Identifier: **SOP-5229**	Revision: **0**
Effective Date: **3/4/09**	Next Review Date: February 9, 2014

Environmental Programs
Waste & Environmental Services

Standard Operating Procedure

for **DEVELOPING DATA QUALITY OBJECTIVES**

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1.0 PURPOSE AND SCOPE

This procedure describes the process for developing and documenting data quality objectives (DQOs) for projects requiring environmental sampling, including defining nature and extent of contamination for a site investigation. These DQOs will be presented at a decision review meeting by the project leader who will be joined by managers, Subject Matter Experts (SMEs), and U.S. Department of Energy – Los Alamos Site Office (DOE/LASO) reviewers.

2.0 BACKGROUND AND PRECAUTIONS

2.1 Background

The DQO process is useful for objectively determining decisions to be made and the number, type, location, and analytical requirements of samples required to be collected to effectively and efficiently support the decision. Los Alamos National Laboratory (LANL) project leaders can use the DQO process to develop an efficient and logical sampling plan and as a means to communicate the basis for the sampling strategy to regulators and other stakeholders.

2.2 Precautions

The DQO process is well documented in various U.S. Environmental Protection Agency (EPA) guidance documents. The formal process involves multiple steps that can involve sophisticated statistical evaluations. This procedure provides a means to use the valuable framework for designing sampling strategies but does not presume that the result will be statistically based sampling plans. Users should be familiar with the EPA's DQO process.

3.0 STEP-BY-STEP PROCESS DESCRIPTION

3.1 Collect needed information for DQO process

Project Leader	1.	Conduct a DQO planning meeting to identify • objectives/scope/milestones • decision makers • resources: facilitator, recorder, and support staff • members of DQO team • action list with roles, responsibilities, and assignments.
	2.	Request appropriate personnel (identified in step 1 above) to complete the assigned part of the DQO Scoping Checklist (Attachment 1). The scoping process involves gathering and evaluating existing historical information about the site or facility under investigation and the technical/regulatory considerations for the monitoring project. This information may include historical reports, analytical data, maps, diagrams, photographs, process knowledge, etc. Most of the information requested on the DQO Scoping Checklist may have already been collected or considered during previous investigations – this may be noted on the form in the Summary section.

3.2	**Develop DQOs**	
Project Leader	1.	Arrange regular meetings as needed to develop the DQOs. Follow the EPA guidance for development of DQOs provided in EPA QA/G-4 (February 2006), as applicable, available at http://www.epa.gov/QUALITY/qs-docs/g4-final.pdf (document number EPA/240/B-06/001 February 2006). An EPA case study in applying the dqo process, "Systematic Planning: A Case Study for Hazardous Waste Site Investigations," is found at http://www.epa.gov/quality1/qs-docs/casestudy-final.pdf
	2.	Document the DQOs developed in Attachment 2 or equivalent version of this form. Attachment 2 is step-by-step guidance of the DQO process for a solid waste management unit (SWMU) aggregate area investigation work plan (IWP).
3.3	**Decision peer review meeting**	
Project Leader	1.	Arrange a decision peer review meeting to review the DQO Scoping Checklist and completed DQOs with appropriate managers, subcontractors, SMEs (geologists, hydrologists, etc), and DOE-LASO personnel.
	2.	Document the decisions made at the decision peer review meeting in an appropriate memo or email to all participants.
3.4	**Implementation of DQOs**	
	1.	Incorporate the final DQO information from the decision peer review meeting into the IWP or other planning document.

4.0 RESULTING RECORDS

The following records are generated as a result of this procedure and are to be maintained in accordance with the applicable records management procedure (EP-DIR-SOP-4003, Records Management):

- Completed DQO Scoping Checklist
- Completed DQO documentation
- Documentation of decisions from Decision Peer Review meeting (memo or email) according to Peer Review procedure (EP-ERSS-SOP-4005, Peer Review Process)

5.0 PROCESS FLOW CHART

No flow chart is included.

6.0 ATTACHMENTS

Attachment 1: 5229-1 DQO Scoping Checklist

Attachment 2: 5229-2 DQO Documentation

7.0 REVISION HISTORY

Revision No. *[Enter current revision number, beginning with Rev.0]*	Effective Date *[DCC inserts effective date for revision]*	Description of Changes *[List specific changes made since the previous revision]*	Type of Change *[Technical (T) or Editorial (E)]*
0		New procedure.	T

Using a CRYPTOCard, click here for "Required Read" credit.

If you do not possess a CRYPTOCard or encounter problems, contact the WES training specialist.

ATTACHMENT 1: DQO SCOPING CHECKLIST

SOP-5229-1 Page 1 of 2

PURPOSE of this form: The following information is required before proceeding with the development of DQOs and finalizing the resulting sampling strategy.

Summarize the requested items below in a separate document and indicate which are not applicable.

1. Identify the decision to be resolved through the study under consideration. What is the focus of the project?

2. Describe the processes/activities for the site under consideration in sufficient detail to support this DQO.

- processes/activities
- dates of operations
- process materials
- constituents and form introduced into the environment from operations

3. Present the most useful pictorial (maps/drawings) materials that can support the DQO.

- maps
- drawings

4. Summarize relevant site visits.

5. Present available analytical data to describe the presence and/or concentrations of chemicals of potential concern (COPCs) at the site under consideration (soil, sediment, air, surface water, waste, groundwater, radiation screening, etc.).

- Are the existing data adequate to support the decision?
- What decisions/conclusions were drawn from existing data?
- What criteria were used to make/draw conclusions from existing data?
- Are additional data needed to complete the investigation?

6. Identify the regulations or other agreements (especially Consent Order) that establish the requirements for the project and describe

- the specific provisions within these regulations that apply
- enforceable milestones, deadlines, or permit conditions that are relevant
- requirements that have been triggered by new data or new data trends.

7. Identify special considerations that affect data collection activities driven by the site/material under evaluation. Identify the governing regulations, if applicable.

- health/safety (e.g., utilities, cliffs)
- biological/cultural (e.g., threatened and endangered species requirements)
- nuclear criticality
- explosive materials, etc.

8. Based on available information, identify COPCs and

- the method for identifying COPCs
- the regulatory limit associated with these COPCs
- the appropriate sampling/analytical methods for evaluating their presence and concentrations
- limitations of the available sampling methodologies.

ATTACHMENT 1: DQO Scoping Checklist

SOP-5229-1 Page 2 of 2

9. Identify the exposure scenarios or modeling that establishes limits for COPCs. If a previous administrative record exists, use limits from this decision.

10. Identify existing studies and fate/transport models/data that evaluate exposure scenarios and/or pathways and describe

- the results of these studies
- results that are applicable to this project under consideration

11. Identify or develop the conceptual site model and any available results for

- COPCs,
- the sources of exposure,
- fate and mobility of the COPCs,
- contaminant transport and affected media,
- potential receptors
- exposure pathways.

ATTACHMENT 2: DQO DOCUMENTATION

SOP-5229-2 Page 1 of 5

Complete this form (or equivalent version) for review at the decision peer review meeting. Follow the EPA DQO process as provided in EPA QA/G4 (February 2006) (available at http://www.epa.gov/QUALITY/qs-docs/g4-final.pdf).

[This example form was created to help project leaders develop consistent DQOs for an investigation work plan. Text in green provides information and instruction on how to complete the item. Paragraphs in black text are standard text that does not (usually) need to be modified.]

Activities	**Output**	**Where to document in IWP**
Step 1: State the problem		
Identify members of the planning team.	*Identify the project leader, Investigation Work Plan subcontractor, SMEs*	n/a
Identify the primary decision maker of the planning team.	*Identify the project leader*	Signature page
Develop a concise description of the problem.	NMED requires that the nature and extent of contamination be identified. Nature (i.e., the COPCs) should be identified based on available technical information, including data from previous samples. Extent is the area and depth of material containing contamination above background values or other specified concentration (action level) to support the stated decision.	Executive summary, Scope of Activities
Specify available resources and relevant deadlines for the study.	*List historical investigation reports (including data and description of operations), operable unit investigations, drawings, reports, and other available documents. Deadlines include date for decision peer review.*	n/a
Step 2: Identify the Decision		
Identify the principal study question.	What are the lateral and vertical nature and extent of contamination for the SWMU or surrounding area? Contaminant concentrations above risk levels will require evaluation and possible remediation.	Executive summary, Scope of Activities
Categorize multiple decisions.	• Identify the COPCs (i.e. "nature" of contamination). • Identify lateral and vertical locations where COPCs have fallen to within a specified concentration *(e.g. background value, 2 * background value, decreasing concentration trend < risk levels, or near/below estimated quantitation limit or detection limit).*	Background or Scope of Activities for historical investigation information and data

State the actions or outcomes that would result from each resolution of the decision statement.	• COPCs are identified • Sampling strategy to determine the lateral and vertical extent of contamination is identified	In Background or Scope of Activities of IWP including operational history of site and historical investigation data. Scope of Activities typically has proposed investigation strategy
Step 3: Identify Inputs		
Identify the information that will be required to resolve the decision.	• Historical sampling information • Conceptual site model of release and subsequent contaminant transport and exposure • Range of background values for contaminants of concern (including fallout values) • Additional samples to fill identified data gaps and adequately represent the distribution of contaminants in each media of concern.	Background or Scope of Activities contains historical sampling information and conceptual site model. Range of background values is in the figures and tables.
Determine the sources for each item of information identified.	• *Title of historical investigation report* • *Titles of other previous investigations* • *Background soil values, if applicable (give reference)*	Background or Scope of Activities contains historical sampling information. Range of background values are in Scope of Activities figures and tables.
Identify the information that is needed to establish the action level for this study.	*Identify the action levels for identifying the extent of contamination; for example:* • *background values,* • *2 × background values,* • *decreasing trends below risk screening levels , and/or* • *estimated quantitation limits*	
Confirm that appropriate field sampling techniques and analytical methods exist to provide the necessary data.	*This is determined on a work plan-by-work plan basis. This will include screening instruments and the analytical laboratory detection limits.*	Field and analytical methods exist. These are described in Investigation Methods.
Step 4: Define Boundaries		
Define the domain or geographic area within which all decisions must apply.	From source areas within the SWMU boundary to areas of decreasing concentration (or other specified action level) in all dimensions and across all affected media. *Consider the drainages that leave the SWMU from the SWMU boundary, down the drainage, to the toe of the slope. Area may be defined by drainage divides, steep slopes, physical structures, etc.*	The description of the SWMUs is presented in Site Conditions. Maps of the sites are presented in Site Descriptions
Specify the characteristics that define the population of interest.	*The media containing COPC concentrations that meet the criteria for extent.*	Contaminant concentrations are known on a SWMU-by-SWMU basis from the historical investigations and reported in Background or Scope of Activities

When appropriate, divide the population into strata that have relatively homogeneous characteristics.	*Materials in different locations (proximity to the source, soils under a septic tank, proximity to drainages, etc.) could be a separate population; different types of materials (e.g., soils, tuff, concrete, and asphalt) could be a separate population.*	The strata are defined in Site Conditions
Define the scale of decision making.	*Define the smallest subset of the population for developing sampling strategy (e.g., individual SWMU and outward). Consider permitted unit as likely smallest subset.*	SWMU-by-SWMU is presented in Background or Scope of Activities
Determine when to collect data.	*Propose on a work plan-by-work plan basis.*	Sampling schedule
Identify any practical constraints on data collection.	*Winter season, land ownership, existing buildings, existing LANL operations, steepness of drainages, time frames for receiving analytical data results, availability of necessary subcontractors, threatened and endangered species requirements, etc.*	Discussed in Scope of Activities and Investigation Methods based on each SWMU.
Step 5: Develop a Decision Rule		
Specify the parameter that characterizes the population of interest.	Contaminant concentrations in the media..	
Specify the action level for the study.	*Document the criteria for defining extent and the basis; for example, the action levels identified in Step 3. :*	Tables and figures in Scope of Activities
Combine the outputs of the previous DQO steps into an "if...then" decision rule that defines the conditions that would cause the decision maker to choose among alternative actions.	*Example:* If [x copc] is above the action level, then the extent of contamination has not been determined.	This should be documented in the IWP, probably in Scope of Activities, although if extent is not defined, the follow-up work is often included in the scope of a subsequent work plan.
Step 6: Specify Limits on Decision Errors	This step is not required for Consent Order investigations, but may be essential for developing an appropriate sampling strategy.	
Determine the possible range of the parameter of interest.	From background values to maximum values	Background or Scope of Activities from historical investigation information.
Define both types of decision errors and identify the potential consequences of each.		
Specify a range of possible parameter values where the consequences of decision errors are relatively minor (gray region).		
Assign probability values to points above and below the action level that reflect the acceptable possibility for the occurrence of decision errors.		

Check the limits on decision errors to ensure that they accurately reflect the decision maker's concern about the relative consequences for each type of decision error.		
Step 7: Optimize the Design		
Review the DQO outputs and existing environmental data.	*Collect all the information from above steps.*	Introduction, Background or Scope of Activities
Translate the information from the DQOs into a statistical hypothesis.	*This step is not required, but should be done if a statistically based sampling plan is developed.*	n/a
Develop general sampling and analysis design alternatives.	*Use expert judgment based on sources, transport mechanisms, geology/geomorphology, soil screening levels, risk levels, and decreasing concentration levels. Alternatively, use a statistically based sampling design. See "things to consider" below.*	
For each design alternative, formulate the mathematical expressions needed to solve the design problems.	*This is not done for sample strategies developed from expert judgment.*	n/a
For each design alternative, select the optimal sample size that satisfies the DQOs.	*This is not done for sample strategies developed from expert judgment.*	n/a
Select the most resource-effective design that satisfies all of the DQOs.	*Expert judgment or statistically based sampling design (or a combination; e.g., judgement in selecting sediment in drainage, statistical design for mesa-top portion of site).*	Scope of Activities
Document the operational details and theoretical assumptions of the selected design in the Sampling and Analysis Plan.	*Each analyte and sampling location/depth is identified in tables and maps.*	Sample locations are presented in Scope of Activities, sampling methods are presented in Investigation Methods

*n/a = Not applicable.

Things to consider when developing sampling plans:

1. Provide the specific rationale for sampling underneath drainlines, including joints, earth stains, etc. NMED has typically requested samples where drain lines exit buildings, at outfall, and in areas in between. For sampling at depth, 2 depths is the minimum number of samples required.

2. If a sample cannot be obtained below a building, make a statement that sampling will occur when the building is demolished; consider alternatives if NMED does not accept this suggestion. Alternatives can include demonstrating that there are no ongoing releases and past releases have low probability of impacting receptors.

3. Sampling design must be related to the conceptual site model. This includes the characteristics of the release, the site geology/geomorphology, location of drainages, location of buildings, etc. Language must be included in the sampling design to demonstrate the relationship to the conceptual site model.

4. Consideration must be given to sampling the full extent of drainages from the SWMU, to the toe of the slope in the canyon. The sampling locations must be based on the geomorphology and the presence of sediment packages – include these descriptions in the justification of locations. Maps must also include the locations of canyons investigation locations.

5. Explain when information is not available about historical operations.

6. For defining nature and extent of a septic tank, consideration must be given to the locations of potential leaks from the tanks and drainlines (inlet pipes, outlet pipes, etc). Samples must be taken at a minimum of two depths.

7. If sampling is not proposed, state the basis: known operations, source term, site geography, etc.