This appendix of the Interim Facility-Wide Groundwater Monitoring Plan (the Interim Plan) provides supplemental information relevant to sampling frequencies and analytical suites assigned to locations in each area-specific monitoring group or watershed within Los Alamos National Laboratory (LANL or the Laboratory). The following are primary considerations used to define sampling frequencies and analytical suites that are protective of groundwater:

- general types of contaminants released from upgradient sources
- extent to which contaminant nature and extent have been defined
- expected transport characteristics of the released contaminants
- frequency of detection of contaminants in the monitoring group
- magnitude of concentrations relative to the lowest applicable standard
- nature and rate of change of contaminant concentrations
- regulatory direction specified in New Mexico Environment Department (NMED) approval letters related to earlier Interim Plans
- programmatic data requirements to support decisions regarding corrective actions

The highest sampling frequencies apply to areas where a mobile contaminant has been detected above a standard but its nature and extent may not be characterized sufficiently to support decisions about potential remedial actions to be taken. Lower sampling frequencies apply to analytes that are not of significance for a given monitoring group, are relatively immobile in the subsurface, and have not been detected or have been detected infrequently.

The following general rules of thumb were used to define the lowest sampling frequencies for specific analytical suites (excluding those locations undergoing characterization sampling).

Field Parameters. Field parameters are measured at all locations during every sampling event. Field parameters include pH, turbidity, specific conductance, dissolved oxygen, and temperature. Oxidation-reduction potential will be measured if a flow-through cell is used and will not be measured in surface water, spring water, or water collected from Westbay sampling systems unless specified otherwise.

Inorganic Constituents. General inorganics and metals are typically sampled annually if these suites contain one or more significant contaminants for a monitoring group, the nature and extent of those constituents are well characterized, and additional data are not needed to support regulatory decision-making, such as an investigation report or a corrective measures evaluation (CME). To the extent that additional data are needed to meet project objectives or for new wells, the relevant analytical suite is sampled more frequently.

Organic Constituents. The main characteristic used to determine the lowest sampling frequency for an organic analytical suite is the mobility of its constituents. Suites containing organic constituents with moderate to high mobility in the environment (volatile organic compounds [VOCs] and, to a lesser extent, semivolatile organic compounds [SVOCs]) are sampled annually or not sampled in areas for which there is a history of nondetections and where additional data are not needed to support regulatory decision-making, such as an investigation report or a CME. If consistently detected or if additional data are needed to meet project objectives, then the relevant suite is sampled annually or more frequently. Data from across the Laboratory show a history of nondetections for dioxins/furans, pesticides, and polychlorinated biphenyls (PCBs) in deeper groundwater zones, reflecting the tendency for these constituents to sorb to soils and fine-grained materials rather than to migrate to deeper groundwater zones. Therefore, the frequency of sampling for these constituents has been significantly reduced in regional monitoring wells at many locations, and in some cases, these constituents are no longer analyzed. Similarly, high explosives (HE~~XMOD~~) are not present in the northern watersheds (those north of Pajarito Canyon) and are typically

not part of the analytical suite after initial characterization sampling of new wells has been completed. Pesticides are no longer sampled under the interim groundwater monitoring program, as they are not primary contaminants at the Laboratory.

Low–method detection limit (MDL) VOCs and SVOCs refer to analyses of 24 VOCs and SVOCs using lower MDLs as discussed in the Laboratory's letter to NMED, dated April 4, 2013, in its "Response to Approval with Modifications for the 2011 Interim Facility-Wide Groundwater Monitoring Plan, Revision 1" (LANL 2013, 239555). For 9 of 24 constituents discussed in the letter, lower MDLs have been achieved using other analytical methods. In monitoring year (MY) 2014 (starting October 2013), the Laboratory began to characterize select VOC and SVOC constituents at low MDLs. During MY2015, remaining locations will be sampled for these 9 low MDL VOCs and SVOCs. Samples from most locations were analyzed for low-MDL VOCs and SVOCs during MY2015, with some reductions in MDLs for the analytes.

The Laboratory has been working closely with General Engineering Laboratory to achieve lower detection limits as required by NMED and the Compliance Order on Consent (Consent Order), and significant improvements have been made. Because the analytical methods for measuring low MDL VOCs and SVOCs have continued to improve, the Laboratory plans to conduct additional sampling for low MDL VOCs and SVOCs at all Interim Plan locations during MY2016.

Radionuclides (Excluding Tritium). If there is a history of nondetections or if detections fall within the range of natural background (for naturally occurring radionuclides), then the lowest sampling frequency applies: quarterly or semiannually for new wells, annually if radionuclides are among the significant constituents for an area being monitored, and biennially otherwise.

Tritium. Tritium samples are collected from select springs and deep groundwater on an annual or greater basis. Tritium may not be analyzed at locations where tritium is not a significant contaminant, such as in some General Surveillance locations. Samples are collected for low-level tritium analysis at locations in select monitoring groups where a very low minimum detectable activity is useful to support a conceptual model for fate and transport.

Tritium samples may be submitted for analysis by liquid scintillation if average activities are anticipated to exceed 200 pCi/L. Low-level tritium is analyzed using electrolytic enrichment or direct counting.

Table C-1 provides background information and the objectives generally used to define the sampling frequencies and analytical suites for the area-specific monitoring groups. The specific sampling frequencies and analytical suites for individual sampling locations are provided in Tables 2.4-1 through 8.3-2 of the Interim Plan.

REFERENCES

The following list includes all documents cited in this appendix. Parenthetical information following each reference provides the author(s), publication date, and ER ID or ESH ID. This information is also included in text citations. ER IDs were assigned by the Environmental Programs Directorate's Records Processing Facility (IDs through 599999), and ESH IDs are assigned by the Environment, Safety, and Health (ESH) Directorate (IDs 600000 and above). IDs are used to locate documents in the Laboratory's Electronic Document Management System and, where applicable, in the master reference set.

Copies of the master reference set are maintained at the NMED Hazardous Waste Bureau and the ESH Directorate. The set was developed to ensure that the administrative authority has all material needed to review this document, and it is updated with every document submitted to the administrative authority. Documents previously submitted to the administrative authority are not included.

Table C-1
Background Information and Objectives Used to Determine
Sampling Frequencies and Analytical Suites for Area-Specific Monitoring Groups

Monitoring Group	Background*	Proposed Frequency	Proposed Analyte Suites	Objectives
TA-21	• Nature and extent of groundwater contamination generally understood • No concentrations exceed standards or screening levels (SLs) in regional groundwater	• Annual sampling of intermediate and regional wells • Semiannual sampling of R-6, R-64, R-66 to monitor Material Disposal Area (MDAs) T and U	• Radionuclide, tritium or low-level tritium, and general inorganics analyses annually for most wells • VOC, and SVOCs sampled annually in select wells and biennially in other wells	• Focus on mobile constituents and radionuclides
Chromium	• Nature and extent of groundwater contamination generally understood • Cr concentrations in regional aquifer exceed New Mexico Groundwater Standard (NM GW STD) • Cr concentrations are increasing at two plume-edge wells. Interim measure and plume-center characterization underway in support of pending CME	• Quarterly sampling of intermediate and regional wells with chromium (Cr) concentrations that exceed 25 µg/L (half the NM GW STD) • Quarterly sampling of intermediate and regional wells with significant rate of change in Cr concentrations • Quarterly sampling of R-35a, R-35b, R-44 S1, and R-44 S2 to provide “early warning” of possible contamination for supply well PM-3	• The focus is on metals (chromium), and related co-contaminants; tritium, and general inorganics (nitrate, perchlorate, sulfate) for all samples • Semiannual VOC and SVOC analysis for samples from Mortandad Canyon intermediate wells with consistently detected 1,4-dioxane • Biennial analyses for VOCs and SVOCs in select regional wells and one Sandia Canyon intermediate well • Annual analysis for radionuclides at intermediate wells; biennial for regional wells except new wells that undergo full suite for first year	• Focus highest frequency sampling and analysis for mobile constituents, including perchlorate • Focus highest frequency sampling and analysis at locations with highest Cr concentrations • Monitoring wells located where potential for greatest rate of change is possible because of the presence of Cr in the vadose zone • Monitoring wells located at downgradient edge of Cr plume • Monitoring wells located between Cr plume and water-supply wells

Table C-1 (continued)

Monitoring Group	Background*	Proposed Frequency	Proposed Analyte Suites	Objectives
MDA C	Current data sufficient to support remedy selection for MDA C CME, submitted to NMED in 2012 (LANL 2012, 222830) • No concentrations of constituents exceed standards or SLs in regional groundwater • Determination that groundwater is protected is supported by vapor-phase VOC sampling conducted to date	• Semiannual sampling of all wells	• Semiannual VOC, SVOC, and low-level tritium analyses for all samples • Semiannual or biennial metals analysis for all samples • Annual analysis for radionuclides, and annual or semiannual for general inorganics • Quinquennial analysis for high explosives ~~(and RDX degradation products (~~HEXP analytical suite~~MOD~~) at all locations	• Focus highest frequency analysis for mobile constituents known to be present beneath MDA C
TA-54	• Current data sufficient to support remedy selection; CMEs for MDAs G, H, and L submitted to NMED in 2011 (LANL 2011, 205756; LANL 2011, 206319; LANL 2011, 206324) • No constituent concentrations exceed standards or SLs in regional groundwater • Determination that groundwater is protected is supported by vapor-phase VOC sampling conducted to date	• Quarterly sampling of most intermediate and regional wells • Quarterly monitoring at R-55 S1 and R-23, located downgradient of MDAs at Los Alamos County boundary • Quarterly sampling for VOCs and low-level tritium at key wells located downgradient of MDAs	• Quarterly sampling for VOCs and low-level tritium at key wells located down-gradient of MDAs (R-23, R-37 S1 and S2, R-39, R-41 S2, R-55 S1, R-56 S1, and R-57 S1) • Semiannual VOC and low-level tritium analyses for most other wells • Semiannual SVOC analysis for R-37 S1 (1,4-dioxane consistently detected) • VOCs and low-level tritium analysis only at R-40 S1 because of low yield • Annual metals, SVOCs, radionuclides, and general inorganics for all other locations • Quinquennial analysis for PCBs and HEXP~~MOD~~ at most ~~all~~ locations ~~R-57 S1 and R-57 S2~~	• Focus highest frequency analysis for mobile constituents known to be present beneath TA-54 MDAs

Table C-1 (continued)

Monitoring Group	Background*	Proposed Frequency	Proposed Analyte Suites	Objectives
TA-16 260	• Increased runoff following Las Conchas fire impacted near-surface hydrology • Nature and extent of groundwater contamination generally understood • RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine) exceeds U.S. Environmental Protection Agency tap water SL in intermediate groundwater • No constituent concentrations exceed standards or SLs in regional groundwater	• Quarterly monitoring at most TA-16 260 monitoring group locations to support CME • Semiannual sampling of the remaining intermediate and regional wells	• Metals, VOC, HEXMOD, and general inorganics analyses quarterly or semiannually for most locations • Quarterly analysis of tracers (including naphthalene sulfonate compounds and bromide) • Biennial analysis for radionuclides and SVOCs for most locations; annual analysis for low-level tritium in intermediate and regional wells • Quinquennial sampling for PCBs and dioxins/furans at shallow sampling locations (base flow, springs, and alluvial wells)	• Collect data to support 260 CME, and to further refine site conceptual model.
MDA AB	• No constituent concentrations exceed standards or SLs in regional groundwater	• Annual sampling of intermediate and regional wells • Semiannual sampling of regional wells R-29 and R-30 to monitor MDA AB	• Metals, VOC, SVOC, ~~HEXMOD~~, radionuclide, low-level tritium, and general inorganics analyses for all samples	• General analyte suite for constituents that may have been released from MDA AB

Table C-1 (continued)

Monitoring Group	Background*	Proposed Frequency	Proposed Analyte Suites	Objectives
General Surveillance and White Rock Canyon	• Number of outfalls significantly reduced and remaining outfalls have improved water quality • Nature and extent of groundwater contamination generally understood • Canyons investigations are complete and show contribution to risk from surface water is low and within acceptable limits • Constituent concentrations generally below standards or SLs • Decades of annual monitoring at springs in White Rock Canyon show little evidence of Laboratory contaminants. • Focused monitoring around MDAs and areas of known groundwater contamination along with generally low groundwater velocities support proposing a biennial sampling frequency at White Rock Canyon springs.	• Annual monitoring at key alluvial monitoring wells, springs, and base-flow locations to capture unexpected near-surface conditions • Annual sampling of all intermediate and regional wells • Semiannual monitoring at R-10a to monitor groundwater at Laboratory boundary • Annual sampling at select White Rock Canyon springs and base-flow locations to monitor groundwater at Laboratory boundary • Biennial sampling at other White Rock Canyon base-flow locations and springs	• Metals, radionuclide, and general inorganics analyses for most locations ~~all samples~~ • Analyses of additional constituents at monitoring well 03-B-13 • HEXP~~MOD~~ analysis for southern watersheds • VOC analysis semiannually, annually or biennially and SVOC analysis semiannually, annually, biennially, or triennially at most ~~all~~ locations~~, except at R-19 and R-31~~ • Low-level tritium analysis annually or biennially ~~in~~ at select base flow and well~~s~~ locations and annually ~~in~~at all ~~and~~ springs • Quinquennial sampling for PCBs and dioxins/furans at base-flow locations and alluvial wells • Annual~~Biennial~~ sampling for metals, VOCs, SVOCs, radionuclides, low-level tritium and general inorganics at ~~most~~ all White Rock Canyon springs~~;, with annual sampling at select springs;~~ annual, biennial, or triennial sampling for ~~SVOCs and~~ HEXP~~MOD~~ at all~~most locations~~White Rock Canyon Springs	• Focus highest frequency analysis for mobile constituents known to be present in particular watershed • Limit monitoring in the alluvial groundwater because of limited contamination • Focus on intermediate and regional locations for groundwater protection

* Constituents discussed in this column do not include detections of spurious organic constituents, naturally occurring constituents, or constituents related to well corrosion or to potential drilling effects.