Quality Assurance Project Plan

for the
Alaska Department of Environmental Conservation
Division of Environmental Health
Pesticide Control Program

1700 E. Bogard Road #B103
Wasilla, AK 99654

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Quality Management Identification and Approval Form

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Approval for Implementation:

1. Christina Carpenter, Director, Alaska Department of Environmental Conservation (ADEC), Division of Environmental Health
   Phone: (907) 269-7645
   Approval Signature:

2. Robert Blankenburg, Program Manager, ADEC Solid Waste/Pesticide Control Program
   Phone: (907) 269-7690
   Approval Signature:

3. Karin Hendrickson, Program Coordinator, ADEC Pesticide Control Program
   Phone: (907) 376-1856
   Approval Signature:

4. Kaylie Holland, Environmental Program Specialist IV (Quality Assurance Manager), ADEC Solid Waste/Pesticide Control Program
   Phone: (907) 269-1099
   Approval Signature:

EPA Acceptance and Approval:

Organization Title:	Environmental Protection Agency, Region 10
Address:	Pesticide Unit (OCE-084) 1200 Sixth Avenue, Suite 900 Seattle, WA 98101

1. Donald Brown, Quality Assurance Manager, EPA Region 10
   Phone: (206) 553-0717
   Approval Signature: DONALD BROWN Digitally signed by DONALD BROWN Date: 2022.05.17 07:02:10 -07'00'

Concurrence:

1. Dirk Helder, EPA Project Officer
   Phone: (208) 378-5749
   Approval Signature: Helder, Dirk Digitally signed by Helder, Dirk Date: 2022.05.16 13:54:33 -06'00'

2. Derrick Terada, FIFRA/TSCA Team Leader (Responsible Official), EPA Region 10
   Phone: (206) 553-4768
   Approval Signature: DERRICK TERADA Digitally signed by DERRICK TERADA Date: 2022.05.16 10:11:08 -07'00'

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Acronyms and Abbreviations

%	Percent
%R	% Recovery
ADEC	Alaska Department of Environmental Conservation
CFR	Code of Federal Regulation
CoC	Chain-of-Custody
DGR	Dangerous Goods Regulations
DOT	U.S. Department of Transportation
DQO	Data Quality Objectives
EH	Division of Environmental Health
EPA	U.S. Environmental Protection Agency
FIFRA	Federal Insecticide, Fungicide and Rodenticide Act
IATA	International Air Transportation Association
LC	liquid chromatography
MS	mass spectrometry
MS	Matrix Spike
MSD	Matrix Spike Duplicate
PCP	Pesticide Control Program
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
QMP	Quality Management Plan
RPD	Relative Percent Difference
SOP	Standard Operating Procedures
WSCHL	Washington State Chemical and Hop Laboratory

The Alaska Department of Environmental Conservation (ADEC), Division of Environmental Health's (EH) Pesticide Control Program (PCP) does not currently conduct regular environmental sampling or monitoring to test for pesticides. Infrequently however, samples may be taken and analyzed as a result of inspections or investigations. The practices presented in this document provide a framework for assuring the quality of all environmental data generated and processed is appropriate for the intended use. The data should be scientifically valid, of known precision and accuracy, of acceptable completeness, representative and comparable, and where appropriate, legally defensible.

1.0 Project Management

1.1 Project/Task Organization

Under the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA), as amended, a Cooperative Agreement has been developed between the U.S. Environmental Protection Agency (EPA) and ADEC. ADEC is the state lead agency for pesticide regulatory programs and is authorized under Alaska Statutes Title 46 Water, Air, Energy, and Environmental Conservation to conduct pesticide product compliance, misuse investigations, and monitoring programs in the state. This Quality Assurance Project Plan (QAPP) operates under the specifications and provisions of the ADEC PCP Quality Management Plan (QMP), Revision 5, dated March 2022.

The quality system is led, ultimately, by the ADEC EH Director and includes both administrative functions, such as program management, work plan development, and plan updates, and technical functions, such as inspections, enforcement, and technical assistance. Project organizational chart and responsibilities are provided in Figure 1 and Table 1, respectively.

Figure 1
Pesticide Control Program Organization Chart

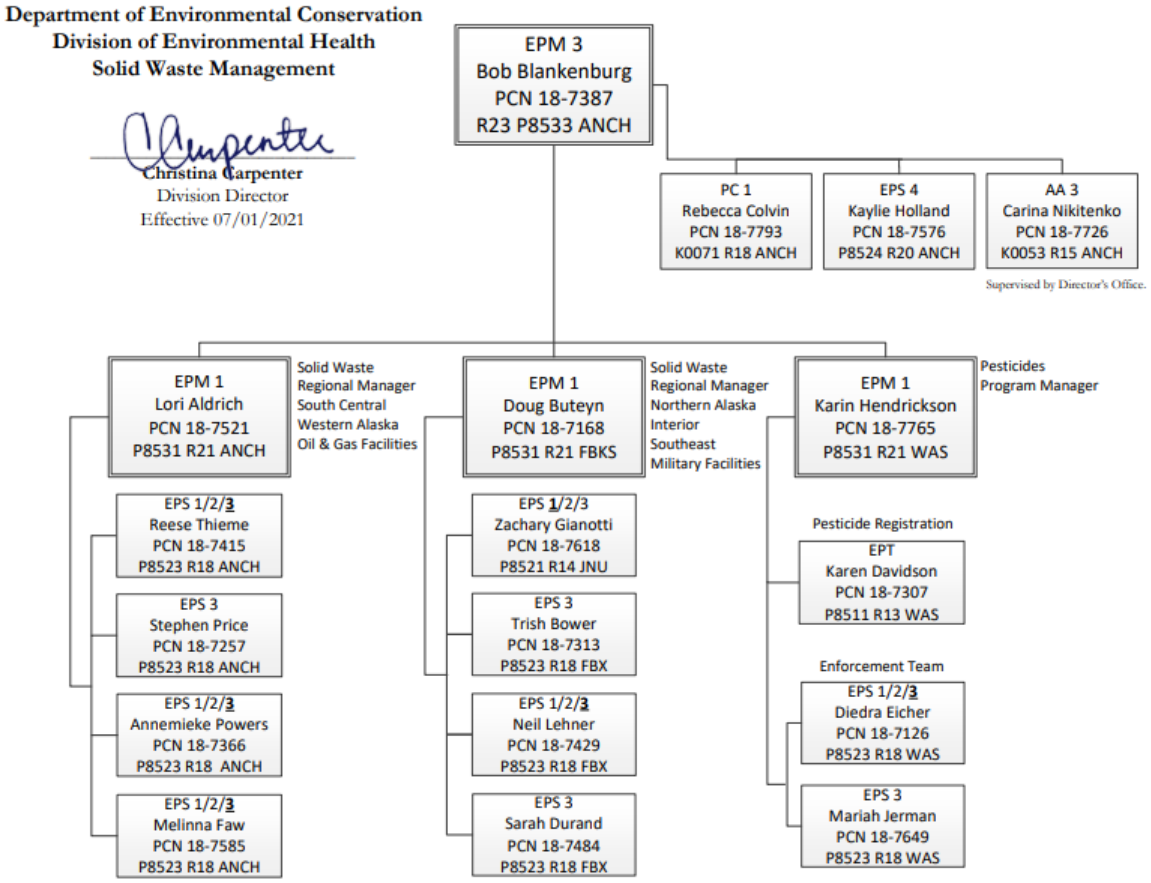

Table 1
Project Organizational Responsibilities

NAME/ POSITION TITLE	ASSOCIATION	CONTACT INFORMATION	RESPONSIBILITIES
Christina Carpenter, ADEC EH Director	ADEC, EH	555 Cordova Street Anchorage, AK 99501 (907) 269-7645 christina.carpenter@alaska.gov	Provides policy definition, leadership, and oversight for ADEC EH quality system. Serves as the overall authority for directing activities in accordance with EH policy. Responsibilities, with regard to quality, include: serving as the final authority for resolving quality related issues and ensuring that the proper training is provided; resources are available to support the quality approach; and QMP is in place and functioning.
Robert Blankenburg, ADEC Solid Waste Program/PCP Manager	ADEC, EH, Solid Waste Program/ PCP	555 Cordova Street Anchorage, AK 99501 (907) 269-7690 bob.blankenburg@alaska.gov	Provides leadership and oversight for the Solid Waste Program and PCP quality system and serves as the overall authority for directing activities in accordance with EH policy. Responsibilities, with regard to quality, include: serving as the final authority for resolving quality related issues and ensuring that the proper training is provided; resources are available to support the quality approach; and QMP is in place and functioning.
ADEC PCP Staff	ADEC, EH, PCP	1700 E Bogard Road Bldg. B, Suite 103 Wasilla, AK 99654	Conduct inspections, investigations, and sampling as described in the QAPP and EPA's most recent FIFRA Inspection Manual.
Karin Hendrickson, PCP Coordinator	ADEC, EH, PCP	1700 E Bogard Road Bldg. B, Suite 103 Wasilla, AK 99654 (907) 376-1856 karin.hendrickson@alaska.gov	Responsible for overall technical and contractual management of the project. Maintains a central resource file of quality related documents and coordinates all audits.
Kaylie Holland, Quality Assurance Manager	ADEC, EH, Solid Waste Program/ PCP	555 Cordova Street Anchorage, AK 99501 (907) 269-1099 young.ha@alaska.gov	Responsible for the review of the QAPP and QMP as well as the SOPs. Also responsible for providing technical advice to the PCP program for sampling.

1.2 Problem Definition/Background

ADEC implements a comprehensive pesticide program for the State of Alaska and has had primary enforcement responsibility for pesticide use since 1989. The ADEC PCP trains, certifies, and licenses pesticide applicators; conducts compliance assistance, education and outreach; and implements programs related to water quality, agricultural worker protection, and endangered species protection. These activities are conducted in accordance with a Cooperative Agreement between EPA and ADEC. In addition to program elements required by the Cooperative Agreement, the PCP also implements a program for state pesticide product registration and issues Pesticide-Use Permits for certain pesticide uses.

The purpose of the Cooperative Agreement is to develop an effective pesticide enforcement program for pesticide product compliance, misuse investigations, and monitoring programs. Examples of pesticide compliance programs include:

- Marketplace inspections
- Applicator records inspections
- Applicator use inspections
- Restricted use pesticide dealer inspections

Program activities also include:

- Groundwater protection
- Endangered species protection
- Worker protection
- Other environmental protection programs

This generic QAPP was written in support of EPA requirements (*EPA Requirements for Quality Assurance Project Plans* - EPA QA/R-5) and the State of Alaska.

1.3 Project/Task Description and Schedule

Alaska Statute Title 46 Water, Air, Energy, and Environmental Conservation authorizes the ADEC PCP to establish and maintain, groundwater monitoring and enforcement programs for pesticides. The PCP may enter into cooperative agreements with other federal and state agencies or local governments for various pesticide projects. The PCP also has the authority to contract with outside laboratories for analytical services. Currently, pesticide related samples may be analyzed by the Washington State Chemical and Hop Laboratory (WSCHL) in Yakima, WA.

PCP staff are responsible for collecting and documenting representative samples and for maintaining chain-of-custody (CoC) of the samples until they are officially transferred to the laboratory. The analytical laboratory is responsible for analyzing samples using the appropriate analytical techniques and methods, and for transmitting analytical results, including quality control data, to PCP staff. This QAPP is written to provide and document quality assurance (QA) procedures which will be used for all pesticide sampling and analysis conducted by the PCP. To support this project plan, PCP will maintain a copy of the WSCHL's most current written Standard Operating Procedures (SOPs) detailing laboratory procedures. SOPs will also be prepared for activities conducted by the PCP staff that may affect the overall quality and defensibility of analytical data (e.g. Sampling Procedure, Sample Packaging, and etc.). SOPs for sampling are covered in Appendix III.

The following forms, attached in Appendix I, are used by the PCP to develop pesticide inspections:

- Worker Protection Standards Inspection Form
- Marketplace Inspection Form
- Restricted Use Pesticide Dealer Inspection Form

- Non-Agricultural Pesticide Use Inspection Form
- Certified Applicator Records Review Inspection Form

The inspection database will include dates for the inspections performed. Information about sampling frequency, laboratory schedules, and reporting cycles will also be included, if required. These forms may include the following specific information, as needed:

- Pesticide application records, product labeling, and/or other documentation providing information on the identity of the pesticide product(s)
- Measurements such as label and application rates, area maps and photographic documentation.
- Applicable technical, regulatory, or program-specific quality standards, criteria, or objectives
- Any special personnel and equipment used.

1.4 Quality Objectives and Criteria for Measurement Data

Data Quality Objectives (DQOs) define the quantitative and qualitative terms that inspectors and project managers will use to describe how good data needs to be to meet a project's objectives. DQOs for measurement data include precision, accuracy, representativeness, completeness, comparability, and measurement range. It may not be possible to include actual numbers for some of the data quality measurements until the site inspection/monitoring effort has already begun. Therefore, PCP staff will need to discuss project goals or objectives for data quality and the methods that will be used to make actual determinations. PCP staff must also discuss at what point changes will be made if project specifications are not achieved. DQOs for measurement data should be given for each parameter that is measured in each "matrix" (i.e. water or soil).

The overall QA objective for analytical data is to ensure that data of known and acceptable quality are provided. To achieve this goal data must be reviewed for 1) representativeness, 2) comparability, 3) precision, 4) accuracy (or bias), and 5) completeness. The nature of unique events and sampling constraints in Pesticide inspection and enforcement work, may impact the ability to assess all these parameters.

Representativeness

Representativeness is the degree to which data from the project accurately and precisely represent site conditions. The representativeness criterion is best satisfied by confirming that the sampling protocol is designed to collect samples from appropriate locations and in sufficient numbers and sample types to accurately represent the nature of the pesticide problem and the location of the pesticide problem. Therefore, background samples of non-affected areas will be taken, when appropriate, as well as samples from pesticide affected areas.

Comparability

Comparability is the measure of the confidence with which one data set or method can be compared to another. Using standard sampling and analytical procedures will maximize comparability. When applicable, sampling collection procedures will be consistently followed, and the same analytical procedures will be used to ensure data comparability.

Precision

The relative percent difference (RPD) of duplicate samples will be used to assess data precision. For laboratory duplicates, field duplicates, and matrix spike duplicates the formula below will be used to calculate RPD.

$$RPD = \frac{ABS\ (R1 - R2)}{((R1 + R2))/2)} \times 100$$

R1 = Recovery for matrix spike (MS) or duplicate 1

R2 = Recovery for matrix spike duplicate (MSD) or duplicate 2

Precision will be based on field, laboratory control spikes, and if used, matrix spike duplicates, with an RPD goal of ±25% for low level concentrations (<20 x method detection limit) and ±10% for high level concentrations (>20 x method detection limit). The maximum RPD allowed under this QAPP is ±50%.

Accuracy

Accuracy is a measure of the overall agreement of a measurement to a known value. Accuracy will be evaluated by the use % recovery (%R) of the target analyte in spiked samples.

$$\%\ R = \frac{SQ - NQ}{S} \times 100$$

SQ = quantity found in spiked sample

NQ = quantity found in native (unspiked) sample

S = quantity of spike added to native sample

Completeness

Completeness is the percentage of valid results obtained compared to the total number of samples taken for a parameter.

$$\%\ Completeness = \frac{\#\ of\ valid\ results}{\#\ of\ samples\ taken}$$

Data completeness is expressed as the % of the total data which are valid. The data completeness must be at least 95 % for reported data from all work areas. Data completeness will be confirmed by the QA Manager.

The quality assurance objectives outlined above will be evaluated in conjunction with the data validation process.

Representativeness, comparability, precision, accuracy, and completeness are necessary attributes to ensure that analytical data are reliable, scientifically sounds, and defensible. Each analytical result or set of results generated for various compliance programs should be fully defensible in any legal action, whether administrative, civil or criminal. The extent and form of data collection and confirmation depends on whether the sample(s) is residue (environmental) or formulation (product). Analysis of residue samples frequently involves the detection and measurement of unknown pesticides at unpredictable levels in different matrices.

The precision and accuracy of each residue method is dependent on the sample matric and analyte concentration. Therefore, for residue analysis, the matric and concentration of target compounds influence acceptable limits of precision and accuracy. Laboratory precision and accuracy may be measured via analysis of Matrix Spike/Matrix Spike Duplicate (MS/MSD) samples.

Pesticide related inspection and investigations frequently generate a few unique or localized samples that do not lend themselves to the quality control practices recommended for long range environmental sampling and/or monitoring programs. In these cases, the laboratory must provide adequate quality control and adhere to established standard operating procedures to ensure reliable data. Data must be of sufficient quality that the analysis will stand on its own merit.

1.5 Special Training Requirements/Certification

The ADEC PCP has three staff members who are involved in inspection and enforcement activity. PCP inspectors are required to attend Basic Inspector/Investigator Training as provided by EPA Region 10 and other state-authorized or required training. Each inspector is expected to obtain state inspector or enforcement credentials within one year of hire. At least two inspectors must obtain EPA enforcement credentials as soon as possible and maintain them. Skills are assured by field training, provided by senior inspectors.

PCP staff attend regional and national courses, training sessions, meetings, and conferences, as appropriate, including EPA Pesticide Inspector Residential Training, EPA Pesticide Regulatory Education Program courses, and the EPA Pacific Northwest Pesticide Inspector Conference.

Documentation of trainings or certifications will be the responsibility of the Program Manager and Program Coordinator.

1.6 Documentation and Records

Depending on the specifics of the individual inspection, complete documentation for inspections will include at least some of the following forms completed by the inspector:

- ADEC Notice of Inspection
- ADEC Marketplace Inspection Form
- ADEC Restricted Use Pesticide Use Inspection Form

- ADEC Non-agricultural Pesticide Use Inspection Form
- ADEC Certified Applicator Records Review Inspection Form
- ADEC Worker Protection Standards Inspection Form
- ADEC Stop Sale, Use, or Removal Order
- ADEC Receipt for Pesticides Samples
- Chain of Custody
- Laboratory Analysis Reports
- Photographs, paper copies, pesticide labels, application records or other documentation
- Field notes
- Correspondence with affected/involved parties, agencies, or others

Records and documentation will be retained in the ADEC building at 1700 E. Bogard Rd. #B103, Wasilla, Alaska 99654 in in hard copy form, whereas electronic documents will be retained on the ADEC servers. The records will be retained in accordance with the official State of Alaska Records Retention Schedule in the PCP files.

2.0 Data Generation and Acquisition

2.1 Sampling Process Design (Experimental Design)

SOPs and Forms (such as inspection forms) are followed for routine inspections, investigations, and sampling. For complex investigations, the investigator will develop a sampling plan (example in Appendix II) that outlines the number of samples to be collected, types of samples to be collected, location of sample sites, any special sample requirements, and the most appropriate pesticide for measurement. For routine inspections the inspection forms and inspection instructions provided in Appendix I will be used to guide data collection.

If sampling is required the PCP program will coordinate with the QA Manager or laboratory to determine the appropriate sampling design, sample preservation, packaging, sample submission procedures, and proper documentation procedures. Such procedures may be found in the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) *Inspection Manual* (Revised August 1, 2019). In addition, SOPs in Appendix III have been developed to clarify methods, approaches, and documentation expectations, and can be used stand-alone.

2.2 Sampling Methods Requirements

Procedures for: collecting samples; identifying sampling methods and equipment; sample preservation requirements; decontamination procedures; and materials needed are specified in the EPA's *FIFRA Inspection Manual* (Chapter 6 and 7) and ADEC Contaminated Sites Program's *Field Sampling Guidance* (October 2019). In addition, SOPs in Appendix III have been developed to clarify methods, approaches, and documentation expectations, and can be used stand-alone. The WSCHL

may also be contacted for further instructions on minimum sample size, container type and preservation method, and shipping procedures for samples. This information will be summarized in the investigation report.

Data collection during routine inspections will follow the requirements listed in the applicable inspection forms provided in Appendix I.

When a failure in the sampling or measurement system occurs, corrective actions will be discussed and identified by PCP staff and any responsible party identified. The effectiveness of the corrective action will be evaluated and determined by PCP staff.

2.3 Sample Handling and Custody Requirements

Proper field protocol for sample collection and documentation is essential for samples to provide valid information and useful, defensible evidence. Sample handling includes preservation, packaging, shipment from the site, and storage in the laboratory. Samples must be properly labeled in the field with identification labels that include sample location, sample number, date and time of collection, sample type, sampler's name, and method use to preserve the sample. SOPs for sample handling are included in Appendix III.

For the analysis of the sample to be defensible a logical and well documented chain of custody must be shown between the point that the sample(s) are collected and when analytical results are reported. Chain of custody consists of two components: documentation and actual physical custody of a sample. A chain of custody form is included in Appendix II. The chain of custody form must be filled out by the sampler in the field during sample collection.

Samples will be kept in a designated, secured storage area until they can be forwarded to the WSCHL. The PCP staff will make arrangements with the laboratory, as appropriate, before shipping samples. All samples will be shipped overnight with a traceable delivery method as soon as possible after collection. Care will be taken to preserve the integrity of the sample; consider temperature during storage and shipping; sample container type and material; sample preservative; sample volume; and sample hold time.

The PCP Coordinator will request that the laboratory manager notify them when problems are encountered with the integrity of incoming pesticide samples or when laboratory problems arise that could affect the reliability and/or defensibility of analytical results.

2.4 Analytical Methods Requirements

The analytical methods required for the sample will be determined on a case-by-case basis; however, Table 5 presents the most common analytical methods that may be used for pesticides analyses. WSCH Laboratory should be contacted to help determine which methods should be used for a given sample.

WSCH Laboratory's most recent Generic Quality Assurance Project Plan and SOPs for measurement procedures and sampling and document control are in Appendix IV. Detection limits are compound, method, matrix, and instrument specific. The laboratory will include the limit of detection and limit of quantitation with any results reported.

Table 5
Common EPA Analytical Methods for Pesticides

ANALYTES	EPA METHOD
Glyphosate in Water	547
Diquat and Paraquat in Water	549.1, 549.2
Organochlorine Pesticides	608, 8081B
Organophosphorous Pesticides	614, 8141B
Dithiocarbamate Pesticides in Water	630.1
Benomyl and Carbendazim in Water	631
Carbamate and Urea Pesticides in Water	632, 8321B
Chlorinated Herbicides	615, 8151, 8321B
Miscellaneous Pesticides	8270D (GC-MS, SIM mode)
N-Methyl Carbamate Pesticides	8321B
Miscellaneous Pesticides (HPLC-MS)	8321B

2.5 Quality Control Requirements

QC criteria for routine laboratory procedures conducted by the WSCHL are contained in the WSCHL Generic Quality Assurance Project Plan (Appendix IV). The criteria may be modified based on the specific requirements and/or methods necessary for each type of sample. Modifications will be approved by the PCP and fully documented.

2.6 Instrument/Equipment Testing, Calibration, Inspection, and Maintenance Requirements

Sampling procedures are covered in Appendix III. Some procedures involve collection of samples directly into a sample container, and others involve the use of disposable equipment. Sampling equipment is obtained from suppliers that assure an acceptable level of quality and cleanliness of their products. Reusable sampling equipment, such as scissors or tweezers, will be meticulously cleaned between samples by thoroughly rinsing with water, followed by rinsing with isopropyl alcohol, and air drying. Once clean and no longer being used for a sampling event the equipment will be covered and sealed in plastic to prevent contamination until it is used again.

2.7 Instrument Calibration and Frequency

The PCP does not utilize analytical instruments or sampling equipment that require calibration.

Calibration and frequency of calibration for laboratory instruments are described in the WSCHL Generic Quality Assurance Project Plan and SOPs (Appendix IV).

2.8 Inspection/Acceptance Requirements for Supplies and Consumables

PCP staff will inspect all sampling supplies and consumables (gloves, booties, packing equipment, sample containers, etc.) prior to use. Only undamaged, clean, intact items will be used.

Supplies and consumables to be used for laboratory procedures are purchased to meet purity and quality specifications required by the analyses being conducted. Any special quality requirements are included in the WSCHL SOPs.

2.9 Data Acquisition Requirements (Non-direct Measurements)

Data needed for project implementation or decision making that are obtained from non-measurement data sources may include sources such as:

- Pesticide application records
- Inspection forms listed in Section 1.6 (Documentation and Records) of this document
- Local (project site-specific) or weather data
- PCP computer databases maintained for pesticide registrations, pesticide complaints, etc.
- Department files including literature from recognized outside sources, previous inspections, projects and reports
- Internet sources and databases such as EXTOXNET and National Pesticide Information Center

Data will be accepted for use based on the applicability to the project, authentication from sources recognized by the industry, academia, and regulatory authorities. The sources of the data, rationale for their use, and limitations on their use are determined by the PCP.

2.10 Data Management

PCP staff will evaluate analytical data to determine whether environmental data collection and analysis complied with the QAPP and results meet project specific objectives. PCP staff will identify any quality assurance problems and recommend solutions. The PCP coordinator will review these evaluations and issue a report, as needed. The PCP coordinator will also coordinate with the program manager on an ongoing basis. PCP staff will send any reports on data issues to the Division Director and the EPA Region 10 Pesticide Unit Alaska Project Officer, as appropriate.

Each inspection is logged into the inspection tracking excel. Some of the information recorded in the excel includes the facility name, date of inspection, inspection type, and the initials of the inspector. Each inspection file is reviewed by the PCP Program Coordinator to check for accuracy, completeness, and correct errors if needed. The inspection files include the inspection report, any

correspondence or enforcement associated with the inspection, photos, field notes, notice of inspection, and any submissions by the inspected.

3.0 Assessment and Oversight

3.1 Assessment and Response Actions

The purpose of the quality assurance documents (QAPP and SOPs) is to ensure the reliability and quality of the data.

Throughout the year the PCP Program Coordinator reviews each inspection report to ensure that all enforcement follow up has been completed and documented. If the work is complete, then it is recorded on the enforcement log.

Field sampling is not a common activity however if field sampling occurs the PCP staff will work with the QA Manager to ensure that the field sampling and laboratory analysis meets all of the requirements in this QAPP.

3.2 Reports to Management

The Solid Waste and PCP Manager is informed of any significant enforcement actions and the planned course of action.

At the end of the year the EPA Region 10 grant managers review approximately 10% of the inspection files with the PCP and provides feedback. The feedback is then incorporated into inspection activities the following year.

4.0 Data Validation and Usability

4.1 Data Review, Verification, and Validation Requirements

The WSCHL follows SOPS and their generic Quality Assurance Project Plan for the review and validation of laboratory data and the laboratory's analytical reports. Questionable data may result from the condition of the sample, inadequacy of the method, lack of validation, time constraints, or other factors. Any questionable data are clearly identified and qualified in each raw data package according to the WSCHL quality system documents.

The PCP Coordinator or the QA Manager will review the qualified data to determine if it meets the requirements in the QAPP and is useable for the project.

Inspection/investigation final reports are viewed for completeness by the PCP Coordinator. These reviews are conducted to verify that the data have been generated according to the specified sampling and analysis SOPs, that the data have been accurately recorded in the specified format, and

that supporting information is properly documented. Deficiencies in the report are corrected where possible. Insufficient or non-valid data items are rejected.

4.2 Verification and Validation Methods

Analytical data validation, reduction, and reporting are in accordance with the guidelines in the following document:

EPA Contract Laboratory Program National Functional Guidelines for Organic Superfund Methods Data Review (EPA 540-R-20-005).

The PCP Coordinator or QA Manager will review the data collected to identify if all of the requirements specified in the QAPP and associated SOPs have been met and if not, to determine the extent to which requirements failed to be achieved. Data verification will include the following activities, as applicable:

- Verification that all data completeness criteria, as stated in the QAPP, have been satisfied. This shall include items such as the number of samples and number of QC samples such as spikes and duplicates.
- Verification of the precision of the data using relative percent difference calculations.
- Verification that all data has been appropriately qualified
- Verification that all supporting information and documentation for non-direct measurement data meet the requirements of the QAPP and are complete.
- Verification that data and sample collection practices adhered to the SOPs, to include a review of project logs and field notes
- Verification that sample handling activities conform to QAPP requirements. Examples include sample shipment timelines, sample holding times, preservatives, and COC documentation.
- Determine and document and limitations on the use of the project data.

4.3 Reconciliation with User Requirements

PCP staff will review the results and data validation performed by the laboratory on the analytical data to determine usability of the data to meet the project objectives stated in this QAPP. If data for a particular sample did not meet the data quality objectives the data will be qualified. The PCP Coordinator will determine the final usability of the data.

PCP coordinator will review inspection reports for completeness, will identify any deficiencies, and will reject insufficient or non-valid data. PCP staff will correct problems where possible.

4.0 References

ADEC, 2019. Field Sampling Guidance. Division of Spill Prevention and Response, Contaminated Sites Program. October 2019.

EPA. 2001. Requirements for Quality Assurance Project Plans (EPA QA/R-5). March 2001.

EPA. 2019. Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) Inspection Manual (OECA-MANL-2019-001-R0). August 2019.

EPA. 2017. National Functional Guidelines for Organic Superfund Methods Data Review (EPA-540-R-20-005). November 2020.

U.S. Department of Transportation. Code of Federal Regulation Title 49 parts 100-185 (49 CFR Parts 100-185) Transportation of Hazardous Materials. (Note: This document is revised every three years.)

International Air Transportation Association (IATA). Transportation of Dangerous Goods Regulations (Note: This document is revised every year.)

Appendices