Section 4
SI APPROACH AND RATIONALE

The SI approach employed the data quality objective (DQO) development process. The data quality objective process is presented in EPA guidance (U.S. EPA 1994b) and comprises seven steps:

1. Statement of Problem: This is a concise description of the problem(s) to be studied.
2. Identification of Decisions. The questions the study will attempt to resolve are identified.
3. Identification of Decision Inputs. This step involves identification of who will contribute to the decision making process, and the information (data) that needs to be obtained to make the decisions.
4. Study Boundaries. Study boundaries are temporal, spatial, and resource limits.
5. Decision Rules. These rules are statements that describe the logical basis for choosing among alternative actions.
6. Limits on Decision Error. These limits define allowed variability of measurements of population characteristics based on consequences of a wrong decision.
7. Sampling Design. This step includes definition of the sampling program necessary to collect the data (decision inputs) to make the decisions.

The seven steps in the data quality objective process are discussed below.

4.1 STATEMENT OF PROBLEM

The purpose of the SSTB SI is to collect information concerning the potential presence of hazardous substance contamination at the SSTB. The problem statement is three-part. First, does contamination related to former base operations exist? Second, does contamination related to former base operations present potential significant risk to human health? Third, does contamination related to former base operations present a potential significant ecological risk?

The third problem statement is not addressed as part of the SI. Ecological risk will be evaluated as part of follow-on investigation activities (i.e., the Removal Site Evaluation).

4.2 IDENTIFICATION OF DECISIONS

Decisions made based on data gathered in the SI include:

- No further action is required at a given site.
- A remedy to protect human health should be implemented.
- Additional information is required to make a decision.

A no further action recommendation was made if the data do not indicate former base activities had a measurable effect on the environment or that the effect does not result in a finding of significant risk to human health relative to screening threshold values.

Recommendations for no further action are contingent on the outcome of future ecological risk screening evaluation. If contamination is present and information obtained is conclusive, a remedy is proposed. Additional study is proposed when a site could not be located or the data obtained is judged to be inconclusive, or the human health risk appears to exceed screening thresholds.

4.3 IDENTIFICATION OF DECISION INPUTS

There are two types of decision inputs, guidance and data. Guidance input comes from regulatory agencies and the Navy through policies or procedures and comments on or concurrence with proposed work plans. Input also includes comments by the public or the Restoration Advisory Board, a local organization formed to facilitate community input to the SSTB environmental restoration.

Data input required to make decisions was obtained by the collection and interpretation of field and analytical data. The data inputs collected for the SI are discussed in more detail in Section 4.7.

4.4 STUDY BOUNDARIES

The investigation was concentrated on potential contaminant sources identified in the PA (NEESA 1993) prepared for the SSTB. Sampling was conducted in locations estimated to have the highest potential for contamination. The sites investigated at the SSTB are loosely grouped into the following four categories of suspected contaminant sources:

- landfills (Sites 1, 4, 11, 12, 13, and 14),
- leach fields and septic tanks (Sites 6, 7, 20, 23, 25, and Remote Camera Site B1),
- aeroballistic targets (Site 10), and
- maintenance facilities (Sites 8, 9, 15, 16, 17, 18, 19, 21, and 22).

The last category includes maintenance facilities and shops (Sites 8, 9, 15, 16, 17, 18, and 19), the oiled roads (Site 21), and the small arms range (Site 22).

The SI also included an effort to characterize background conditions for comparison with the data obtained from the potentially contaminated sites. The background characterization effort was designed to reflect the range of investigation methodologies, sampling rationales, and analytical protocols selected for the various sites.

4.5 DECISION RULES

The decision rules applied to reach the SI conclusions are presented in a flowchart format which illustrates the sequential nature of the decisions to be made. The flowchart is presented as Figure 4-1 and discussed below.

The exact locations and extents of sites identified in the PA (NEESA 1993) and the Work Plan (JEG 1993) were uncertain. The first set of decision statements was developed to assess the locations and extents of sites for further investigation.

Once the boundary of a given site was identified, it was characterized. Analytical and other data were gathered which were intended, based on the historical information and site location, to sample the part of the site most likely to be contaminated.

The next series of decision rules encompasses the main portions of the problem statement: "does contamination related to former base operations exist, and, if so, does that contamination present potential significant risk to human health?" The outcome of the decision making process is whether there is a finding of significant risk from contaminants from past operational practices at SSTB. If there is significant risk, additional work may be required to evaluate the extent of contamination and assess potential remedies. If significant risk to human health is not identified, the extent of future action will be restricted to ecological assessment.

4.6 LIMITS ON DECISION ERROR

Application of the decision error analysis step of the DQO process is appropriate when using statistical estimates of a characteristic of the sampled population versus a fixed action threshold. The SI approach incorporated a judgmental sampling approach which involved the comparison of individual sample values with background threshold values (upper tolerance limits, see Section 6.2) and health-based screening values. The process of setting limits on the decision error, as discussed in the DQO guidance, are not applicable to this SI.

4.7 SAMPLING DESIGN

To assemble the data required to make the decisions, investigation methodologies were selected. The investigation methodologies included the following:

- land and marine geophysical surveys;
- land surveying and aerial topographic mapping;
- soil gas surveys;
- a radiological survey;
- collection and laboratory analysis of soil samples collected from the shallow surface, soil borings, and test pits;
- collection and laboratory analysis of groundwater samples from monitoring wells;
- aquifer testing;
- collection and laboratory analysis of sediment samples using a vibrocore sampler; and
- collection and laboratory analysis of surface water samples.

The investigation methodologies employed at each site are summarized in Table 4-1.

The field activities were conducted at an accelerated pace to satisfy project scheduling constraints. Therefore, various phases of interdependent field implementation were

conducted concurrently. For instance, land geophysical surveys, soil gas surveys, and drilling were conducted during overlapping time periods. The activities were scheduled so that initial investigations related to the location and delineation of potential contaminant sources (e.g., geophysical surveys) were completed first at each site. Subsequent phases of investigation (e.g., collecting soil samples) were then conducted based on the information obtained during the initial phases of investigation.

4.7.1 Feature Location and Delineation

Because the locations of most of the sites were not accurately known, geophysical surveys were performed to locate and delineate suspected subsurface contaminant sources such as landfills, underground fuel tanks, underground septic tanks, leach lines, and unrecovered aeroballistic test units. Test pits were excavated to confirm the sources of subsurface anomalies interpreted from the land geophysical survey results, with the exception of leach lines. Test pits were also excavated to locate and delineate landfills.

4.7.2 Surveying

Aerial topographic mapping was performed for the entire SSTB to prepare a base map for documentation of the SI activities. Land surveying was performed to document locations and elevations of all soil borings, groundwater monitoring wells, test pits, soil gas sampling locations, and to identify the limits of geophysical survey grids. Marine sampling and geophysical survey locations were determined using differential global positioning system (GPS) units.

4.7.3 Contaminant Characterization

To identify and quantify potential contaminants, soil gas and radiological surveys as well as soil, groundwater, sediment, and surface water sampling were conducted. The selection of sampling methodology was based on the nature of the suspected contaminant(s) and potential contaminated medium. For instance, soil gas surveys were conducted only where the presence of volatile organic compounds (VOCs) was suspected based on historical information, and sediment and surface water samples were collected only for partially or completely submerged sites (i.e., Sites 4, 10, and 12). Common uses of suspect and potential contaminants are listed in Appendix B.

4.7.3.1 SAMPLING RATIONALE

Sampling locations and intervals (depths) were selected based on the nature of the suspected contaminant(s), location of features identified based on the results of the geophysical surveys, and the nature of the potential contaminated media. Soil sampling intervals were typically selected from areas and depths estimated to have the greatest potential for contamination and/or contaminant migration (e.g., proximate to the suspected source such as a leach line or within a landfill and within the capillary fringe overlying the groundwater table). Groundwater monitoring wells were typically installed to evaluate groundwater gradient and collect groundwater samples to characterize

contaminant concentrations upgradient, underlying, and downgradient of the potential contaminant source(s) at each site.

4.7.3.2 SELECTION OF ANALYTICAL METHODOLOGIES

Analytical methods selected for samples reflected the types of contaminants expected for the sampled medium. For instance, samples collected at landfill sites, where numerous potential contaminants were possible, were typically subjected to a wider range of analyses. At sites where the potential contaminants were better defined (e.g., expended lead bullets at Site 22, the Small Arms Range), the range of analyses was more narrowly focused. The analytical methodologies employed for samples collected at each site are summarized in Table 4-2.

The analytical methods were selected based on Navy guidance (NEESA 1989) and the need for deliverables which could be subject to validation. U.S. EPA Contract Laboratory Program (CLP) methods and deliverables met those initially identified requirements. Additional data requirements were identified later, specifically detection limit needs, which were not met by the CLP methods. The detection limits for some analytes, principally VOCs in groundwater samples, were greater than some health-based screening threshold values. Specific discussion of this issue is presented in Section 5.2. Appropriate methods will be used to achieve the desired data objectives in future work, based on contaminants of concern. It should be noted that it is not always technically feasible to achieve detection limits less than the health-based screening thresholds, which are developed as risk-based concentrations.

4.7.4 Contaminant Fate and Transport Parameter Characterization

Aquifer testing, groundwater elevation monitoring, and lithologic characterization were performed to identify parameters affecting the fate and transport of potential contaminants. The aquifer testing and groundwater elevation monitoring were conducted to evaluate the subsurface hydrogeologic conditions. Geologic logging and geotechnical testing of soil and sediment were conducted to characterize the subsurface soils.

4.7.5 Risk Screening

Risk screening was performed to evaluate if the analytes detected in samples collected during the SI present potentially significant human health risks that may warrant further investigation and/or remedial action. The risk screening was performed using two data sets, one representing **total combined risk**, and the second representing **incremental risk**.

The total combined risk is based on calculations which include all analytes detected. It represents the risk due to both naturally occurring analytes and potential contaminants related to previous base activities.

The incremental risk estimate is based on a data set prepared by removing naturally occurring metals and radionuclides present at background concentrations (i.e., less than

the calculated upper tolerance limit $[UTL]_{(95,95)}$ values) from the first (total combined risk) data set. Risk estimates based on the second data set represent that due to the potential presence of contaminants that may have been released to the environment by Navy operations at the SSTB.

Assumptions and qualifications incorporated into the risk screening and the conclusions are further discussed in Section 7.

4.7.6 Standards for Data Quality

The following processes helped to assess whether the data quality was sufficient to achieve the objectives of the SI:

- Published and controlled CLEAN II standard operating procedures were employed for field and data gathering procedures.
- Technical specifications, developed for the CLEAN II program, were followed by subcontractors.
- Field and drilling logs, as well as calculations, were subjected to second party review by qualified staff. Logs, calculations, and notes were reviewed for internal consistency and discrepancies were resolved.
- Electronic laboratory data deliverables were subjected to 100-percent verification against report hard copies.
- Laboratory data were subject to ten-percent Level C validation. The presence of any rejected data would have required additional review of the balance of the data.
- Field operations were audited by the CLEAN II Quality Management staff, with documented findings and corrective action requirements, in accordance with the CLEAN II Quality Management Plan.
- Analytical detection limits were compared with health-based screening threshold values.

The results of data review following the processes outlined above is described, as appropriate, in Section 5 of this report. The data review indicates that the data quality was sufficient to achieve the objectives of the SI.