be infeasible.

Components of a CEA

Whenever the Department approves a discharge to ground water through a NJPDES permit, or approves a ground water pollution remedy at a privately or publicly funded contaminated site under an applicable regulatory program, a CEA must be established and notice of the CEA designation provided if the constituent standards are not or will not be met by a discharge and during implementation of an approved remedy, irrespective of the type of remediation (active or passive) implemented. Formal designation of the CEA is effected pursuant to the authority of an oversight document or regulatory program, or as part of a permit approval (see N.J.A.C. 7:9-6.6(a)). SRP will establish CEAs under NJPDES-Discharge to Ground Water (DGW) permits only when a discharge is outside a capture zone.

The three fundamental elements of a CEA are described below. Appendix A provides some examples of equations and models that can be used to delineate CEA plume areas and to calculate the time expected before contaminant concentrations degrade to acceptable standards. It should be noted that the examples in Appendix A, which use a simple analytical model to calculate CEA boundaries and longevity, are intended to illustrate how CEAs involving readily degradable contaminants (e.g., BTEX) and relatively simple geologic settings can be determined. Cases where ground water is contaminated by more persistent pollutants (e.g., chlorinated compounds) and/or where geologic settings are more complex (e.g., bedrock aquifers) may require the use of more sophisticated numerical models.

A CEA consists of a written and mapped description of the area in which constituent standards are not or will not be met in any of the four circumstances outlined above (see "Regulatory Basis"); an identification of the contaminants for which the CEA has been established; and an estimate of the longevity of the CEA. Additional information related to the CEA (such as present and projected future property and surrounding land use, and presence or absence of receptors) should be incorporated into the narrative description based on case particulars.

CEA Boundaries: As specified in N.J.A.C. 7:9-6.6(a), the appropriate boundaries for each CEA shall be determined or described by the Department in the context of an applicable regulatory program. CEA boundaries for permitted discharges must include only the area affected by the

permitted discharge, not the entire plume or site. Pursuant to the Technical Requirements for Site Remediation, N.J.A.C. 7:26E, the horizontal and vertical extent of contamination in all media must be delineated as part of the remedial investigation. In cases where active or natural remediation of a ground water plume is being proposed, the CEA boundaries must include both the current and projected future extent of the plume. If the plume is not expected to migrate offsite, the extent of the CEA can be defined by the site boundaries. The description of the CEA boundaries must include an identification of roads, streams, and other natural and manmade borders, and the lot and block numbers of all impacted properties.

The CEA vertical boundaries should also be defined by an identification of the affected formation(s). For example, if ground water monitoring has verified that contaminant concentrations exceed constituent standards only in the uppermost, unconfined aquifer, then only this unit should be included in the CEA. This does not imply that installation and monitoring of "deeper" wells should be automatically required to verify the absence of contamination at depth. As discussed in "Ground Water Monitoring Requirements," below, ground water monitoring programs should be based on the Technical Requirements for Site Remediation, N.J.A.C. 7:26E, which allow for implementation of more extensive ground water and delineation programs when warranted by site-specific conditions.

N.J.A.C. 7:26E-6.2(a)17 requires submittal of a map of the proposed area of the CEA, compatible with the Department Geographic Information System (see N.J.A.C. 7:1 Appendix A), both as a paper hard copy and electronically by means of computer disk. Further information related to electronic data submissions may be found on the Site Remediation Program home page at the following internet address: http://www.state.nj.us/dep/srp/. The "Regulations and Guidance" page of this web site has a section dedicated to HazSite which includes downloadable files, an explanation of how to use these files to comply with Department requirements, the SRP Electronic Data Interchange (EDI) manual, and the document "Guidance for the Submission and Use of Data In GIS Compatible Formats Pursuant to "Technical Requirements for Site Remediation" ."

Contaminants: N.J.A.C. 7:9-6.6(a) requires that a CEA description specify the ground water contaminants to which the exception applies. CEAs may be developed to include all or some of the ground water quality criteria within a given aquifer classification, and obviously will be dependent on the site-specific pollutants exceeding respective criteria. Each of the constituents for which the CEA is established must be identified. Contaminants which have not been specifically identified as part of the CEA must meet constituent standards within the CEA. Constituent standards of the surrounding classification area are applicable at the boundaries of, and outside, the CEA.

Longevity: CEAs are typically of limited duration and are related to the term of a permit approval or estimated time for completion of a remediation. In some cases (e.g., sites where ground water has been contaminated by metals from historic fill or other discharges), the Department may accept a proposal for an "indeterminate" CEA longevity. If necessary, the term of a CEA also can be renewed or extended in the context of the permit or program providing regulatory oversight.

N.J.A.C. 7:9-6.6(c) states that CEAs established under NJPDES permits shall have the same life as the approved permit action. Since NJPDES-DGW permits are issued for a five (5) year period, a CEA incorporated into a permit action will remain in effect for five years. Pursuant to N.J.A.C. 7:14A-2.8, permits may be administratively continued beyond five years provided that the permittee submits a timely and complete application for renewal. Designated aquifer uses within the CEA are suspended for the term of the permit. Upon expiration of the permit, the constituent standards must be met and the water quality in the affected portion of the aquifer restored so that primary designated uses are viable. In the event that constituent standards are not met at the end of the permit span, the Department has the option to (1) "extend" the longevity of the CEA through the permit renewal process, or (2) require that an active treatment system be modified so that the effluent meets constituent standards.

N.J.A.C. 7:9-6.6(d) states that regulatory actions other than NJPDES permits shall specify the longevity of the exception. Therefore, CEAs established as part of a pollution remedy approved pursuant to a Department oversight document or program will remain in effect for the projected term of the cleanup. If natural remediation is proposed, the responsible party must provide an estimate of the time that will be required for the pollutants to degrade to concentrations below applicable water quality criteria or Practical Quantitation Limits (PQLs) (refer to N.J.A.C. 7:26E-6.2(a)17 and 6.3(d)). This estimate can be based on such criteria as historical ground water monitoring and statistical data (showing decreasing concentrations and trends over time); case studies where similar remedial techniques have been successfully employed for similar pollutant classes; pollutant degradation rates; results of pilot tests; and ground water modeling.

CEAs established as part of an active remediation or under a plan of natural remediation prior to the decision to issue a conditional No Further Action (NFA) approval (see "Ground Water Monitoring Requirements" for a discussion of NFAs with CEAs) should be reevaluated periodically to determine whether the time frame originally projected for contaminants within the area to degrade to acceptable standards needs to be adjusted. The time frame within which a CEA remains in effect can be indeterminate, but not permanent. The only exception to this is when the GWQS are exceeded due to natural water quality. Since the Department will not require anyone to enhance natural water quality in an aquifer, permanent CEAs can be established in such areas.

Responsibility for providing adequate documentation that the constituent standards in the CEA have been met and the CEA designation can be removed rests with the responsible party. Refer to the section entitled "Ground Water Monitoring Requirements" for a discussion of the circumstances under which the Department will require the person responsible for conducting the remediation to perform confirmatory sampling. Following review of data demonstrating that the constituent standards of the designated aquifer classification have been met, the Department will terminate the CEA using, in most cases, the same regulatory/oversight mechanism under which the CEA was established. Constituent standards are met when the least restrictive of the ground water quality criteria or PQLs have been achieved. For example, if the CEA was designated as part of a NJPDES-DGW permit, CEA termination would also be effected under a NJPDES-DGW permit. The Department will also amend the Known Contaminated Site List (KCSL) and Geographic Information System (GIS) to reflect removal of the CEA designation.

Well Restriction Areas

As discussed previously, a CEA designation is required as part of a permit or pursuant to an oversight mechanism or regulatory program whenever compliance with the GWQS is not immediately feasible. In effect, the CEA describes the impact that the ground water contamination has on the aquifer classification. In areas where the risk of impact to a potable receptor is low, the CEA will primarily be a means of notifying the Division of Watershed Management and local officials that water quality criteria are not being met within the designated area. Refer to the section on "Public Notice Requirements" to determine the appropriate level of notice required based on current and projected ground water use within a CEA.

Pursuant to N.J.A.C. 7:9-6.6(d), the Department is obligated to restrict or require the restriction of potable ground water uses within any CEA where there is or will be an exceedance of the Primary Drinking Water Standards (N.J.A.C. 7:10). Therefore, when contaminant concentrations in a CEA exceed Maximum Contaminant Levels (MCLs), and designated aquifer use based on classification includes potable use, the Department will identify the CEA as a Well Restriction Area (WRA). The WRA functions as the institutional control by which potable use restriction can be effected.

The Department ordinarily will not prohibit installation of wells in WRAs but will identify any special installation and construction requirements (for example, installation of double-cased wells below the first confining layer) through the well permit program administered by the Bureau of Water Allocation. Prohibition of well installation may be warranted if installation and pumping of a proposed well would negatively impact an approved remediation. For example, well installation may be prohibited if use of a proposed industrial supply well would draw a portion of a contaminant plume into its cone of influence and alter the configuration of the plume, potentially contaminating a previously clean portion of the aquifer. Although WRAs will be the mechanism by which the Department primarily will protect potable users, restrictions on installation and use of other types of wells (e.g., irrigation, industrial, recovery) also can be required. Figure 1 presents a flow chart to assist in determining when a CEA must be identified as a WRA and the appropriate level of public notice required based on ground water use within an impacted area.

Department Responsibilities

Although the Case Manager, with assistance from support staff, upon request by the lead program, will formally designate an area of non-compliance with the GWQS as a CEA, the information that is needed to develop the CEA should be provided by the responsible party. Pursuant to the Technical Requirements for Site Remediation, N.J.A.C. 7:26E-4.1(b), the horizontal and vertical extent of contamination in all media must be delineated as part of the remedial investigation. The data and information needed to establish CEAs therefore should be collected during and as part of the overall site investigation and remedial decision process.

The Department can require this information under the authority of an oversight document or during the UST or ISRA review and approval process, or as part of the NJPDES-DGW permit application process. The CEA designation can then be incorporated into the appropriate document.

CEAs and WRAs will be developed by the Department for publicly-funded sites. The equations and models referenced in Appendix A, provided as examples of methods available to determine the extent and projected longevity of a CEA, are also applicable to WRAs.

The Remedial Lead will be responsible for providing notifications of CEA designations internally within the DEP. For each CEA established, the Fact Sheet presented as Appendix B must be completed by the case manager (or support geologist, upon request by the lead program). This Fact Sheet and a map on which the CEA has been identified should be sent to the Division of Watershed Management, the Bureau of Water Allocation, and the Environmental Claims Administration. The Bureau of Safe Drinking Water should be notified if the CEA is within one mile upgradient of a public community supply well or wellfield, and there is hydraulic communication between the contaminated water-bearing zone and the portion of the aquifer from which the public community water supply is drawn. Although CEA locations are being catalogued on the Department GIS, separate internal notifications to each of these programs are necessary on an interim basis until current initiatives to integrate the various databases within the Department with the GIS have been completed.

The lead program is responsible for updating the KCSL by indicating that a CEA has been established for a site and the downgradient plume extent. The Division of Watershed Management will track CEAs throughout the State using the GIS and will utilize this information in developing Wellhead Protection Areas. Restrictions on installation of any wells within a CEA will be implemented by the Bureau of Water Allocation whenever application for a permit to drill a well within a CEA is made. Information on CEAs can be used by the Environmental Claims Administration in establishing liability for damages claims which may be filed by affected parties within a CEA.

Public Notice Requirements

As described in the preceding section, the Remedial Lead will provide internal notifications of CEA designations to appropriate programs within the Department. As specified in N.J.A.C. 7:26E-6.2(a)17v, the Department will require the person responsible for conducting the remediation to notify external agencies/affected parties of these designations according to the guidelines established below. By requiring responsible parties to notify appropriate municipal authorities, health agencies, and, when necessary, individual property owners, the Department can ensure that present and potential ground water users are made aware that constituent standards within the designated area have been contravened and that the use of this portion of the aquifer is restricted for the duration of the CEA. Since the Department is primarily concerned with protecting present and future potable users in these areas, the degree of public notice required for a CEA will depend upon both current and projected ground water use in a given area.

The need to establish a CEA for a contaminated area is determined based on the classification of an aquifer pursuant to the GWQS, N.J.A.C. 7:9-6.1 et seq. CEAs must be established under a permit or Department oversight mechanism whenever constituent standards for a given aquifer classification are exceeded, irrespective of present or projected ground water uses within that classification area. At present, there are no portions of the State that are designated

Class II-B areas. Until such time as Class II-B areas are formally established pursuant to the reclassification procedures outlined in the GWQS, CEAs are required when Class II-A standards are exceeded, even in heavily industrialized areas where ground water is not being used for potable or other purposes. No distinction between Class II-A and "probable future" Class II-B areas should be made in deciding whether a CEA is needed.

Present and future ground water use in the impacted area will dictate the appropriate level of public notice required when a CEA is established. Therefore, existing and planned uses of ground water supplies (potable, industrial, agricultural, etc.) within the contaminated area must be identified. N.J.A.C. 7:26E-6.2(a)17iv identifies sources of information that will aid in determining whether the CEA is in a ground water use area. Detailed information on current ground water use can be obtained by reviewing the Department Bureau of Water Allocation records, by consulting the New Jersey Water Supply Master Plan (copies are available for review in the Division of Watershed Management), and by contacting the municipal or regional water purveyor. Bureau of Water Allocation records are less certain for older wells than new wells, and it may be necessary to augment a records review with a door-to-door well search. The best source of information regarding future ground water supplies can be obtained from the municipal or regional water purveyors, who are required to consider issues such as system growth, replacement and new wells or surface water supplies, and the potential locations for such supplies. Since many rural towns do not have municipal or regional water purveyors, both the local planning board and board of health can assist in providing this information in these areas. The New Jersey Water Supply Master Plan also provides information relative to projected ground water use in a given area.

Once ground water use in the affected area has been determined, public notice to the appropriate agencies and affected parties must be provided as specified in N.J.A.C. 7:26E-6.2(a)17v and explained further below.

If the CEA is established under a NJPDES permit, a description of the CEA should be included in the permit Fact Sheet and Public Notice which are routinely distributed to local or county health offices and municipal governing bodies and planning boards. No additional, separate notifications to local officials by responsible parties will be necessary. In a current or planned (based on a 25-year planning horizon) ground water use area, the person responsible for conducting the remediation should document that impacted offsite property owners are individually notified of the CEA designation by the start of the public comment period (30 days), since publication of a newspaper notice does not guarantee that all affected parties are made aware of, and afforded the opportunity to comment on, the proposed permit action.

If the CEA is established pursuant to the authority of an oversight document or regulatory program, the responsible party must provide documentation that appropriate external agencies (local and county health departments, municipal governing bodies, municipal planning board) and, if necessary, impacted property owners have been informed of the CEA designation and ground water use restrictions within the area.

In non-ground water use areas it will be sufficient to provide notice to local authorities only, even if the contaminant plume has migrated offsite. For cases managed by the Division of Responsible Party Site Remediation, notification procedures should follow the RPSR Outreach

SOP. For publicly funded sites, notice must be provided to the municipal governing body and board of health.

In a ground water use area, if a CEA impacts property not owned by the party conducting the remediation, the responsible party must notify individual property owners within the affected area as well as local officials before the Department can approve a RAW (or other cleanup proposal). Should the information and data necessary to identify the boundaries or project the term of the CEA be incomplete at the time of RAW submittal, the Department will be flexible to allow remedial work for the defined plume area to proceed while the additional data are collected. For example, if a plume is split during active remediation and a portion of the plume is allowed to migrate offsite and naturally attenuate, additional ground water monitoring or modeling may be required before a CEA can be designated for the offsite plume. In this case, the Department can approve the RAW for onsite contamination and establish a CEA for the pump-and-treat area, while ground water monitoring data are collected or modeling is performed to project the migration path of the offsite plume and length of time it will take before contaminant concentrations decrease to acceptable standards. Once the data needed to characterize the offsite plume are complete, a second CEA is designated following public notification procedures based on aquifer use in the area, as described above.

Ground Water Monitoring Requirements

It should be emphasized that a CEA will not specify ground water monitoring requirements since it functions as a notification mechanism, not as a "stand alone" enforcement or regulatory document. A CEA is not a remedy, but is an institutional control established in conjunction with an approved remedy, either under a NJPDES permit, or pursuant to the authority of an oversight mechanism or regulatory program. The need for and extent of ground water monitoring required during the term of the CEA should be determined as part of the overall remedial decision process for each site and should be based on the Technical Requirements for Site Remediation, N.J.A.C. 7:26E.

Generally, an approved RAW will include provisions for scheduled ground water monitoring during and, if appropriate, after active remediation has been terminated. For active pump and treat programs, ground water monitoring typically is required to verify that the treatment system is successfully capturing the plume and reducing contaminant concentrations. Ground water monitoring and performance requirements for natural remediation are outlined under N.J.A.C. 7:26E-6.3(e). For natural remediation, ground water monitoring data are used to show that contaminant sources have been contained or removed, plume migration will not impact any receptors before contaminants degrade to acceptable concentrations, and pollutant concentrations are declining over time as predicted. For example, in natural remediation scenarios, the Mann-Whitney U-Test should be applied to eight consecutive rounds of ground water sampling data to document whether a decreasing trend in contaminant concentrations is occurring over time. The need for imposition of requirements to collect eight rounds of ground water monitoring data as part of this demonstration will be determined on a case-specific basis, depending on the presence or absence of historical ground water monitoring data for the site. If at least eight quarters of valid data already exist at the time of RAW approval, for example, the case team will determine the appropriate number and frequency of additional future sampling episodes to verify continuing

contaminant decreases. Since GWQS must be met at the boundaries of and outside the CEA, plume fringe and sentinel well ground water monitoring data can be used to demonstrate that the area in which standards are temporarily exceeded has not increased beyond the original boundaries of the CEA.

Cases where the responsible parties have completed the investigative and active remedial phases under an Administrative Consent Order or a regulatory program (ISRA or UST) but are required to maintain long-term containment and/or ground water monitoring programs for some period of time because it is not expected that constituent standards will be achieved prior to that time, will remain listed on the KCSL although active case management may no longer be necessary. In these situations, the Department must designate a CEA under the authority of the oversight document or regulatory program, and identify any additional ground water monitoring/reporting requirements as part of the remedial oversight mechanism.

Ground water pollution cases in which contaminant concentrations exceed constituent standards should not be given unconditional NFA approval or removed from the KCSL until compliance with the applicable standards has been demonstrated. However, conditional NFAs (NFA with CEA and/or WRA) may be given in cases where ground water contaminant concentrations within a CEA are not expected to meet standards for some time, but active remedial work and continued Department oversight are not needed. For example, in very specific circumstances, leaking UST cases involving petroleum-based ground water contamination may be given a conditional NFA with a CEA following implementation of a natural remediation plan or adequate ground water monitoring to insure that natural remediation has, and continues, to reduce contaminant concentrations such that the GWQS will be met. The criteria which must be met in order for the conditional NFA with a CEA to be given in these UST cases are as follows:

1) Source and source area are remediated (i.e., no soil contamination above the site-specific impact to ground water criteria and no product remaining);

2) Decreasing ground water contaminant trends are established based upon site-specific ground water monitoring and a sound technical decision can be made to predict the duration it will take to meet the GWQS;

3) Monitoring of ground water clearly indicates that contaminants have not and will not migrate beyond given boundaries; and

4) No receptors are at risk and public water supply is available.

A conditional NFA can specify any requirements necessary to ensure continued stability of the site, or require collection of confirmatory samples at the end of the time projected for natural processes to restore ground water quality.

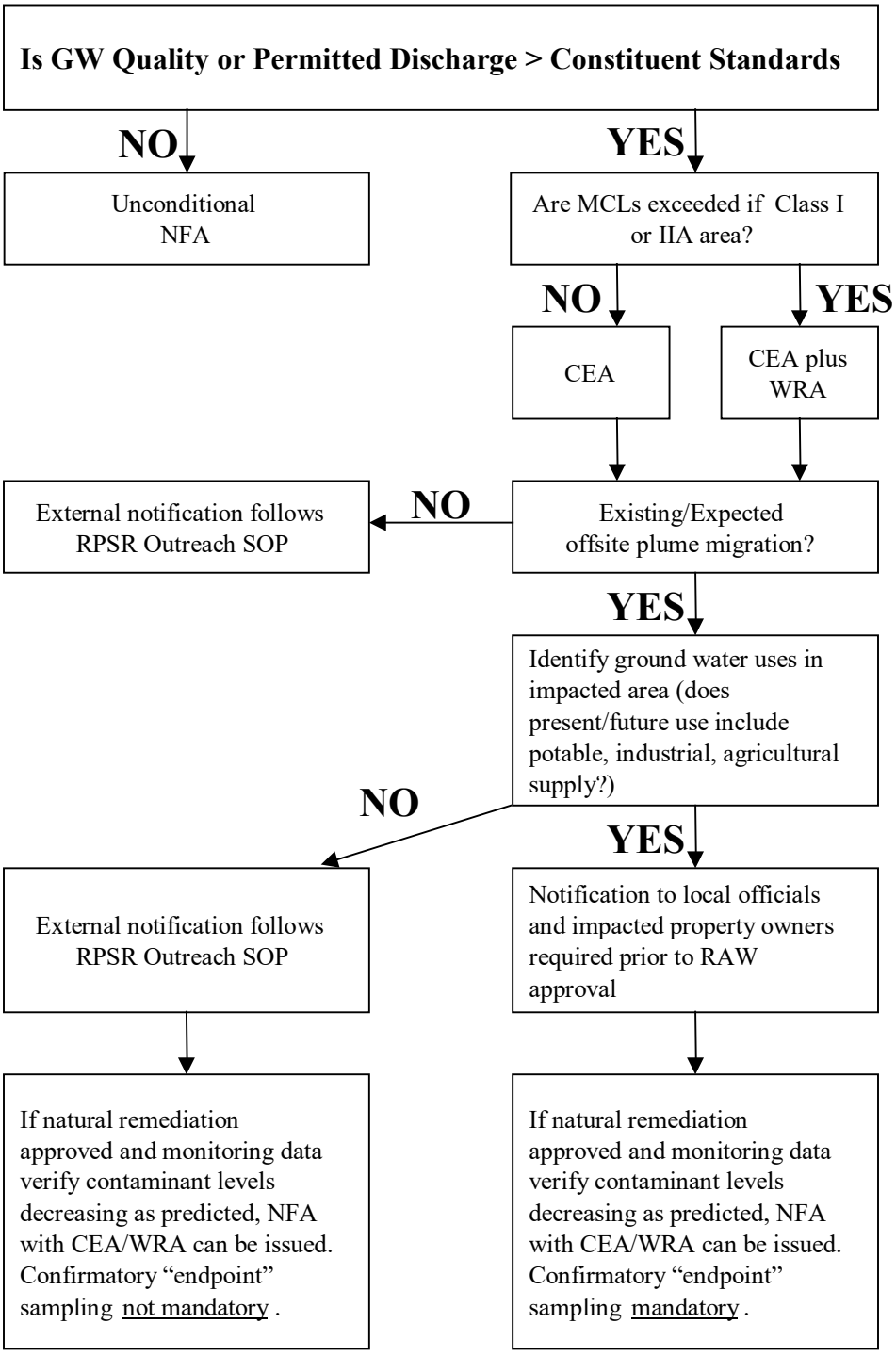
As stated in the "Components of a CEA" section above, responsibility for documenting that contaminant concentrations have achieved the higher of the PQLs or constituent standards rests with the person responsible for conducting the remediation. However, the Department will not require responsible parties to perform confirmatory sampling and submit results for Departmental

review unless the CEA is in a ground water use area (see the preceding section on "Public Notice Requirements" for a discussion on determining ground water use). Although confirmatory sampling will only be required in ground water use areas, the Department will not remove a CEA designation or give an unconditional NFA unless confirmatory ground water sampling indicates that standards have been achieved, and that primary aquifer uses can be restored within the formerly contaminated area (see N.J.A.C. 7:26E-6.1(g)). Refer to N.J.A.C. 7:26E-6.4(a)6 for the confirmatory sampling requirements in ground water use areas.

In present or future ground water use areas, verification that contaminant concentrations have decreased to concentrations below applicable constituent standards should be based on a minimum of two rounds of sampling (N.J.A.C. 7:26E-6.4(a)6). The time between sampling events should ensure that seasonal fluctuations are accounted for. If this demonstration is being made following termination of active remediation, the sampling must be performed after the ground water pumping system has been shut off. Following evaluation of information supporting attainment of the standard, the Department will remove the CEA designation. This review could be conducted under a Memorandum of Agreement (MOA) for cases not assigned to a lead bureau.

FIGURE 1

FIGURE 1


Is GW Quality or Permitted Discharge > Constituent Standards
NO
YES
Unconditional NFA
Are MCLs exceeded if Class I or IIA area?
NO
YES
CEA
CEA plus WRA
External notification follows RPSR Outreach SOP
NO
Existing/Expected offsite plume migration?
YES
Identify ground water uses in impacted area (does present/future use include potable, industrial, agricultural supply?)
NO
YES
External notification follows RPSR Outreach SOP
Notification to local officials and impacted property owners required prior to RAW approval
If natural remediation approved and monitoring data verify contaminant levels decreasing as predicted, NFA with CEA/WRA can be issued. Confirmatory "endpoint" sampling not mandatory .
If natural remediation approved and monitoring data verify contaminant levels decreasing as predicted, NFA with CEA/WRA can be issued. Confirmatory "endpoint" sampling mandatory .

APPENDIX A

METHODS OF CLASSIFICATION EXCEPTION AREA DELINEATION

I. PURPOSE OF THE PROCEDURE

The CEA delineation procedures outlined below should be used to identify the kinds of data needed to project the extent and longevity of an area within which GWQS (Ground Water Quality Standards) are exceeded, and to assist staff in consistent, reproducible CEA determinations. It is not the intent of the Department to require that additional investigative activities be initiated when existing information and data can be used in CEA determinations. The bulk of the input data and information needed for delineation of the CEA should be generated during the remedial investigation phase, as discussed in the text of this guidance document.

Sources of information used in CEA delineations should be, in order of preference, as follows: site-specific data; data from nearby sites; regional studies (the New Jersey Geological Survey is a good source of regional ground water information); and literature values. The methods outlined below also can be used to delineate Well Restriction Areas (WRAs), which are institutional controls implemented by the Department whenever Primary Drinking Water standards (N.J.A.C. 7:10) are violated. When calculating or modeling the extent of a WRA, MCLs should be used in lieu of GWQS (less restrictive of the Ground Water Quality Criteria or PQLs).

II. WATER QUALITY ASSESSMENT REQUIREMENTS

A. TIME FACTOR

1. The designation of water quality at each well location shall be based upon the most recent samples collected and confirmed within the two years prior to the CEA determination. It should be noted that for some cases, it may be more appropriate to use historical "worst-case" data when making CEA determinations. This issue is addressed in Section III-C of this Appendix.

2. Water quality data older than two years should not be included in the CEA determination unless more recent data are not available and it is judged by the Department that these data represent existing ground water quality conditions.

B. CONFIRMATORY WELL SAMPLING

Confirmatory or additional well sampling shall be required if:

1. A significant portion of the data is more than two years old; and/or

2. The full extent of existing ground water contamination has not been determined in a ground water use area (see "Public Notice Requirements" in main text of this guidance for discussion on determining ground water use).

III. DETERMINATION OF CLASSIFICATION EXCEPTION AREA

A. GENERAL

In general, two problems must be solved in order to calculate a CEA. First, the amount of time that the contaminant concentration will take to reach the GWQS must be determined. Second, the distance that the contamination will migrate must be established. Because the purpose of the modeling/calculations is to project the boundaries of the CEA and approximate the time necessary to achieve the GWQS, where multiple pollutant classes are represented in the plume, **pollutants with the greatest mobility and persistence should be used in the models/calculations**.

B. NUMERICAL MODELING OPTION

1. Numerical ground water flow and contaminant transport models (e.g., BIOTRANS, BIOPLUME2, MOC, MODFLOW, etc.) may be used to determine the duration and boundaries of the CEA. The numerical model technique uses an approximate solution to solve an equation. The approximation usually incorporates the finite difference approximation of the flow equation.

Hydrogeologic data, such as hydraulic conductivity (K), Storativity (S), aquifer thickness (b), and ground water head elevations (h), need to be entered for each grid of the model. Sufficient and accurate data must be collected in order to properly model the site. In addition, verification and calibration of the model must be performed to ensure accurate results (prevents "garbage in garbage out"). Numerical models are very powerful and can be used to evaluate very complicated hydrogeologic problems.

2. If this option is chosen, only properly documented models shall be used.

3. If this option is chosen, all data inputs, assumptions and references shall be properly documented.

C. ANALYTICAL SOLUTION OPTION

1. April 1995 Classification Exception Area Guidance Document Model

The model included in the April 1995 version of the Classification Exception Area (CEA) guidance document was initially developed to address cases with "de minimus" volumes of BTEX ground water contamination. The model was an attempt to quickly estimate how far contamination might migrate from a source area. It was a simple solution to a simplistic problem, which applied to a small population of remediation sites. It was not intended to be or presented as a solution for all cases. However, the Department has received numerous submittals using this model to establish a CEA for cases other than those with "de minimus" concentrations of BTEX contamination. In order to apply the model to other cases, the Department has determined that certain clarifications and changes in this Appendix are required, as outlined below.

Geology: The model was developed for uniform sites (i.e., isotropic and homogeneous). The lack of sophistication of this model may make it unsuitable for complex geological regimes, such as a bedrock aquifers or heterogeneous aquifers. Use of this model for these geological conditions will likely yield inaccurate fate and transport results.

Contaminant(s) of concern: The model was developed for gasoline constituents that undergo aerobic degradation. In addition, the model assumes that the site conditions are conducive to aerobic degradation (available oxygen and nutrients).

The model assumes that the compound is degradable and the degradation of the compound is not part of a series (i.e., there are no daughter products). Because of this, the model may not be appropriate for other types of contaminants, especially chlorinated solvents, gasoline additives, and metals.

a. When calculating a CEA duration for a chlorinated solvent, the entire degradation series must be evaluated, including all daughter products.

b. At the present time, the degradation of gasoline additives has not been fully documented, and it is assumed that MTBE and TBA do not degrade. Therefore, the model included in the guidance document should not be used for these additives.

c. In order to establish a CEA for gasoline additives and/or metals, an advection-dispersion model should be used. **As a rule, if the compound does not degrade, this model should not be used**.

Half-life or Degradation Rate: As stated in the April 1995 guidance document, the degradation rate (k) is equal to 0.693 divided by the half-life ($t_{1/2}$). The Department requires that a site specific degradation rate be determined, if possible. Equation 1, which was included in the April 1995 CEA guidance document, can be used to determine a site-specific half-life based on historical sampling data. This approach, although correct, does not account for possible variations in the data set.

$$k = \frac{\ln(C / Co)}{t} \qquad \textbf{(1)}$$

In order to establish a more representative value for the site, the degradation rate should be determined by a linear regression method. The degradation rate is equal to the slope of the best-fit line of the natural log of the sampling data plotted over time (i.e., the slope of concentration vs. time plotted on log normal paper). The correlation coefficient (R) of the best fit line, which is an estimate of how well the data 'fits' a straight line, should also be calculated. The correlation coefficient will assist the Department in the review of the CEA submittal, as well as in determining whether the calculated degradation rate is meaningful. These issues are discussed in more detail below.

Initial Concentration: In the April 1995 guidance document, the initial concentration was defined as the concentration during the most recent ground water sampling event. However, if the plume has already migrated some distance away from the source area, using the most recent concentration will underestimate the duration and travel distance of the CEA. Therefore, for some cases, the highest historical concentration should be used to determine the CEA. In addition, if the discharge occurred significantly before the initial sampling round, the historical

sampling may not represent the highest concentration and may also underestimate the CEA. However, if the ground water contamination has not migrated away from the source area, it may be appropriate to use the most recent sampling data (the model was developed for this scenario).

Using the historical ground water data will also allow the fate and transport model/calculations to be evaluated. For example, if the model predicted that the contaminant plume would migrate 10 feet, but ground water data indicate that the plume has actually migrated 100 feet, then the model should be recalibrated to match the actual site data. In general, the results of the model should always be compared to the actual site data. Using the greatest contaminant concentration can also be used to calibrate the model.

Lastly, the model also assumes that the discharge is a slug release. Therefore, use of this model may yield inaccurate results if the discharge was (or still is) an ongoing discharge.

Partition coefficient: The April 1995 guidance document stated that the octanol–water partition coefficient (K_{ow}) should be used in determining the partition coefficient. In general, the organic carbon partition coefficient (K_{oc}) should be used in calculating the partition coefficient. The K_{ow} should be used only when the K_{oc} is unknown.

2. Modeling Guidance

The following modeling guidance is similar to that included in the April 1995 CEA guidance document. As noted, the differences are in the application of the modeling, and some minor changes to the equations.

As before, the CEA calculation procedure is a two step process. The first step is to determine the duration of the CEA, and the second step is to determine how far the contamination will travel during that time. The following is a description of how to use this model in order to establish a CEA.

Duration: The biotransformation of some hydrocarbon contaminants can be described by Equation 2:

$$C = C_o\, e^{-kt} \qquad \textbf{(2)}$$

Where:
- C = Final Concentration
- C_o = Initial Concentration
- k = degradation rate ($days^{-1}$) or $[0.693 / t_{1/2}]$
- t = time (days)

This equation can be rearranged to calculate the anticipated time to reach the Ground Water Quality Standard (GWQS).

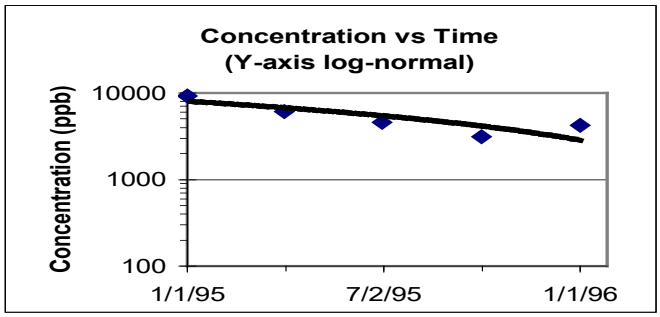
$$t = -\frac{\ln \frac{C}{C_o}}{k} \qquad \textbf{(3)}$$

As noted above, for some cases, the greatest historical concentration should be substituted into Equation 3. However, the most recent sampling data may be used if the contamination has not migrated from the source area.

If enough ground water sampling data have been collected, the Department recommends that a best-fit method be used to determine contaminant degradation rates, rather than using the equations noted above. The following example demonstrates how a degradation rate should be determined using the best–fit method:

Best–Fit Method Example: Sampling data from a single ground water monitoring point

Date	Concentration
1/1/95	9250
4/1/95	6100
7/1/95	4550
10/1/95	3100
1/1/96	4250



k = -0.0024 days-1
R = -0.85

$t_{1/2}$ = -284.0 days

The correlation coefficient (R) determines how well the data actually "fit" the best-fit line, and are values between –1.0 and +1.0. R-values closer to –1.0 or +1.0 indicate that the data better fit the line. R-values closer to zero indicate that the data do not fit the line, and that the degradation rate therefore ***may not be accurate***. This indicates that the model may not be appropriate to use.

Distance: Prior to calculating the projected migration distance of the plume, the seepage velocity and retardation factor must be calculated. The ground water seepage velocity is calculated by Equation 4:

$$V_s = \frac{K^* i}{n_e} \qquad \textbf{(4)}$$

Where:
V_s = seepage velocity
K = hydraulic conductivity
i = hydraulic gradient
n_e = effective porosity

The retardation factor is calculated by Equation 5:

$$R_d = 1 + \frac{K_{oc} * f_{oc} * \rho_b}{n_e} \quad \textbf{(5)}$$

Where: R_d = retardation factor
K_{oc} = organic carbon partition coefficient
f_{oc} = fraction of organic carbon
ρ_b = dry bulk density of aquifer matrix

As noted above, the organic carbon partition coefficient (K_{oc}) should be used in calculating the retardation factor, rather than the n-octanol/water partition coefficient (K_{ow}). If the K_{oc} of a compound is unknown, then it can be calculated from the K_{ow} for that compound. Commonly, the equation $K_{oc} = 0.63 * K_{ow}$ is used (Karichoff et al., 1979[1]). However, there are other algorithms that can be used to calculate K_{oc} from K_{ow} (Fetter, 1993[2]).

The pollutant transport rate is determined by dividing the seepage velocity by the retardation factor (Equation 6):

$$V_{pt} = \frac{V_s}{R_d} \quad \textbf{(6)}$$

Where: V_{pt} = pollutant transport rate
V_s = seepage velocity
R_d = retardation factor

Finally, the distance that the plume might travel is calculated by Equation 7:

$$D = V_{pt} * t \quad \textbf{(7)}$$

Assumptions

This model is not applicable for all sites. There are several major assumptions that have been made in establishing the CEA as shown above, and this method should only be applied when the following assumptions are met:

1. All of the contaminant mass is in the aqueous phase; hence, no mass is contributed by the desorption of contaminants from the soil matrix (unsaturated in addition to saturated),
2. The environment is aerobic (not anaerobic),

[1] Karichoff, S. W., D. S. Brown, and T. A. Scott. 1979. Sorption of hydrophobic pollutants on natural sediments. Water Resources 13:241-248.

[2] Fetter, C. W. 1993. Contaminant Hydrogeology. New York: MacMillan Publishing Company, p. 134.

3. The only variable governing the degradation of a contaminant is biotic. The nutrients, O_2, and hydrocarbon metabolizing bacteria that are needed for this process are present in sufficient quantities as to not limit the contaminant breakdown.
4. The biodegradation of the contaminant is first-order,
5. Advection is the major component of ground water transport (dispersion is negligible), and
6. The formation is homogeneous and isotropic.

Attachment 1

Worksheet to calculate CEA

Given: Compound of Concern: Benzene
Initial Concentration: 400 ppb
GWQS: 1 ppb
Half-life: 100 days

Then: Concentration at given time and half-life

	half-life (days)					
Time [years]	**100**	**25**	**50**	**100**	**250**	**500**
0.25	212.5	31.9	112.9	212.5	310.6	352.5
0.5	112.9	2.5	31.9	112.9	241.2	310.6
0.75	60.0	0.2	9.0	60.0	187.3	273.7
1	31.9	0.0	2.5	31.9	145.4	241.2
2	2.5	0.0	0.0	2.5	52.9	145.4
3	0.2	0.0	0.0	0.2	19.2	87.7
4	0.0	0.0	0.0	0.0	7.0	52.9
5	0.0	0.0	0.0	0.0	2.5	31.9
7.5	0.0	0.0	0.0	0.0	0.2	9.0
10	0.0	0.0	0.0	0.0	0.0	2.5
15	0.0	0.0	0.0	0.0	0.0	0.2
20	0.0	0.0	0.0	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0	0.0	0.0

Amount of time to reach the GWQS

[days]	864.6	216.1	432.3	864.6	2161.	4322.8
[years]	2.4	0.6	1.2	2.4	5.9	11.8

Given:

K = 1.5 ft/day
i = 0.01 ft/ft
n_e = 0.35
ρ_b = 1.5 g/ml
K_{oc} = 63
f_{oc} = 0.005
$t_{1/2}$ = 100 days

Then:

V_s = 0.043 ft/day
R_d = 2.35
V_{pt} = 0.018 ft/day

Final results based on the data given:
Duration of the CEA is: 2.37 Years
Length of the CEA is: 15.8 feet

Site Name: Typical Site

Calculation of the Duration of the CEA

		Predicted Concentration	
Time [years]		**Conc. [ppb]**	
Compound of Concern:	Benzene	0	400.0
Initial Concentration:	400 ppb	0.25	212.5
GWQS:	1 ppb	0.5	112.9
Half-life:	100 days	1	31.9
		2	2.5
		3	0.2
Time to reach GWQS:	864.6 days	5	0.0
	2.4 years	7.5	0.0
		10	0.0
		20	0.0
		25	0.0

Calculation of the Length of the CEA

Hydraulic Conductivity [K] = 1.5 ft/day
Hydraulic Gradient [i] = 0.01 ft/ft
Effective Porosity [n_e] = 0.35
Formation Bulk Density [ρ_b] = 1.5 g/ml
Soil sorption Coefficient [K_{oc}] = 63
Fraction of organic carbon [f_{oc}] = 0.005

Then: Seepage Velocity = 0.043
Retardation Factor = 2.35
Pollutant Transport Rate = 0.018

Duration of CEA 2.37 Years
Length of CEA 15.8 feet

$Vs = K * i / ne$
$= 0.043$ ft/day

$Rd = 1 + (K_{oc} * f_{oc} * \rho_b / ne)$
$= 2.35$

$Vpt = Vs / Rd$
$= 0.018$ ft/day

$$\text{CEA duration} = \frac{-t_{1/2} * [\ln (C/Co)]}{0.693}$$
$= 2.37$ years
CEA length = CEA duration * Vpt
= 15.8 feet

APPENDIX B

CLASSIFICATION EXCEPTION AREA/WELL RESTRICTION AREA
FACT SHEET

Site Name: **DATE:**
Location: (Include Address Municipality and County):
Block(s):
Lot(s):
See Exhibit A (Site Location Map)

Site Contact Person:
Address:
Phone Number:

Case Number: Site Identification # (if applicable - i.e., ISRA or UST Case #, NJPDES permit #, etc.)

DEP Lead Program (Include Phone Number):

DEP (Remedial Action Workplan or No Further Action) Approval Document dated:

Description of CEA:

- Identification of impacted aquifer

Example: Pursuant to N.J.A.C. 7:9-6.5, this area is presently designated as Class II-A. The primary designated use for Class II-A ground water is potable water; secondary uses include agricultural and industrial water. Any proposed ground water use within the CEA will require Department review for feasibility of well installation and modifications that would be protective of any impacts from these contaminants for the duration of the CEA.

- Contaminants exceeding constituent standards and applicable standards

This CEA/WRA applies only to the contaminants listed in the table below. The ground water quality criteria/ primary drinking water standards for these contaminants are listed in parts per billion (ppb). All constituent standards (N.J.A.C. 7:9-6) apply at the designated boundary.

(Note: add MCLs as appropriate)

Contaminant	Ground Water Quality Criteria (ppb)

- CEA boundaries

  Horizontal Boundaries - See Exhibit B (CEA/WRA Location Map)
  Vertical Boundaries - Include appropriate narrative or exhibit

- Projected term of CEA

Note: (Include as applicable) Since ground water quality data indicates exceedance of contaminants above the Primary Drinking Water Standards, and the designated uses of Class IIA aquifers include potable use, the CEA established for this site is also a Well Restriction Area. The extent of Well Restriction Area shall coincide with the boundaries of the CEA.

If any general or specific recommendations regarding well installation or construction can be given at this time, include them in the fact sheet. For example, if there are known or suspected DNAPL pools which could be mobilized and migrate if a clay layer is breached, this should be mentioned.

APPENDIX C

The guidance documents “Minimum Accuracy Requirements for GIS Submissions” and “Administrative Requirements for GIS Deliverables” are available on the GIS webpage at: https://www.nj.gov/dep/srp/gis/.