New Jersey Department of Environmental Protection

Site Remediation Program

ANALYTICAL LABORATORY DATA GENERATION, ASSESSMENT AND USABILITY TECHNICAL GUIDANCE

Version 1.0

April 2014

PREAMBLE

The New Jersey Department of Environmental Protection (NJDEP) has been working to improve the quality and consistency of analytical data used to support environmental investigation and remediation projects statewide. The NJDEP Analytical Technical Guidance Work Group (the Work Group) was established in 2010 to assist and advise the NJDEP in these efforts. The Work Group is comprised of licensed environmental professionals, data validators, and representatives from private laboratories, and the NJDEP. The NJDEP gratefully acknowledges the contributions and assistance of those individuals who volunteered their time and effort to help develop and prepare this document. Specifically, the workgroup would like to thank Peter Hill from the Connecticut Department of Energy and Environmental Protection (CTDEEP) for allowing us to use the CTDEEP *Laboratory Quality Assurance Quality Control Reasonable Confidence Protocols (effective November 2007 and revised December 2010)* and *Laboratory Quality Control Assurance* and the CTDEEP *Quality Control, Data Quality Assessment and Data Usability Evaluation Guidance Document (DQA/DUE Guidance) (effective May 2009 and revised December 2010)* as a starting point for the guidance documents produced by our committee.

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1. INTENDED USE OF GUIDANCE DOCUMENT

This guidance is designed to help the person responsible for conducting remediation to comply with the Department's requirements established by the Technical Requirements for Site Remediation (Technical Rules), N.J.A.C. 7:26E. Because this guidance will be used by many different people that are involved in the remediation of a contaminated site such as Licensed Site Remediation Professionals (LSRP), Non-LSRP environmental consultants and other environmental professionals, the generic term “investigator” will be used to refer to any person who uses this guidance to remediate a contaminated site on behalf of a remediating party, including the remediating party itself.

The procedures for a person to vary from the technical requirements in regulation are outlined in the Technical Rules at N.J.A.C. 7:26E-1.7. Variances from a technical requirement or departure from guidance must be documented and adequately supported with data or other information. In applying technical guidance, the Department recognizes that professional judgment may result in a range of interpretations on the application of the guidance to site conditions.

This guidance supersedes previous Department guidance issued on this topic. Technical guidance may be used immediately upon issuance. However, the NJDEP recognizes the challenge of using newly issued technical guidance when a remediation affected by the guidance may have already been conducted or is currently in progress. To provide for the reasonable implementation of new technical guidance, the NJDEP will allow a 6-month “phase-in” period between the date the technical guidance is issued final (or the revision date) and the time it should be used.

This guidance was prepared with stakeholder input. The following people were on the committee who prepared this document:

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- Nancy Rothman, Ph.D., New Environmental Horizons, Inc.
- Rodger Ferguson, CHMM LSRP, Pennjersey Environmental Consulting
- Stuart Nagourney (Department), Office of Quality Assurance
- David Robinson, LSRP, Synergy Environmental Inc.
- Joseph Sanguiliano (Department), Office of Data Quality
- Phillip Worby, Accutest Laboratories, Inc.

2. PURPOSE

The purpose of this guidance is to provide the framework (and the locations of other technical guidance documents) to generate, assess and use analytical data such that the correct decisions can be made with regard to the remedial processes. This guidance document acts as an "umbrella" document in that it summarizes and ties together three other guidance documents (originating from this Work Group) that are interrelated in purpose yet can stand alone based upon the phase of the data generation and usability decision-making processes.

Usable data result from well though-out processes (as described in these guidance documents). The most important question to ask at the beginning of the process is, "For what purpose are these data to be used?" That question establishes the data quality objective (DQO) that all site investigations have in common. The DQOs are presented in the Quality Assurance Project Plan (QAPP). A QAPP is required per the Technical Rule at N.J.A.C. 7:26E-2.2 for all remedial activities for which data are generated. After data are generated, the processes of data evaluation followed by data usability assessments occur to determine if the data generated can be incorporated into the remedial decision making process and if the data have met the DQOs defined for the activities in question. In order to make the data evaluation and usability assessments easier and standardized such that investigators would have similar conclusions based on the same set of data, Data of Known Quality Protocols (DKQPs) were developed. These protocols should aid the investigator in that much of the "guess work" has been taken out of the decision making process.

3 DOCUMENT OVERVIEW

This guidance and the associated guidance documents were prepared in accordance with the Technical Rules, N.J.A.C. 7:26E, the Site Remediation Reform Act, N.J.S.A. 58:C-1 et seq. and the Administrative Requirements for the Remediation of Contaminated Sites (ARRCS), N.J.A.C. 7:26C.

This guidance document discusses three key topics that are associated with the analytical data generation and usage processes. The principles, purposes and components of a QAPP are addressed. The concepts of data of known quality (DKQ) and its involvement in the data generation and use process (especially with regard to their incorporation into QAPPs) are discussed. Finally, the procedures to evaluate and determine usability assessments are discussed. Due to the importance of each of these three topics, all of these have their own technical guidance documents. The titles of these guidance documents are as follows:

- Data Of Known Quality Protocols Technical Guidance, version 1.0, March, 2013
- Quality Assurance Project Plans Technical Guidance, version 1.0, March, 2013
- Data Quality Assessment and Data Usability Evaluation Technical Guidance, version 1.0, March 2013.

4. PROCEDURES

The results of analyses performed on environmental matrices are used to determine if remediation is needed. Because of the nature of environmental matrices, limitations of analytical methods, characteristics of analytes, and human error, the results of environmental analysis may contain an element of uncertainty and in some cases may be significantly biased, and therefore may not be representative of the actual concentrations of the analytes in the environmental matrix. Thus, an evaluation of the quality of the analytical data in relation to the intended use is important in order for the investigator to make decisions that are supported by data of known and adequate quality.

A significant concept to be taken from these guidance documents is that all analytical data inherently have associated error. It is to be stressed that the "old" preexisting notion of data that are qualified are unusable is a notion that is to be removed from the data usability decision making process. Almost all data are usable for some purpose. Data that have been qualified may still be usable. Good, usable data are established as a result of a partnering (partnership) between the laboratories, investigators and collaborators. Toward this end, all three guidance documents work toward the goal of minimizing error with regard to data generation and usability decisions.

4.1 Quality Assurance Project Plans

The U.S. Environmental Protection Agency (EPA) has developed the QAPP as a tool for project managers and planners to document the type and quality of data needed for environmental decisions and to describe the methods for collecting and assessing those data. The development, review, approval, and implementation of QAPP are part of EPA's mandatory Quality System. The EPA Quality System requires all government organizations to develop and operate management structures and processes to ensure that data used in Agency decisions are of the type and quality needed for their intended use. The QAPP is an integral part of the fundamental principles and practices that form the foundation of the EPA Quality System. NJDEP is in agreement, has adopted much of the views of the EPA and has incorporated those views into its rules and guidance.

The QAPP integrates all technical and quality aspects of a project, including planning, implementation, and assessment. The purpose of the QAPP is to document planning results for environmental data operations and to provide a project-specific “blueprint” for obtaining the type and quality of environmental data needed for a specific decision or use. The QAPP documents how quality assurance (QA) and quality control (QC) are applied to an environmental data operation to assure that the results obtained are of the type and quality needed and expected. The ultimate success of an environmental program or project depends on the quality of the environmental data collected and used in decision-making, and this may depend significantly on the adequacy of the QAPP and its effective implementation.

QAPPs are the primary result of a systematic planning process and are used to document the results of planning, to implement environmental operations, and to assess project data. It is important to remember during the QAPP development process that data quality is an issue because of the possibility of both variability and error in sampling and analysis. The natural environment is inherently variable; nothing stays the same from time-to-time or from place-to-place. In addition, all of our measurement processes are flawed to some degree, imposing error on top of the inherent variability. The QAPP documents the results of the project’s technical planning process, providing a single and concise plan for the collection and management of environmental data and the DQO.

The QAPP should be prepared by the investigator in cooperation with representatives from all groups (i.e., investigator, laboratory, driller, the Department, etc.) expected to be involved in the project. It should be completed before environmental data collection or use activities begin. When changes in the project will affect the technical or DQO of the project, the QAPP will need to be amended with notification of all project participants. QAPPs for multi-year projects should be reviewed periodically and revised when necessary. While time spent on such planning may seem unproductive and costly, the penalty for ineffective planning includes greater cost and lost time. Therefore, it is recommended that a systematic planning process be used to plan all environmental data operations. To support this approach, DQOs are used. The establishment of the DQO(s) for any remedial activity involves a planning process that is developed by the

investigator to ensure that a sufficient quantity of information is collected and to ensure that the quality of the analytical data generated meet the goals of the project and support defensible conclusions that are protective of human health and the environment. More detail describing the DQO process is described in the Technical Guidance for Quality Assurance Project Plans.

The generation of a QAPP may be used in concert with other Department guidance documents. For instance, Conceptual Site Model (CSM) and Ecological Evaluation technical guidance documents may be used to develop a QAPP. While the CSM can greatly assist in explaining results of an investigation, it is not a required deliverable for documents submitted to the NJDEP. The use of the CSM does not replace the need for documenting procedures, or methodologies for proper site investigation or remediation in accordance with the Department's regulatory requirements. Also, the Ecological Evaluation technical guidance on how to conduct an Ecological Evaluation and an Ecological Risk Assessment, pursuant to the Technical Rule at N.J.A.C. 7:26E-1.16 and N.J.A.C. 7:26E-4.8 in environmentally sensitive natural resources associated with contaminated sites could provide useful information with regard to the generation of a site specific QAPP. Additional information as to the content of these topics may be found in their specific guidance documents found at:

http://www.nj.gov/dep/srp/guidance/index.html#analytic_methods.

Finally, it is recognizing that a "one size fits all" approach to quality requirements will not work in the site remediation program. As such, QAPPs are to be generated using a graded approach. Applying a graded approach means that the level of detail for different projects will vary according to the specific objectives, needs and goals of that remediation. For example, the level of activity to be described in a QAPP in a scenario where 10 gallons of number two fuel oil were spilled while filling up an above ground storage tank at a factory are significantly different than a scenario where a former chemical manufacturing facility was located in a populous residential area and the area is to be remediated to residential standards.

4.2 Data of Known Quality Protocols

If the remedial process is to run effectively and efficiently, analytical and environmental monitoring data must be scientifically valid and defensible. A level of precision and accuracy commensurate with the intended use should take into consideration relevant regulations, technical guidance, and investigator's professional judgment. Data that comply with the QA/QC and performance standards detailed in the individual QAPP may be considered **Data of Known Quality (DKQ)**.

Many of the analytical methods used in conjunction with the remediation of sites for SRP contain QA/QC criteria that are user defined and as a result, the QA/QC criteria are variable and are different for each laboratory (albeit QA/QC criteria that may be acceptable under the constraints of a method). It is this variability that poses an impediment to the goal of consistency, especially with regard to data usability decisions. If the assessment and usability process is to work with a level of consistency, then it is important that the analytical QA/QC followed is the same for all laboratories. If not, the task of creating and using a technical guidance document that addresses the assessment and usability of data (most decisions of which are based on the results of laboratories' QA/QC results) may become difficult to interpret. If data are to be assessed and used uniformly and consistently by the investigator and others, then it is beneficial to standardize the QA/QC associated with analytical methods and developed *Data of Known Quality Protocols* (DKQP).

The *NJDEP Analytical Technical Guidance Work Group developed the DKQPs*. The DKQPs are a collection of analytical methods that contain specific performance criteria and are based on the conventional analytical methods published by the EPA and the CTDEEP *Laboratory Quality Assurance Quality Control Reasonable Confidence Protocols (effective November 2007 and revised December 2010)* and *Laboratory Quality Control Assurance and Quality Control, Data Quality Assessment and Data Usability Evaluation Guidance Document (DQA/DUE Guidance) (effective May 2009 and revised December 2010)*. DKQPs have been developed for the most commonly used analytical methods. DKQPs may be developed (employing the same process that was used to generate the current DKQP) for other methods in the future.

When the DKQPs are followed the investigator can have confidence that the data are of known and documented quality. This will enable the investigator to evaluate whether the quality of the data is sufficient for project uses. (When the performance criteria in the DKQPs are met, it is likely that the data will be usable for project decisions.) Information regarding the DKQPs and laboratory QA/QC is presented in the NJDEP guidance document titled *NJDEP Site Remediation Program, Data of Known Quality Protocols Technical Guidance, April, 2014* (DKQ Guidance). The DKQ Guidance and DKQPs are published on the NJDEP web site at:

http://www.nj.gov/dep/srp/guidance/index.html#analytic_methods.

The primary function of the DKQPs is to describe specific QA and QC procedures which, if performed by the laboratory, will provide analytical data of known and documented quality. Other components of this guidance include a **Data of Known Quality Conformance/Non-Conformance Summary** that the laboratory may use to certify whether the data meets the guidelines for DKQ. When DKQ are achieved for a particular data set, the investigator will have confidence that the laboratory has followed the DKQPs, has described non-conformances, if any, and has adequate information to make judgments regarding data quality. Subsequently, this will enable the investigator to evaluate whether the quality of the data is sufficient for its intended purpose. Key document submittals should include details regarding any known conditions or findings that may affect the usability of analytical data.

In order to achieve DKQ, the investigator should conduct the following:

- Use the DKQP specified for the particular contaminant species and matrix analyzed.
- Incorporate required analytical QC elements specified in the QAPP.
- Implement, as necessary, required corrective actions and analytical response actions for non-conforming analytical performance standards.
- Evaluate and narrate, as necessary, identified DKQPs non-compliances.

- Comply with the reporting requirements specified in the *Site Remediation Reform Act*, Technical Rule, and/or ARCCS.

Achieving DKQ status should be considered minimum requirements to assure data validity. Investigators have an obligation to demonstrate and document an overall level of QA/QC (laboratory and field), data usability, and data representativeness adequate for the intended use of the data.

There are many ways to obtain data of known and documented quality. Use of the DKQPs will provide consistency in evaluation and presentation of data quality information that will facilitate review, especially in concert with the *Data Quality Assessment and Usability Evaluation Technical Guidance* available at

http://www.nj.gov/dep/srp/guidance/index.html#analytic_methods.

However, it must be emphasized that DKQPs are NOT required, and other methods with their associated quality control may be acceptable based on a site specific data quality objective. If alternative analytical procedures are used, such procedures should be documented in order to demonstrate that the analytical data produced is of known and documented quality.

Investigators who elect not to utilize the DKQP should utilize a more robust traditional data validation approach. In cases where DKQ is achieved, but where data are qualified as being outside a required QC limit (e.g., low surrogate recoveries), additional evaluation, and possibly additional field sampling and analysis, may be necessary. For example, the investigator may want to collect additional post excavation samples to be satisfied that low surrogate spike recoveries obtained in original samples are reproducible and due to sample matrix effects. However, an investigator performing an initial site investigation may consider data from analyses with low surrogate recoveries as “usable” if the associated data is above regulatory limits and additional investigation is required.

The Data of Known Quality performance standards are given in Appendix B of the *NJDEP Site Remediation Program, Data of Known Quality Protocols Technical Guidance, April 2014*. These protocols will enhance the ability of the investigator to

obtain the necessary information from the laboratory to identify and document the precision, accuracy and sensitivity of data.

4.3 Data Quality Assessment/Data Usability Evaluation

Laboratory QA/QC is a comprehensive program used to enhance and document the quality of analytical data. QA involves planning, implementation, assessment, reporting, and quality improvement to establish the reliability of laboratory data. QC procedures are the specific tools that are used to achieve this reliability.

There are many ways to evaluate the quality of analytical data in terms of precision, accuracy, representativeness, comparability, completeness and sensitivity in relation to the intended use of the data. Precision, accuracy, representativeness, comparability, completeness and sensitivity are collectively referred to as the PARCCS parameters. This guidance document describes a NJDEP-accepted, two-step process for data evaluation. Evaluating the quality of analytical data to determine whether the data are of sufficient quality for the intended purpose is a two-step process. The first step of the process is a data quality assessment (DQA) to identify and summarize any quality control problems that occurred during laboratory analysis (as noted by the QC nonconformances or in the case narratives). The results of the DQA are used to perform the second step, which is a data usability evaluation (DUE) to determine whether or not the quality of the analytical data is sufficient for the intended purpose. Use of the technical guidance provides consistency in evaluation and presentation of data quality information that will facilitate review. Alternative processes may be used (e.g., the USEPA Contract Laboratory Program (CLP) Functional Guidelines). If an alternative process is used, such a process should be documented in order to explain the thought process and may involve a commitment of significant resources to demonstrate that the data are of known and sufficient quality and is usable relative to their intended purpose.

4.4 Target Compounds/Analytes

When the source is unknown, or in other specific instances, the analysis of the EPA Target Compounds/Analytes is required per the Technical Rule at Per N.J.A.C. 7:26E-2.1(c)1:

> *Samples for all environmental media shall be analyzed for:*
>
> *i. The contaminants that may be present as determined during the preliminary assessment and/or from any other information obtained during the remediation; or*
>
> *ii. The Target Compound List plus TICs/Target Analyte List (TCL + TICs/TAL), hexavalent chromium, EPH, and pH when contaminants are unknown or not well documented;*

The EPA CLP Target Compound and Target Analyte Lists (TCL/TALs) were originally derived from the EPA Priority Pollutant List. Priority Pollutants refer to a list of 126 specific pollutants that includes heavy metals and specific organic chemicals. The priority pollutants are a subset of "toxic pollutants" as defined in the Clean Water Act (USA). These 126 pollutants were assigned a high priority for development of water quality criteria and effluent limitation guidelines because they are frequently found in wastewater. The initial list of priority pollutants was based on a 1977 consent decree that settled a legal challenge to the U.S. EPA's program for controlling hazardous pollutants. A relatively small number of revisions to the list have been made by the U.S. EPA Administrator since 1977. Decisions to expand the list must take into account the toxicity, persistence, and degradability of the pollutant; the potential presence and the importance of affected organisms in any waters; and the nature and extent of the effect of the toxic pollutant on such organisms.

In the years since the inception of the CLP, compounds and analytes have been added to and deleted from this list based on advances in analytical methods, evaluation of method performance data, and the needs of the Superfund program. A list of the TCL, separated into volatile organic compounds (VOC), semi-volatile organic compounds (SVOC), pesticides and polychlorinated biphenyls (PCB), and the TAL for metals/cyanide is presented in the tables below. Those compounds highlighted in blue

have available hyperlinks to the Agency for Toxic Substances and Disease Registry (ATSDR) where information including, but not limited to, general chemical information, health affects/risks, and environmental fate for that compound may be found. However, the hyperlinks for these highlighted compounds may not contain the most current toxicological information. Specifically, with regard to the highlighted compounds, the following disclaimer applies:

Disclaimer: Please note that the State of New Jersey, its agencies, its employees and the members of this Work Group assume no responsibility to any person or entity for the use of this information. There are no representations or warranties, expressed or implied, of any kind with regard to this information, and any use of this information is made at the risk of the user. Neither the Department nor the State of New Jersey maintains these web addresses in this guidance document. The Department makes no special endorsement for the content of these links, their sites or the views expressed by the sites' publishers. Web sites may change or remove their contents at any time. Therefore, the Department cannot guarantee that the material on the referenced Web sites will be the same as it was when technical guidance was developed or even that the links will be available. Trademarks (e.g., Microsoft Works, Adobe Acrobat) belong to their respective companies.

Target compounds and analytes noted in Tables 1 through and including Table 4 below may be found on the USEPA website at:

http://www.epa.gov/superfund/programs/clp/target.htm

Table 1 Volatile Target Compound List and Corresponding CAS Numbers

Volatile Compounds	CAS No.	Volatile Compounds	CAS No.
Dichlorodifluoromethane	75-71-8	Methylcyclohexane	108-87-2
Chloromethane	74-87-3	1,2-Dichloropropane	78-87-5
Vinyl chloride	75-01-4	Bromodichloromethane	75-27-4
Bromomethane	74-83-9	cis-1,3-Dichloropropene	10061-01-5
Chloroethane	75-00-3	4-Methyl-2-pentanone	108-10-1
Trichlorofluoromethane	75-69-4	Toluene	108-88-3
1,1-Dichloroethene	75-35-4	trans-1,3-Dichloropropene	10061-02-6
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	1,1,2-Trichloroethane	79-00-5
Acetone	67-64-1	Tetrachloroethene	127-18-4
Carbon disulfide	75-15-0	2-Hexanone	591-78-6
Methyl acetate	79-20-9	Dibromochloromethane	124-48-1
Methylene chloride	75-09-2	1,2-Dibromoethane	106-93-4
trans-1,2-Dichloroethene	156-60-5	Chlorobenzene	108-90-7
Methyl tert-butyl ether	1634-04-4	Ethylbenzene	100-41-4
1,1-Dichloroethane	75-34-3	o-Xylene	95-47-6
cis-1,2-Dichloroethene	156-59-2	m,p-Xylene	179601-23-1
2-Butanone	78-93-3	Styrene	100-42-5
Bromochloromethane	74-97-5	Bromoform	75-25-2
Chloroform	67-66-3	Isopropylbenzene	98-82-8
1,1,1-Trichloroethane	71-55-6	1,1,2,2-Tetrachloroethane	79-34-5
Cyclohexane	110-82-7	1,3-Dichlorobenzene	541-73-1
Carbon tetrachloride	56-23-5	1,4-Dichlorobenzene	106-46-7
Benzene	71-43-2	1,2-Dichlorobenzene	95-50-1
1,2-Dichloroethane	107-06-2	1,2-Dibromo-3-chloropropane	96-12-8
1,4-Dioxane	123-91-1	1,2,4-Trichlorobenzene	120-82-1
Trichloroethene	79-01-6	1,2,3-Trichlorobenzene	87-61-6

Table 2 Semivolatile Target Compound List and Corresponding CAS Numbers

Compound	CAS No.	Compound	CAS No.
Benzaldehyde	100-52-7	4-Nitrophenol	100-02-7
Phenol	108-95-2	Dibenzofuran	132-64-9
Bis(2-chloroethyl) ether	111-44-4	2,4-Dinitrotoluene	121-14-2
2-Chlorophenol	95-57-8	Diethylphthalate	84-66-2
2-Methylphenol	95-48-7	Fluorene	86-73-7
2,2'-Oxybis(1-choloropropane)	108-60-1	4-Chlorophenyl-phenyl ether	7005-72-3
Acetophenone	98-86-2	4-Nitroaniline	100-01-6
4-Methylphenol	106-44-5	4,6-Dinitro-2-methylphenol	534-52-1
N-Nitroso-di-n propylamine	621-64-7	N-Nitrosodiphenylamine	86-30-6
Hexachloroethane	67-72-1	1,2,4,5-Tetrachlorobenzene	95-94-3
Nitrobenzene	98-95-3	4-Bromophenyl-phenylether	101-55-3
Isophorone	78-59-1	Hexachlorobenzene	118-74-1
2-Nitrophenol	88-75-5	Atrazine	1912-24-9
2,4-Dimethylphenol	105-67-9	Pentachlorophenol	87-86-5
Bis(2-chloroethoxy) methane	111-91-1	Phenanthrene	85-01-8
2,4-Dichlorophenol	120-83-2	Anthracene	120-12-7
Naphthalene	91-20-3	Carbazole	86-74-8
4-Chloroaniline	106-47-8	Di-n-butylphthalate	84-74-2
Hexachlorobutadiene	87-68-3	Fluoranthene	206-44-0
Caprolactam	105-60-2	Pyrene	129-00-0
4-Chloro-3-methylphenol	59-50-7	Butylbenzylphthalate	85-68-7
2-Methylnaphthalene	91-57-6	3,3'-dicholorobenzidine	91-94-1
Hexachlorocyclopentadiene	77-47-4	Benzo(a)anthracene	56-55-3
2,4,6-Trichlorophenol	88-06-2	Chrysene	218-01-9
2,4,5-Trichlorophenol	95-95-4	Bis(2-ethylhexyl) phthalate	117-81-7
1,1'-Biphenyl	92-52-4	Di-n-octylphthalate	117-84-0
2-Chloronaphthalene	91-58-7	Benzo(b) fluoranthene	205-99-2
2-Nitroaniline	88-74-4	Benzo(k) fluoranthene	207-08-9
Dimethylphthalate	131-11-3	Benzo(a) pyrene	50-32-8
2,6-Dinitrotoluene	606-20-2	Indeno(1,2,3,-cd) pyrene	193-39-5
Acenaphthylene	208-96-8	Dibenzo(a,h) anthracene	53-70-3
3-Nitroaniline	99-09-2	Benzo(g,h,i) perylene	191-24-2
Acenaphthene	83-32-9	2,3,4,6-Tetrachlorophenol	58-90-2
2,4-Dinitrophenol	51-28-5		

Table 3 Pesticides/PCB Target Compound List and Corresponding CAS Numbers

Compound	CAS No.	Compound	CAS No.
Pesticides		PCBs as Aroclors	
alpha-BHC	319-84-6	Aroclor-1016	12674-11-2
beta-BHC	319-85-7	Aroclor-1221	11104-28-2
delta-BHC	319-86-8	Aroclor-1232	11141-16-5
gamma-BHC (Lindane)	58-89-9	Aroclor-1242	53469-21-9
Heptachlor	76-44-8	Aroclor-1248	12672-29-6
Aldrin	309-00-2	Aroclor-1254	11097-69-1
Heptachlor epoxide	1024-57-3	Aroclor-1260	11096-82-5
Endosulfan I	959-98-8	Aroclor-1262	37324-23-5
Dieldrin	60-57-1	Aroclor-1268	11100-14-4
4,4'-DDE	72-55-9		
Endrin	72-20-8		
Endosulfan II	33213-65-9		
4,4'-DDD	72-54-8		
Endosulfan sulfate	1031-07-8		
4,4'-DDT	50-29-3		
Methoxychlor	72-43-5		
Endrin ketone	53494-70-5		
Endrin aldehyde	7421-93-4		
alpha-Chlordane	5103-71-9		
gamma-Chlordane	5103-74-2		
Toxaphene	8001-35-2		

Table 4 Metals and Cyanide Target Analyte List and Corresponding CAS Numbers

Analyte	CAS No.	Analyte	CAS No.
Aluminum	7429-90-5	Lead	7439-92-1
Antimony	7440-36-0	Magnesium	7439-95-4
Arsenic	7440-38-2	Manganese	7439-96-5
Barium	7440-39-3	Nickel	7440-02-0
Beryllium	7440-41-7	Potassium	7440-09-7
Cadmium	7440-43-9	Selenium	7782-49-2
Calcium	7440-70-2	Silver	7440-22-4
Chromium	7440-47-3	Sodium	7440-23-5
Cobalt	7440-48-4	Thallium	7440-28-0
Copper	7440-50-8	Vanadium	7440-62-2
Iron	7439-89-6	Zinc	7440-66-6
Mercury by Cold Vapor Atomic Absorption (CVAA)			7439-97-6
Cyanide by Spectrophotometry			57-12-5

4.5 Vapor Intrusion Compounds

The analysis of the full list of volatiles for potential vapor intrusion concerns is required by the Technical Rule at N.J.A.C. 7:26E-2.1(c)3,

> *Initial vapor intrusion samples (sub-slab, indoor air, and ambient air) shall be analyzed for the compound list in Table 2 of the NJDEP Method LLTO-15, plus TICs. In addition, when vapor intrusion samples (sub-slab, indoor air or ambient air) are taken due to petroleum contamination other than all gasolines or light petroleum distillates, the samples shall be analyzed for naphthalene in addition to any other site specific contaminant that may be present*.

The table from the LLTO-15 method listing the applicable compounds, CAS numbers, molecular weights and method required reporting limits is shown below. The reporting limits shown below are routinely attainable when a 6 liter canister is used.

Table 5 Vapor Intrusion Compounds

Required Compound Name	***CAS Number***	***Molecular Weight***	***Reporting Limits (ppbv)***	***Reporting Limits ug/m^3***
Acetone	67-64-1	58.08	5.0	12
Allyl chloride	107-05-1	76.53	0.20	0.6
Benzene	71-43-2	78.11	0.20	0.6
Bromodichloromethane	75-27-4	163.8	0.20	1
Bromoform	75-25-2	252.8	0.20	2
Bromomethane	74-83-9	94.94	0.20	0.8
1,3-Butadiene	106-99-0	54.09	0.20	0.4
Chlorobenzene	108-90-7	112.6	0.20	0.9
Chloroethane	75-00-3	64.52	0.50	1
Chloroform	67-66-3	119.4	0.20	1
Chloromethane	74-87-3	50.49	0.50	1
Carbon disulfide	75-15-0	76.14	0.50	2
Carbon tetrachloride	56-23-5	153.8	0.20	1
2-Chlorotoluene	95-49-8	126.6	0.20	1
Cyclohexane	110-82-7	84.16	0.20	0.7
Dibromochloromethane	124-48-1	208.3	0.20	2
1,2-Dibromoethane	106-93-4	187.9	0.20	2
1,2-Dichlorobenzene	95-50-1	147.0	0.20	1
1,3-Dichlorobenzene	541-73-1	147.0	0.20	1
1,4-Dichlorobenzene	106-46-7	147.0	0.20	1
Dichlorodifluoromethane	75-71-8	120.9	0.50	2
1,1-Dichloroethane	75-34-3	98.96	0.20	0.8
1,2-Dichloroethane	107-06-2	98.96	0.20	0.8
1,1-Dichloroethene	75-35-4	96.94	0.20	0.8
1,2-Dichloroethene (cis)	156-59-2	96.94	0.20	0.8
1,2-Dichloroethene (trans)	156-60-5	96.94	0.20	0.8
1,2-Dichloropropane	78-87-5	113.0	0.20	0.9
1,3-Dichloropropene (cis)	10061-01-5	111.0	0.20	0.9
1,3-Dichloropropene (trans)	10061-02-6	111.0	0.20	0.9
1,2-Dichlorotetrafluoroethane	76-14-2	170.9	0.20	1
1,4-Dioxane	123-91-1	88.12	5.0	18
Ethanol[1]	*64-17-5*	*46.07*	*5.0*	*9*

Required Compound Name	*CAS Number*	*Molecular Weight*	*Reporting Limits (ppbv)*	*Reporting Limits ug/m^3*
Ethylbenzene	100-41-4	106.2	0.20	0.9
4-Ethyltoluene	622-96-8	120.2	0.20	1
n-Heptane	142-82-5	100.2	0.20	0.8
1,3-Hexachlorobutadiene	87-68-3	260.8	0.20	2
n-Hexane	110-54-3	86.17	0.20	0.7
Isopropanol[1]	67-63-0	60.10	5.0	12
Methylene chloride	75-09-2	84.94	0.50	2
Methyl ethyl ketone	78-93-3	72.11	0.50	1
Methyl isobutyl ketone	108-10-1	100.2	0.50	2
Methyl methacrylate	80-62-6	100.12	0.50	2
Methyl tert-butyl ether	1634-04-4	88.15	0.20	0.7
Styrene	100-42-5	104.1	0.20	0.9
Tert-butyl alcohol	75-65-0	74.12	5.0	15
1,1,2,2-Tetrachloroethane	79-34-5	167.9	0.20	1
Tetrachloroethene	127-18-4	165.8	0.20	1
Tetrahydrofuran	109-99-9	72.11	5.0	15
Toluene	108-88-3	92.14	0.20	0.8
1,2,4-Trichlorobenzene	120-82-1	181.5	0.50	4
1,1,1-Trichloroethane	71-55-6	133.4	0.20	1
1,1,2-Trichloroethane	79-00-5	133.4	0.20	1
Trichloroethene	79-01-6	131.4	0.20	1
Trichlorofluoromethane	75-69-4	137.4	0.20	1
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	187.4	0.20	2
1,2,4-Trimethylbenzene	95-63-6	120.2	0.20	1
1,3,5-Trimethylbenzene	108-67-8	120.2	0.20	1
2,2,4-Trimethylpentane	540-84-1	114.2	0.20	0.9
Vinyl bromide	593-60-2	106.9	0.20	0.9
Vinyl chloride	75-01-4	62.50	0.20	0.5
Xylenes (m&p)	179601-23-1	106.2	0.50	2
Xylenes (o)	95-47-6	106.2	0.20	0.9

Note 1: Ethanol and Isopropyl alcohol is listed only because labs report data for these compounds, but dilutions are not required. If looking for these compounds, other methods may be required.

4.6 Applicable Standards/Screening Levels

Most investigations will rely on an applicable standard of screening level to determine what additional remediation, if any, needs to be performed. The program has many standards that may have applicability. Those standards with their hyperlinks appear below.

Residential Direct Contact Health Based Criteria and Soil Remediation Standards (RDC SRS)[1] http://www.nj.gov/dep/srp/regs/rs/rs_rule.pdf

Nonresidential Direct Contact Health Based Criteria and Soil Remediation Standards (NRDC SRS)[2] http://www.nj.gov/dep/srp/regs/rs/rs_rule.pdf

Default Impact to Ground Water Soil Screening Levels for Contaminants[3] http://www.nj.gov/dep/srp/guidance/rs/partition_equation.pdf

Default Leachate Criteria for Class II Ground Water (Synthetic Precipitation Leachate Procedure)[4] http://www.nj.gov/dep/srp/guidance/rs/splp_guidance.pdf

Specific Ground Water Quality Criteria (Ground Water Quality Standards)[5] http://www.nj.gov/dep/rules/rules/njac7_9c.pdf

Surface Water Quality Criteria for Toxic Substances (SWQC)[6] http://www.nj.gov/dep/rules/rules/njac7_9b.pdf

Maximum Contaminant Levels (MCL) for State Regulated VOCs[7] http://www.state.nj.us/dep/rules/rules/njac7_10.pdf

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[1] NJDEP, *Remediation Standards*, N.J.A.C. 7:26D.
[2] NJDEP, *Remediation Standards*, N.J.A.C. 7:26D.
[3] NJDEP, *Development of Site-Specific Impact to Ground Water Soil Remediation Standards Using the Soil-Water Partition Equation,* December 2008, http://www.nj.gov/dep/srp/guidance/rs/.
[4] NJDEP, *Guidance for the use of the Synthetic Precipitation Leaching Procedure to Develop Site-Specific Impact to Ground Water Remediation Standards*, June 2, 2008, http://www.nj.gov/dep/srp/guidance/rs/.
[5] NJDEP, *Groundwater Quality Standards*, N.J.A.C. 7:9C.
[6] NJDEP, *Surface Water Quality Standards*, N.J.A.C. 7:9B.
[7] NJDEP, *Safe Drinking Water Act Regulations*, N.J.A.C. 7:10.

NJDEP Master Table Generic Vapor Intrusion Screening Levels including

- Vapor Intrusion Ground Water Screening Levels (GWSL)[8]
- Vapor Intrusion Residential Indoor Air Screening Level (RIASL)[9]
- Vapor Intrusion Nonresidential Indoor Air Screening Level (NRIASL)[10]

All at http://www.nj.gov/dep/srp/guidance/vaporintrusion/vig_tables.pdf

NJDEP Action Levels for Indoor Air[11]
http://www.nj.gov/dep/srp/guidance/vaporintrusion/vig_tables.pdf

Vapor Intrusion Health Department Notification levels (HDNL)[12]
http://www.nj.gov/dep/srp/guidance/vaporintrusion/vig_tables.pdf

Extractable Petroleum Hydrocarbons (EPH)[13]
http://www.nj.gov/dep/srp/guidance/srra/eph_method.pdf

Hexavalent Chromium Cleanup Criterion[14]
http://www.state.nj.us/dep/srp/guidance/rs/chrome_criteria.pdf

Ecological Screening Criteria[15]
http://www.nj.gov/dep/srp/guidance/ecoscreening/esc_table.pdf

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[8] NJDEP, *Vapor Intrusion Technical Guidance*, criteria dated March 2013, http://www.nj.gov/dep/srp/guidance/vaporintrusion/.
[9] Ibid.
[10] Ibid.
[11] Ibid.
[12] Ibid.
[13] NJDEP *Protocol for Addressing Extractable Petroleum Hydrocarbons,* Version 5.0, August 9, 2010, http://www.nj.gov/dep/srp/guidance/srra/eph_protocol.pdf.
[14] NJDEP, *Chromium Soil Cleanup Criteria,* April 2010.
[15] NJDEP, *Ecological Screening Criteria,* March 10, 2009. http://www.nj.gov/dep/srp/guidance/ecoscreening.