Appendix A-1: Monitoring objectives addressed by Gresham/Fairview environmental monitoring program

	Environmental Monitoring Elements							Additional SWMP BMP Monitoring	Modeling Element	Literature Review and D
	Instream Monitoring			Stormwater Monitoring			Structural BMP Monitoring	Dry Season Field Screening	Pollutant Load Modeling	Literature Review
Monitoring Objective	**Dry and Wet Season Monitoring**	**Continuous Flow and Temperature**	**Macroinvertebrate Monitoring**	**Storm Event Monitoring**	**Mercury Monitoring**	**Pesticide Monitoring**				
1. Evaluate the source(s) of and means for reducing the pollutants of concern applicable to the co-permittees' permit area, including 2018/2020 303(d) listed pollutants, as applicable;	Includes many TMDL and a few 303(d) listed pollutants (some are monitored using surrogates, such as TSS). Many 303(d) listed pollutants are listed for media other than surface water	TMDL is developed for temperature. Continuous monitoring of summer temperatures will help determine long-term effectiveness of teamperature TMDL strategy.	Macroinvertebrate sampling will provide information to support the identification of pollutant sources.	Stormwater monitoring will provide information to evaluate what influences stormwater quality	TMDL is developed for Hg. Stormwater monitoring will help determine long-term effectiveness of TMDL strategy.	Limited data exists for current use pesticides in stormwater. Characterizing presence in stormwater will help determine whether stormwater is a significant source to surface water	Influent and effluent samples may be analyzed for applicable TMDL and 303(d) parameters	Dry weather field screening will be used to determine potential sources of pollutants, which may include 303(d) and TMDL pollutants	Comparison of modeled pollutant load by land use may assist in evaluating sources of pollutants	Conduct literature reviews as needed, and attend local ACWA stormwater committee meetings and conferences to gather and exchange information
2. Evaluate the effectiveness of Best Management Practices (BMPs) in order to help determine BMP implementation priorities	Can be used to evaluate the overall effectiveness of BMPs in combination with basic stormwater monitoring	Measurement of discharge and temperature from regional BMPs provides information on effectiveness. Instream flow measurements will help measure long-term effetiveness of volume reduction BMPs	Assessment of overall improvements made using multiple BMPs	Stormwater monitoring will provide information to support the evaluation of the overall effectiveness of BMPs to reduce pollutants in the monitored catchment	Total Hg is monitored for influent and effluent from BMPs. Results will help determine which BMPs are most appropriate for Hg removal.	Stormwater monitoring will provide information to support the evaluation of the overall effectiveness of BMPs to reduce pesticides in the monitored catchment	BMP effectiveness monitoring data will be used to evaluate effectiveness of similar BMPs	Assess the overall effectiveness of the IDDE program BMP	Conduct pollutant load modeling at the end of the permit term to estimate the overall pollutant load reduction achieved through the implementation of BMPs.	Track and review literature related to the performance and cost effectiveness of BMPs (e.g. International Stormwater BMP database)
3. Characterize stormwater based on land use type, seasonality, geography or other catchment characteristics	Provides information to support the evaluation and comparison of in-stream concentrations during dry and wet weather. This information will support the characterization of stormwater discharges.	Seasonal and geographic variations of rainfall and instream flow may assist in evaluating MS4 discharges	Indirectly provides information to support the long-term water quality and in-stream habitat conditions, some of which are affected by stormwater runoff	Probabilistic stormwater monitoring design will allow for more reliable stormwater characterization that can be assessed by land use, vehicle trips, or other watershed criteria	Total Hg will be monitored at all probabilistic stormwater monitoring locations.	Probabilistic stormwater monitoring design will allow for more reliable stormwater characterization that can be assessed by land use, vehicle trips, or other watershed criteria	Influent to BMPs being monitored are long-term stormwater monitoring locations	Screening may identify legal and illicit non-stormwater discharges	Pollutant loads can be modeled by land use type or other catchment characteristics	Compare local data to International Stormwater BMP Database to evaluate differences, pollutants monitored, etc.
4. Evaluate status and long-term trends in receiving waters associated with MS4 stormwater discharges	In-stream monitoring during wet season will allow for assessing trends in pollutants likely associated with MS4 stormwater discharges	Instream flow can be used to evaluate long-term changes in MS4 discharge volume	Macroinvertebrate sampling will provide information to support the evaluation of trends in receiving waters and allows for trending as an independent measure	Stormwater monitoring will assist in the interpretation of in-stream trend analyses.	Stormwater monitoring will assist in the interpretation of in-stream trend analyses.	Pesticide data may help interpret trends observed in on-stream biological monitoring (macroinvertebrates)	Determine whether BMP effectiveness data is verified by in-stream trends	N/A	N/A	Review data collected by DEQ and USGS and published in peer-reviewed articles and compare to and enhance data collected by permittee.
5. Assess the chemical, biological, and physical effects of MS4 stormwater discharges on receiving waters	In-stream water quality monitoring will provide information to assess the chemical effects of stormwater runoff on receiving waters.	Rainfall/flow monitoring will provide information to assess the physical effects of stormwater runoff	Macroinvertebrate monitoring will provide information to assess the biological effects of stormwater runoff on receiving waters.	Stormwater monitoring will assist in the interpretation of in-stream water quality concerns and will be used to evaluate potential impacts of stormwater on receiving water	Stormwater monitoring will assist in the interpretation of in-stream water quality concerns and will be used to evaluate potential impacts of stormwater on receiving water	Stormwater monitoring will assist in the interpretation of in-stream water quality concerns and will be used to evaluate potential impacts of stormwater on receiving water	Understanding of BMP effectiveness may assist in assessment of stormwater affects on receiving water	N/A - unless legal non-stormwater discharges are involved	Modeled loads can assist in evaluating MS4 runoff effects on receiving waters	Review studies conducted by other jurisdictions to learn about methods used and conclusions drawn
6. Assess progress towards meeting TMDL pollutant load reduction benchmarks	In-stream monitoring will provide information regarding progress towards meeting pollutant load reduction benchmarks and TMDL waste load allocations.	Rainfall/flow monitoring is necessary to calculate pollutant loads	Macroinvertebrates are senstiive to some 303(d) and TMDL pollutants. Macro data will provide information regarding progress towards meeting pollutant load reduction benchmarks and TMDL waste load allocations.	Stormwater monitoring will provide information (improved land use concentrations; answer to specific quesitons) for use in the pollutant loads model to assess progress towards meeting pollutant load reduction benchmarks.	Stormwater monitoring will provide information (improved land use concentrations; answer to specific quesitons) for use in the pollutant loads model to assess progress towards meeting pollutant load reduction benchmarks.	N/A	Evaluate pollutant load reductions related to specific BMPs for use in pollutant load reduction benchmark calculations	N/A	Conduct pollutant load modeling at the end of the permit term to estimate progress towards achieving pollutant load reduction benchmarks.	N/A

Appendix A-1: Monitoring objectives addressed by Gresham/Fairview environmental monitoring program

	Data Evaluation Element
Monitoring Objective	**Data Evaluation**
1. Evaluate the source(s) of and means for reducing the pollutants of concern applicable to the co-permittees' permit area, including 2018/2020 303(d) listed pollutants, as applicable;	Data collected through environmental monitoring program will be analyzed to determine status and trends for TMDL, 303(d) and other emerging pollutants
2. Evaluate the effectiveness of Best Management Practices (BMPs) in order to help determine BMP implementation priorities	Report on literature review findings and pollutant load modeling results at the end of the permit term or as appropriate in annual compliance report.
3. Characterize stormwater based on land use type, seasonality, geography or other catchment characteristics	Submit data with annual compliance report, conduct data evaluation (update land use based concentrations) at the end of year 4 for submittal with pollutant load reduction benchmarks
4. Evaluate status and long-term trends in receiving waters associated with MS4 stormwater discharges	Submit data with annual compliance report, conduct data evaluation at the end of year 4 for submittal with pollutant load reduction benchmarks
5. Assess the chemical, biological, and physical effects of MS4 stormwater discharges on receiving waters	Submit data with annual compliance report, conduct data evaluation at the end of year 4 for submittal with pollutant load reduction benchmarks
6. Assess progress towards meeting TMDL pollutant load reduction benchmarks	See benchmark reporting requirements under the permit renewal application requirements.

Appendix A-2: Summary of Gresham and Fairview environmental monitoring program

	Environmental Monitoring Elements							Additional SWMP BMP Monitoring	
	Instream Monitoring			Stormwater Monitoring		Structural BMP Monitoring	Dry Season Field Screening		
	Dry and Wet Season Monitoring	Continuous Flow and Temperature	Macroinvertebrate Monitoring	Storm Event Monitoring	Pesticide Monitoring				
Monitoring Locations(s)	fixed sites; citywide 11 locations	Flow: USGS gages at 3 fixed location (Johnson, Kelley and Fairview) Temp: 11 fixed or probabilistic locations / year	fixed sites; citywide 8 locations	5 fixed and 5 probabilistic sites /year; citywide	5 fixed and 5 probabilistic sites /year; citywide	in/out for 1 facility/year	major outfalls and/or commercial/industrial; 8 fixed and 22 probabalistic sites /year; citywide		
Monitoring Frequency	3/year during wet season (Oct. 1 - Apr. 30); 1/year during dry season (max 4/year)	Flow: continuous every 15-minute; Temperature: continuous every 1-hour	1/year during dry season in connection with basic instream data collection	during storm events: 1/year	during storm events: 1/year	during storm events: 2/year	during dry season: 1/year		
Sampling Type	Grab	Continuous	Composite kick	Grab	Grab	Composite (time or flow)	Grab (as needed)		
Pollutant Parameter Analyte(s)	Field (pH, temperature, conductivity, DO, turbidity); Conventional (BOD, DOC, TSS, hardness, total alkalinity, *E. coli*); Nutrients (nitrate, ammonia, total phosphorus, ortho-phosphorus); Metals (copper, lead, mercury*, zinc); Seasonal (chlorophyll-a; dry season only)	Water Quantity (Flow - in-stream Rainfall - storm event); Temperature	Macroinvertebrate	Field (pH, temperature, conductivity, DO, turbidity); Conventional (BOD, DOC, TSS, hardness, total alkalinity, *E. coli*); Nutrients (nitrate, ammonia, total phosphorus, ortho-phosphorus); Metals (copper, lead, mercury*, zinc)	Current use pesticides (2,4-D, pentachlorophenol)	Water Quantity; Water Quality: Field (pH, temperature, conductivity, DO, turbidity); Conventional (BOD, DOC, TSS, hardness, total alkalinity, *E. coli*); Nutrients (nitrate, ammonia, total phosphorus, ortho-phosphorus); Metals (copper, lead, mercury*, zinc)	Field screening; follow-up analyses depending on result of field screening		
Off-Ramps / Possible Changes	Any analyte that is ND > 90% of the samples will be eliminated from routine sampling	Flow or rain monitoring may be alterd if USGS proposes changes. Temperature monitoring may be moved from fixed to probabilistic locations, depending on data needs.	Decrease frequency if no change is observed after 3 annual events	Changes in number of locations and frequency based on collected data; any analyte that is ND > 90% of the samples will be eliminated from routing sampling	Any pesticide that is ND > 90% of the samples will dropped from future monitoring	Will switch BMP being evaluated once adequate effectiveness data has been collected	May decide to alternate field screening locations if continued investigation of major outfalls yields no illicit discharges and another suitable sampling locations can be identified.		

* Dissolved and total recoverable metals monitored for all but mercury (total phase only)

Appendix B

Cities of Gresham and Fairview

Standard Operating Procedures (SOPs)

SOP A-1 Weather Tracking and Monitoring Preparation

The Storm Event Coordinator will review the daily forecasts and track all potential rainfall events.

If an event being tracked has a 75% or greater probability of generating 0.5" of rainfall within a 24 hour period, the Storm Event Coordinator will inform the Monitoring Team 48 to 72 hours before its predicted arrival and a the Team will be placed in a "Prepare/Stand-by Mode".

Monitoring Team "Prepare/Stand-by Mode"

- Alert lab of possible monitoring activities
- Check field boxes for supplies (see checklists; SOP A-6, A-7 and A-8)
- Test, maintain, and clean, if necessary, all field equipment
- Identify, confirm and arrange team members schedule for field activities
- Arrange vehicle for monitoring activities
- Installed charged battery in flow meter

At 24 hours before the event is predicted to arrive if there is still a 75% probability that the storm will generate 0.5" of rainfall within 24 hours the Storm Event Coordinator will continue to consult with the Weather Consultant and a monitoring "Alert" will be issued.

Monitoring Team "Alert Mode"

- Prep and label bottles
- Assemble field equipment and paperwork
- Load vehicle with monitoring equipment
- Update lab on monitoring activities
- At 4-8 hours before a target event is scheduled to arrive, a Go/No-Go decision on monitoring will be made by the Storm Event Coordinator based on final reports from and discussions with the Weather Consultant.

SOP A-2 Clean Sampling Techniques

Sample collection personnel should adhere to the following rules while collecting stormwater samples to reduce potential contamination.

- No Smoking
- Do not sample near a running vehicle.
- Always wear clean powder-free nitrile gloves when handling bottles, lids, and sample collection equipment.
- Never touch the inside surface of a sample bottle, lid, or sampling tube (even with gloved hands) to be contacted by any material other than the sample water.
- Never allow any object or material to fall into or contact the collected sample water.
- Avoid allowing rainwater to drip from rain gear or other surfaces into sample bottles.
- Do not eat or drink during sample collection.
- Do not breathe, sneeze, or cough in the direction of an open sample bottle.

SOP A-3 Equipment Decontamination Procedures

Non-dedicated sampling equipment will be properly cleaned before sample collection. Non-dedicated equipment may include:

- Teflon or fluoropolymer sampling equipment is preferred. Typically, stainless steel should not be used in the collection of trace metals, however because the sample will collected by stainless steel bailer and transferred immediately into appropriate bottles for each of the specific parameters, it will be acceptable. An equipment rinseate will be collected for stainless steel bailer. Metals will be analyzed to ensure quality control.
- Water quality probe for field parameter measurements

Scoops and buckets used to transfer samples into the sample bottles required for will be cleaned as follows:

- Clean with tap water and phosphate-free laboratory detergent, such as Liquinox®
- Rinse thoroughly with tap water
- Rinse thoroughly with analyte-free water
- Air dry
- Rinse with analyte-free water prior to grab sample collection
- Rinse three times with sample water prior to grab sample collection

Before the water quality probe is used at each site, the probe will be double-rinsed with analyte-free water.

SOP A-4 Grab Sampling

Grab samples will be taken for lab-analyzed constituents, which may include:

- Bacteria
- Ammonia
- Nitrate
- Biochemical Oxygen Demand (BOD)
- Ortho-phosphorus
- Total Phosphorus
- TSS
- Hardness
- Total and Dissolved Metals: Cu, Pb, Zn, Hg
- Particle Size Distribution (BMP and Outfall monitoring only)
- Pesticides (e.g. DDT, Dieldrin, 2,4-D), dependent upon location and time

Labels should be filled out prior to sample collection with point code, date, and time.

Grab sample technique is described as follows:

- Put on sterile nitrile gloves
- Adhere to clean sampling techniques in SOP A-2
- Collect well-mixed, representative sample from mid-depth in thalweg of stream. Do not collect samples from pooled areas.

- Depending upon stream size and bank shape, sample may be collected using stainless steel bailer or directly into sample bottles.
- For samples collected using the stainless steel bailer, the sample collection point should be a mid-depth of the flow stream with the bailer facing upstream.
- Remove lid of sample bottle
- Do not touch or allow inside of lid to contact any objects. Hold lid in hand with lid top down so that the inside isn't exposed to dust or rain while sample bottle is filled.
- Fill the sample bottle to the shoulder of the bottle.
- Replace lid on sample bottle
- Ensure the sample has been labeled and place in cooler

SOP A-5 Chain of Custody Records

A chain of custody (COC) record is a legal document designed to track samples and persons who are responsible for them during preparation of the sample container, sample collection, sample delivery, and sample analysis. These forms are supplied by the analytical laboratory performing the sample analysis. The procedures for filling out these forms are as follows:

Prior to sampling

After bottles are labeled placed in coolers, fill out general information on COC form including:

- Company information and Client Code
- Project Name
- Sample Site ID
- Matrix (stormwater)
- Date
- Type of sample

After sampling is complete

After sampling has been completed, fill out remainder of the COC including:

- Time sampling was initiated
- Number of containers
- Comments or special instructions
- Disposal requirements

Sample transfer

Whenever custody of the samples is relinquished:

- Sign and date
- Have receiving custodian sign and date
- Unique sample code or number assigned to each bottle set
- Relay any special instructions
- Take one copy of COC for your records

SOP A-6 Personal Protective Equipment Checklist

The following items are required for most field sampling to protect field staff conducting sampling:

- Health and Safety Plan
- Safety vest
- Raingear
- Nitrile (or powder-free latex) gloves
- First Aid kit
- Traffic safety cones
- Traffic control signs

SOP A-7 Portable Field Equipment Checklist

The following equipment

- YSI 556 MSP Meter (calibrated)
- Hach 2100P Turbidimeter (calibrated)
- Camera
- Cellular Phone

Lab Sample Receiving:	503-823-5696
Weekdays :	503-823-5631
Weekends:	503-823-5677

- Fueled vehicle

The following items are recommended, depending upon the type of sampling taking place:

- Headlight/flashlight (for storm sampling early morning or late night)
- Manhole hook

SOP A-8 Sampling Equipment Checklist

The following items are required each sampling trip:

- Field data sheet on right in the rain paper
- Chain of custody form
- Cooler(s) with bottles

  For Ambient Monitoring:
  - 2 – plastic quarts (1 L),
  - 2 – 500 mL pre-cleaned plastic "metals" bottles,
  - 1 – plastic pint (500 mL),
  - 2 – plastic 1/2-pints (250 mL),
  - 1 – sterile/autoclaved bacteria bottle (250 mL)
  - 1 – amber glass (1 L) for chlorophyll-*a* (May through October only)

  For BMP and Outfall Monitoring:

  Same list as above, except
  - No Chl-a

    - Add 1 additional 1L plastic bottle for particle size distribution
- Blue ice
- Sharpie or writing utensil
- Extension pole
- Bailer (stored in Ziploc bag)
- Duct tape
- Analyte-free water
- Paper towels

The following items are optional, but recommended, each sampling trip:

- Labeling tape
- One gallon plastic bags

CITY OF GRESHAM
Department of Environmental Services
Field Data Sheet

Project Name: _____ **Date:** _____
Field Crew: _____ **Weather:** _____
_____ **Event Precip:** _____
Antecedent Precip:

GRAB SAMPLES

Site Number	FCI0	FCI1	JCI1	JCI2	KCI1	KCI3	KCI4	KI1	KI2	BCI1	BCI2	FVL1
Time												
DO												
pH												
Temp												
Cond												
Turb												
Color												

Field Replicate Station #: _____ **Time:** _____ **No Field Replicate:** _____

Date: _____

Water Pollution Control Laboratory
6543 N. Burlington Ave.
Portland, Oregon 97203-4552
Sample Custodian: (503) 823-5696
General Lab: (503) 823-5681

City of Portland Chain-of-Custody

Bureau of Environmental Services

Work Order #: _____

Collected By: _____

Client Name: City of Gresham Matrix: Surfacewater

Project Name: **City of Gresham Streams**

Requested Analyses

Special Instructions:

[1] Field Filtered
[2] Chlorophyll a - May through October Only

Lab Number	Location ID	Sample Date	Sample Time	Sample Type	BOD	TSS	E. coli	Ammonia-Nitrogen	Nitrate-Nitrogen [1]	Total Phosphorus	O-Phosphate Phosphorus [1]	TKN	Chlorophyll a [2]	Hardness	Total Metals (Cu, Pb, Zn) + Hg	Dissolved Metals (Cu, Pb, Zn)	DOC [1]	Pesticides (low-level - C	# of Containers	Remarks
01	FCl0			G	●	●	●	●	●	●	●	●	●	●	●	●	●			West of Blue Lake Rd in Trailer Court
02	FCl1			G	●	●	●	●	●	●	●	●	●	●	●	●	●			North of Stark St
03	JCl1			G	●	●	●	●	●	●	●	●	●	●	●	●	●	●		174th Ave
04	JCl2			G	●	●	●	●	●	●	●	●	●	●	●	●	●	●		Palmblad Rd & 252nd Ave
05	KCl1			G	●	●	●	●	●	●	●	●	●	●	●	●	●			Outflow from MHCC Pond
06	KCl3			G	●	●	●	●	●	●	●	●	●	●	●	●	●			Kelly Ck below Kelley Creek Pond
07	KCl4			G	●	●	●	●	●	●	●	●	●	●	●	●	●			Inflow to Kelley Creek Pond
08	Kl1			G	●	●	●	●	●	●	●	●	●	●	●	●	●			17115 SE Foster Rd
09	Kl2			G	●	●	●	●	●	●	●	●	●	●	●	●	●			8605 SE Rodlun Rd
10	BCl1			G	●	●	●	●	●	●	●	●	●	●	●	●	●			Glen Otto Park
11	BCl2			G	●	●	●	●	●	●	●	●	●	●	●	●	●			Division St at Troutdale Rd
12	FD			G	●	●	●	●	●	●	●	●	●	●	●	●	●			Field Duplicate

Relinquished By:	Received By:	Relinquished By:	Received By:
Signature: Date:	Signature: Date:	Signature: Date:	Signature: Date:
Printed Name: Time:	Printed Name: Time:	Printed Name: Time:	Printed Name: Time:

Appendix D: IGA between Gresham & Fairview

10/11/2059

INTERGOVERNMENTAL AGREEMENT BETWEEN THE CITY OF FAIRVIEW AND THE CITY OF GRESHAM FOR JOINT SERVICES UNDER A MUNICIPAL NPDES SEPARATE STORM SEWER PERMIT

This Agreement is entered into between the City of Gresham, Oregon (Gresham) and the City of Fairview, Oregon (Fairview).

RECITALS

WHEREAS, the goal of this intergovernmental agreement is to continue to comply with existing federal and state National Pollutant Discharge Elimination System (NPDES) municipal separate storm sewer system (MS4) permit requirements ("MS4 Permit"); and

WHEREAS, the Fairview City Council and the Gresham City Council both recognize the need to identify and control pollutants entering the MS4 through the application of best management practices established and implemented through the jurisdiction of local government via each municipality's Stormwater Management Plan (SWMP); and

WHEREAS, it has been determined that urban stormwater runoff is a carrier of pollutants into our rivers and streams; and

WHEREAS, the MS4 Permit issued by the Oregon Department of Environmental Quality (DEQ) requires that each co-permittee is individually responsible for the operation of a municipal separate storm sewer system within their respective permit boundary; and

WHEREAS, the cities of Gresham and Fairview are authorized to implement a stormwater management program which is detailed in their respective SWMPs to reduce the contribution of pollutants in stormwater to the maximum extent practicable, to address applicable TMDL wasteload allocations, and to discharge stormwater to waters of the State in conformance with the requirements and conditions set forth in the MS4 Permit conditions issued by Oregon DEQ as permit #101315.

WHEREAS, the MS4 Permit requires that co-permittees "Control through interagency agreements among the co-permittees the contribution of pollutants from one portion of the municipal system to another portion of the municipal system"; and

WHEREAS, compliance with the MS4 Permit and implementation of the SWMP are deemed to be compliance with the requirement to reduce the discharge of pollutants from the MS4 to the maximum extent practicable; and

WHEREAS, water quality needs and development of a consistent and comprehensive SWMP that satisfies the MS4 Permit requirements can best be realized by co-compliance between Gresham and Fairview; and

WHEREAS, it is necessary to provide a basis for defining the co-permittees' primary intentions and relationships, responsibilities and obligations under the MS4 Permit; and

WHEREAS, the purpose of this Agreement is to detail the responsibilities, compensation and services to be provided by each co-permittee in meeting the requirements of the MS4 Permit.

NOW THEREFORE, the parties agree to the following:

1. GENERAL PROVISIONS

A) Gresham and Fairview are co-permittees to an MS4 Permit as provided in 40 CFR Section 122.26; and permitted by Oregon DEQ Municipal NPDES Permit #101315.

B) Each co-permittee is responsible for complying with MS4 Permit conditions relating to stormwater discharges from those parts of the MS4 they continue to operate or own. Neither co-permittee is responsible for the other co-permittee's permit compliance efforts or infractions thereof.

C) Each co-permittee implements their own SWMP in order to control to the maximum extent practicable the contribution of pollutants from one portion of the municipal system to another portion of the municipal system to comply with the MS4 Permit.

2. SCOPE OF FAIRVIEW SERVICES

A) Fairview shall work cooperatively with Gresham and its representatives in developing procedures to ensure effective coordination.

B) Based on mutual agreement, Fairview may undertake tasks to assist with co-permittee compliance activities.

C) Fairview shall be responsible for implementing its SWMP as described in the NPDES permit co-application submitted to Oregon DEQ, or its successive updates.

D) Fairview shall be responsible for writing its portion of the annual report to Oregon DEQ that is based upon its SWMP, and shall provide the report to Gresham at least one week prior to the required report submittal date as defined in the MS4 Permit.

3. SCOPE OF GRESHAM SERVICES

A) Gresham shall provide, or shall contract to provide, or shall lead a joint effort to contract for the following services to Fairview with regard to the MS4 Permit:

1) Gresham shall perform monitoring required by the MS4 Permit, including reporting of the monitoring data and other associated information required by the monitoring component of the MS4 Permit. Gresham shall also provide the monitoring data directly to Fairview at Fairview's request.

2) Gresham shall compile and summarize water quality data required for the MS4 Permit including but not limited to Monitoring and Reporting Requirements as described in Schedule B of the MS4 Permit, or any subsequent modifications to the MS4 Permit.

3) Based on mutual agreement, Gresham may undertake tasks to assist with additional co-permittee compliance activities.

B) Gresham shall assume the lead role with regard to the MS4 Permit and implementation of the Stormwater Management Program in the following manner:

1) Gresham will initiate programmatic discussions with the Oregon DEQ as needed to facilitate implementation of the MS4 Permit requirements that apply to the entire MS4 Permit boundary.

2) Gresham will coordinate and manage the co-permittee process as necessary to ensure a timely and responsive submittal of the annual report as required by the permit.

3) Gresham will prepare and submit the annual report for the MS4 Permit requirements so as to include the Fairview operated municipal separate storm sewer system within the permit boundary.

4. COMPENSATION

Fairview shall pay Gresham for work performed under this Agreement after the effective date as set out below. Likewise, Gresham shall pay Fairview for activities that Fairview conducts on Gresham's behalf, by mutual consent. The payment shall be full compensation for the reasonable cost of work performed, for services rendered, and for all labor, materials, supplies, equipment, and incidentals necessary to perform the work and services. Work will include costs incurred related to management and coordination of the co-permittee process between Gresham and Fairview.

Annual payment to either party shall not exceed $15,000, except by mutual agreement.

5. EFFECTIVE AND TERMINATION DATES

This Agreement shall be effective on the date at which all parties sign the agreement and shall terminate upon expiration of the MS4 Permit. If the MS4 Permit is extended or renewed, the term of this Agreement shall extend automatically to conform to the extended term of the MS4 Permit.

6. BILLING AND PAYMENT PROCEDURE

Billing and payment procedures shall be as set out below.

In July, the Cities shall submit invoices for work performed during the previous fiscal year. Each invoice shall include the amount due and shall include sufficient information to enable the parties to identify the service or product being invoiced as needed to satisfy fiscal requirements.

Invoiced payments are due within 60 days of the invoice date. Payments to Gresham shall be made payable to the City of Gresham, and mailed to City of Gresham, Financial Services Division, 1333 NW Eastman Parkway, Gresham, Oregon, 97030. Payments to Fairview shall be made payable to City of Fairview, and mailed to City of Fairview, 1300 NE Village Street, Fairview, Oregon, 97024.

If a payment is not received within sixty (60) days of the invoice date, interest of 1.5% per month (18% per annum) may be assessed against the entire delinquent balance. The past-due invoice may be subject to either city's collection policy and may be submitted to a collection agency for further action.

7. EARLY TERMINATION OF AGREEMENT

A) Gresham and Fairview, by mutual written agreement, may terminate this Agreement at any time.

B) Either party may terminate this agreement by giving 90 day written notice to the other party.

C) Either Gresham or Fairview may terminate this Agreement in the event of a breach of the Agreement by the other. Prior to such termination, however the party seeking the termination shall give to the other party written notice of the breach and of the party's intent to terminate. If the party has not cured the breach within thirty (30) days of the notice, then the party giving the notice may terminate the Agreement at any time thereafter by giving a written notice of termination.

8. INDEMNIFICATION

Subject to the limitations of the Oregon Constitution and statutes, Gresham and Fairview each shall be solely responsible for any loss or injury caused to third parties arising from Gresham's or Fairview's own acts or omissions under this Agreement and Gresham and Fairview shall defend, hold harmless and indemnify the other party to this agreement with respect to any claims, litigation or liability arising from Gresham's or Fairview's own acts or omissions under this Agreement.

9. FUNDS

Both Fairview and Gresham certify that sufficient funds are available and authorized for expenditure to finance the cost of the Agreement.

10. NON-APPROPRIATION CLAUSE

This agreement is subject to future appropriations by any future Gresham or Fairview City Council.

THE CITY OF GRESHAM

By: _____
Erik Kvarsten, City Manager

Date: 1/3/11

THE CITY OF FAIRVIEW

By: _____
Mike Weatherby, Mayor for City of Fairview

Date: 1.22.11

APPROVED AS TO FORM

By: _____
DAVID RIS, City Attorney for City of Gresham, Oregon

Reviewed:

By: _____
NANCY WERNER, City Attorney for City of Fairview, Oregon

RESOLUTION
(29-2010)

A RESOLUTION OF THE CITY COUNCIL FOR THE CITY OF FAIRVIEW APPROVING THE INTERGOVERNMENTAL AGREEMENT WITH THE CITY OF GRESHAM TO COORDINATE COMPLIANCE WITH NPDES MS4 STORMWATER PERMIT.

WHEREAS, The City of Fairview and the City of Gresham are co-permittees on a National Pollutant Discharge Elimination System Municipal Separate Storm Sewer System Permit, #101315 (MS4 Permit) issued by the Oregon Department of Environmental Quality; and

WHEREAS, the MS4 Permit requires that co-permittees "[c]ontrol through interagency agreements among the co-permittees the contribution of pollutants from one portion of the municipal system to another portion of the municipal system"; and

WHEREAS, compliance with the MS4 Permit and implementation of the Stormwater Management Plan (SWMP) is deemed to be compliance with the requirement of the MS4 Permit to reduce the discharge of pollutants from the Municipal Separate Storm System to the maximum extent practicable; and

WHEREAS, the City of Fairview did develop the SWMP consistent with the MS4 Permit requirements; and

WHEREAS, the City of Fairview finds it necessary to define each jurisdictions intentions and relationships, responsibilities and obligations under the MS4 Permit;

NOW, THEREFORE, BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF FAIRVIEW AS FOLLOWS:

1. The City approves the Intergovernmental Agreement with the City of Gresham to Coordinate Compliance with NPDES MS4 Stormwater Permit substantially in the form attached hereto as Exhibit A.

2. This Resolution is and shall be effective from and after its passage by the City Council.

Resolution adopted by the City Council of the City of Fairview, this 1st day of September, 2010.

Mayor, City of Fairview
Mike Weatherby

Date of Signing
ATTEST:

Recorder, City of Fairview
Joseph Gall

CITY OF GRESHAM 1333 N.W. Eastman Parkway | Gresham, OR 97030

To: Eric Kvarsten

From: Torrey Lindbo, Steve Fancher

Date: August 20, 2019

Re: USGS Joint Funding Agreement

Message:

In 2003, the City entered into an agreement with the United States Geological Survey (USGS) to provide continuous hydrologic and water quality monitoring on Johnson, Kelley and Fairview Creeks to help the city meet monitoring requirements for complying with our Department of Environmental Quality (DEQ) issued National Pollutant Discharge Elimination system (NPDES) stormwater permit. The first 5-year agreement was approved by City Council on October 1, 2003. Two five-year agreements to continue that work have been approved since 2003. The latest contract has expired, and Environmental Services is recommending that the city approve the attached agreement covering the next 5 years of USGS monitoring.

Benefits to the city include:

- Federal matching funds provided by USGS
- Collaboratively funded project which includes funding contributed by Portland, Damascus, Milwaukie, Clackamas County, Multnomah County, and the East Multnomah County Soil and Water Conservation District.
- Addresses four important data needs:
  - Flow and flooding information on major Gresham streams
  - Hydrology in Kelley Creek as Pleasant Valley begins to develop
  - Preliminary data collection on Springwater tributaries prior to development
  - Sediment loads in Johnson Creek, which are believed to primarily come from agricultural areas upstream of Gresham. The USGS monitoring will help DEQ better assign responsibility for reducing pollutants entering Johnson Creek.

The cost of $210,630 over 5 years equates to $39,000-45,000 per year, and is a budgeted cost for the Watershed Division of DES.

United States Department of the Interior
U.S. GEOLOGICAL SURVEY
Oregon Water Science Center
2130 SW 5th Avenue
Portland, OR 97201
http://or.water.usgs.gov/

August 16, 2019

Torrey Lindbo
City of Gresham
1333 NW Eastman Parkway
Gresham, OR 97030

Dear Mr. Lindbo,

The U.S. Geological Survey (USGS), Multnomah County, Clackamas County, City of Gresham, City of Portland, East Multnomah Soil and Water Conservation District, and City of Milwaukie collaboratively maintain the operation of the Johnson Creek hydrologic monitoring program (14211400, 14211499, 14211500, 14211550) in the Johnson Creek Basin, Oregon. The USGS and the City of Gresham also collaboratively maintain the operation of the Fairview Creek stream gage (14211814). This letter and subsequent joint-funding agreement (JFA) provide the mechanism to continue this relationship, and collaboration, between USGS and City of Gresham, in Federal fiscal year (FFY) 2020 through 2024 (October 1, 2019 through September 30, 2024).

The total cost to continue the USGS and City of Gresham portion of this monitoring program from FFY 2020 to FFY 2024 will be $320,851. The USGS will provide $110,221 of Cooperative Matching Funds and the City will provide $210,630. Enclosed is a signed original of our standard JFA for the project covering the period October 1, 2019 through September 30, 2024.

City of Gresham	2020	2021	2022	2023	2024
Johnson Creek Monitoring	$24,400	$25,300	$26,200	$27,100	$28,000
Fairview Creek	$14,908	$15,544	$16,013	$16,415	$16,750
Total	**$39,308**	**$40,844**	**$42,213**	**$43,515**	**$44,750**

USGS CMF	2020	2021	2022	2023	2024
Johnson Creek Monitoring	$13,100	$13,600	$14,200	$14,800	$15,300
Fairview Creek	$7,343	$7,656	$7,887	$8,085	$8,250
Total	**$20,443**	**$21,256**	**$22,087**	**$22,885**	**$23,550**

Please sign and return one fully-executed original to Andrew Kerslake at kerslake@usgs.gov. The signed agreement is not a bill and no funds are required at this time; rather, the agreement is our legal authority that permits the work to be done and authorizes USGS to accept funds. The USGS Water Resources Cooperative Program operates under the authority of statute 43 USC 50, which allows us to perform this work. The Oregon Water Science Center DUNS number is 137883463.

Federal law requires that we have a signed agreement to continue this work; therefore, please return the signed agreement as soon as possible. If, for any reason, the agreement cannot be signed and returned in the near future, please contact Adam Stonewall at (503) 251-3246 or email koverton@usgs.gov to make alternative arrangements.

This is a fixed cost agreement to be billed annually via Down Payment Request (automated Form DI-1040). We can bill you on a specific date if that is more convenient relative to your fiscal year planning and budgeting process. Please allow 30 days from the end of the billing period for issuance of the bill. If you experience any problems with your invoice(s), please contact Andrew Kerslake at (503) 251-3253 or email at kerslake@usgs.gov.

The results of all work under this agreement will be available for publication by USGS in collaboration with the City. During the course of this jointly planned activity and partnership, USGS may provide unpublished USGS data or information to your office for scientific peer and (or) courtesy review. Guidance concerning USGS's non-disclosure policy will be provided with any review material and is further explained in USGS Fundamental Science Practices at (https://www.usgs.gov/about/organization/science-support/science-quality-and-integrity/fundamental-science-practices).

Sincerely,

JAMES CRAMMOND Digitally signed by JAMES CRAMMOND Date: 2019.08.13 15:14:07 -07'00'

James D. Crammond
Center Director

Cc: To file, available upon request

Form 9-1366
(May 2018)

U.S. Department of the Interior
U.S. Geological Survey
Joint Funding Agreement
FOR
Water Resource Investigations

Customer #: 6000001707
Agreement #:
Project #:
TIN #: 93-6002212

Fixed Cost Agreement YES[X] NO[ ]

THIS AGREEMENT is entered into as of October 1, 2019, by the U.S. GEOLOGICAL SURVEY, Oregon Water Science Center, UNITED STATES DEPARTMENT OF THE INTERIOR, party of the first part, and the City of Gresham, party of the second part.

1. The parties hereto agree that subject to the availability of appropriations and in accordance with their respective authorities there shall be maintained in cooperation the operation of the Johnson Creek hydrologic monitoring program (14211400, 14211499, 14211500, 14211550) in the Johnson Creek Basin and the Fairview Creek gage (14211814) in Gresham, Oregon, herein called the program. The USGS legal authority is 43 USC 36C; 43 USC 50, and 43 USC 50b.

2. The following amounts shall be contributed to cover all of the cost of the necessary field and analytical work directly related to this program. 2(b) include In-Kind-Services in the amount of $0.00

(a) $110,221 by the party of the first part during the period October 1, 2019 to September 30, 2024

(b) $210,630 by the party of the second part during the period October 1, 2019 to September 30, 2024

(c) Contributions are provided by the party of the first part through other USGS regional or national programs, in the amount of: $0

Description of the USGS regional/national program: N/A

(d) Additional or reduced amounts by each party during the above period or succeeding periods as may be determined by mutual agreement and set forth in an exchange of letters between the parties.

(e) The performance period may be changed by mutual agreement and set forth in an exchange of letters between the parties.

3. The costs of this program may be paid by either party in conformity with the laws and regulations respectively governing each party.

4. The field and analytical work pertaining to this program shall be under the direction of or subject to periodic review by an authorized representative of the party of the first part.

5. The areas to be included in the program shall be determined by mutual agreement between the parties hereto or their authorized representatives. The methods employed in the field and office shall be those adopted by the party of the first part to insure the required standards of accuracy subject to modification by mutual agreement.

6. During the course of this program, all field and analytical work of either party pertaining to this program shall be open to the inspection of the other party, and if the work is not being carried on in a mutually satisfactory manner, either party may terminate this agreement upon 60 days written notice to the other party.

7. The original records resulting from this program will be deposited in the office of origin of those records. Upon request, copies of the original records will be provided to the office of the other party.

8. The maps, records or reports resulting from this program shall be made available to the public as promptly as possible. The maps, records or reports normally will be published by the party of the first part. However, the party of the second part reserves the right to publish the results of this program, and if already published by the party of the first part shall, upon request, be furnished by the party of the first part, at cost, impressions suitable for purposes of reproduction similar to that for which the original copy was prepared. The maps, records or reports published by either party shall contain a statement of the cooperative relations between the parties. The Parties acknowledge that scientific information and data developed as a result of the Scope of Work (SOW) are subject to applicable USGS review, approval, and release requirements, which are available on the USGS Fundamental Science Practices website (https://www.usgs.gov/about/organization/science-support/science-quality-and-integrity/fundamental-science-practices).

Form 9-1366
(May 2018)

U.S. Department of the Interior
U.S. Geological Survey
Joint Funding Agreement
FOR
Water Resource Investigations

Customer #: 6000001707
Agreement #:
Project #:
TIN #: 93-6002212

9. Billing for this agreement will be rendered **annually**. Invoices not paid within 60 days from the billing date will bear Interest, Penalties, and Administrative cost at the annual rate pursuant the Debt Collection Act of 1982, (codified at 31 U.S.C. § 3717) established by the U.S. Treasury.

USGS Technical Point of Contact

Name: Adam Stonewall
Hydrologist
Address: 2130 SW 5th Avenue
Portland, OR 97201
Telephone: (503) 251-3276
Fax: (503) 251-3470
Email: stonewal@usgs.gov

Customer Technical Point of Contact

Name: Torrey Lindbo
Water Sciences Program Manager
Address: 1333 NW Eastman Parkway
Gresham, OR 97030
Telephone: (503) 618-2405
Fax:
Email: Torrey.lindbo@greshamoregon.gov

USGS Billing Point of Contact

Name: Andrew Kerslake
Financial Specialist
Address: 2130 SW 5th Avenue
Portland, OR 97201
Telephone: (503) 251-3253
Fax:
Email: kerslake@usgs.gov

Customer Billing Point of Contact

Name:
Address:
Telephone:
Fax:
Email:

U.S. Geological Survey
United States
Department of Interior

Signature

JAMES CRAMMOND Digitally signed by JAMES CRAMMOND Date: 2019.08.13 15:14:38 -07'00'

By_____ **Date:** _____
Name: James D. Crammond
Title: Center Director

City of Gresham

Signatures

Torrey Lindbo Digitally signed by Torrey Lindbo DN: cn=Torrey Lindbo, o=City of Gresham, ou=Department of Environmental Services, email=torrey.lindbo@greshamoregon.gov, c=US Date: 2019.08.21 -07'00'

By_____ **Date:** _____
Name: Torrey Lindbo
Title: Watershed Science Manager

By_____ **Date:** 09-03-19
Name: Erik Kvarsten
Title: City Manager

By_____ **Date:** _____
Name:
Title:

Approved as to Form

City Attorney's Office

Hydrologic Monitoring in the Johnson Creek Basin, Oregon

Water Years 2020-2024

Prepared by:

Adam Stonewall (*stonewal@usgs.gov*)
U.S. Geological Survey
Oregon Water Science Center
2130 SW 5th Ave
Portland, Oregon, 97201

Prepared for:

City of Portland, Bureau of Environmental Services
1220 SW 5th Ave, Room 1000, Portland, OR 97204

City of Gresham, Dept. of Environmental Services
1333 NW Eastman Pkwy, Gresham, OR 97030

City of Milwaukie
6101 SE Johnson Creek Blvd, Milwaukie, OR 97206

Multnomah County
1620 SE 190th Ave, Portland, OR 97233

Clackamas County's Water Environment Services
150 Beavercreek Road, Oregon City, OR 97045

East Multnomah Soil and Water Conservation District
5211 North Williams Avenue, Portland, Oregon 97217

July 12, 2019

PURPOSE

Numerous public agencies and organizations are responsible for water quality and stormwater management, endangered species and habitat protection, and watershed restoration and protection in the Johnson Creek watershed. To make wise land-use decisions for the benefit of people and wildlife ecology in the area, decision-makers need information and interpretation of the hydrology of the Johnson Creek basin.

A cooperative study between the U.S. Geological Survey (USGS) and municipalities in the Johnson Creek basin began in 1998. Current cooperators are the cities of Portland, Gresham, and Milwaukie, Multnomah County, East Multnomah Soil and Water Conservation District and Clackamas County's Water Environment Services including Happy Valley. This 5-year plan, for Water Year (WY) 2020-2024 (October 2019 through September 2024) builds on the understanding derived from two decades of study and anticipates needs for further understanding of hydrologic issues in the Johnson Creek watershed. Results from this study provide insight into interaction of the groundwater and surface-water systems, and implications for water quantity and quality in an urbanizing area.

BACKGROUND

A need to understand Johnson Creek flooding was the basis of the original study and cooperative agreement. Through the collection of surface and groundwater data, occurrences of Holgate Lake (an ephemeral lake in southeast Portland) and elevated streamflow levels of Crystal Springs Creek (a tributary located near the mouth of Johnson Creek) and other springs were attributed to elevated groundwater levels in the basin, which resulted from increased levels of recharge during the abnormally wet water years of 1996 and 1997 (Lee and Snyder, 2009). The same study also found that a disproportionate (relative to drainage area) amount of annual streamflow originates from the upper half of the watershed. This has relevance to land-use planning and management of stormwater in the watershed.

Results from the study provide understanding of low (summer) streamflows of Johnson Creek. Streamflow of the lower 5 miles of the creek is dominated by groundwater discharge, and varies depending on recharge conditions. Upstream of the Sycamore gage, which is located near the intersection of SE 148th & Foster Road in Portland, summertime streamflow is minimal.

In addition to providing insight into quantity of streamflow, data collection and interpretation have provided increased understanding of water quality in the Johnson Creek basin. Pesticide and sediment data collected in 1989 and 2002 indicated a linkage of suspended sediment to organochlorine pesticides (DDT, for example). The more recent sampling indicated a decline in pesticide concentration for a given sediment concentration.

Turbidity data and sediment data collected since 2006 were analyzed in a Scientific Investigations Report (Stonewall and Bragg, 2012). The study found that on average 1,890 and 4,640 annual tons of suspended-sediment are transported past the Gresham and Milwaukie streamflow gages, respectively. Although a disproportionately higher (relative to drainage area) amount of suspended-sediment originates upstream of the Gresham gage, the majority of this discrepancy can be explained by higher streamflow yield rather than higher suspended-sediment concentration. In addition, the study showed that approximately 50% of suspended-sediment is transported during the highest 1% of streamflows, suggesting that management of stormwater during flooding may be a more cost-effective solution for limiting sediment-borne contaminants in the creek than other options.

Historic streamflow data, high water marks and local knowledge were used for inundation studies in the Johnson Creek watershed. Annual exceedance probabilities and flood inundation maps were developed for Crystal Springs Creek (Stonewall, 2014; Stonewall and Hess, 2014). Digital flood-inundation maps were created for a 12.9-mile reach of Johnson Creek. The flood-inundation maps depict estimates of water depth and areal extent of flooding from the mouth of Johnson Creek to just upstream of Southeast 174th Avenue in Portland, Oregon (Stonewall and Beal, 2017). Each flood-inundation map is based on a specific water level and associated streamflow at the USGS streamgage, Johnson Creek at Sycamore, Oregon (14211500), which is located near the upstream boundary of the maps. The maps produced by the USGS and the forecasted flood hydrographs produced by National Weather Service River Forecast Center can be accessed through the USGS Flood Inundation Mapper Web site (http://wimcloud.usgs.gov/apps/FIM/FloodInundationMapper.html).

Stream temperature data indicate general warming of Johnson Creek from the upper basin to the lower basin, and a distinct effect from groundwater discharge to the creek. Large, relatively shallow ponds in the Johnson Creek watershed result in summertime warming of the Creek. Although the source of flow to Crystal Springs Creek is relatively cool groundwater, summertime warming due to ponds results in a net increase in temperature of Johnson Creek downstream of the inflow of Crystal Springs Creek.

Crystal Springs Lake is fed by a number of cold-water springs that average around 13.0 °C. However, solar heating and the residence time in the lake result in elevated temperatures that routinely exceed the 18.0 °C Oregon Department of Environmental Quality summer criterion for salmonid rearing and migration. Model results have shown that improved lake management scenarios may result in a decrease in 7-day average of daily maximum values by about 2.0–4.7 °F (1.1 –2.6 °C) for outflow from Crystal Springs Lake during warmest part of the year (Buccola and Stonewall, 2016) .

Products from the cooperative study since 1998 include both data and interpretive reports. Groundwater data include both periodic water-level observations and records from continuous water-level recorders. Surface-water data include streamflow, temperature, turbidity and suspended-sediment data. Interpretive products consist of a report on pesticides and sediment (Tanner and Lee, 2004), a report on the groundwater and surface water hydrology of the Johnson Creek basin (Lee and Snyder, 2009), a report on sediment loading at the Gresham and Milwaukie sites on Johnson Creek (Stonewall and Bragg, 2012), a fact sheet intended for a less technical audience summarizing findings from the past decade's study (Williams and others, 2010), a webpage detailing the calculation of annual exceedance probabilities in Crystal Springs Creek (Stonewall, 2014), a report detailing the development of a temperature model used to evaluate management scenarios for Crystal Springs Creek (Buccola and Stonewall, 2016), a report detailing the evaluation of flood inundation maps for Crystal Springs Creek (Stonewall and Hess, 2016), a report detailing the development of flood-inundation maps for Johnson Creek (Stonewall and Beal, 2017), a report detailing sub-basin hydrology in upper Johnson Creek (in progress) and a follow-up report on streamflow, turbidity and suspended-sediment in the upper Johnson Creek basin (in progress).

PROBLEM

To make wise land-use decisions for the benefit of people and wildlife ecology in the area, decision-makers need information and interpretation of the hydrology of the Johnson Creek basin. Streamflow data are needed to:

- assess real-time flooding hazards,
- access the effectiveness of restoration efforts,
- quantify water-borne contaminants, also
- historical streamflow data are needed for engineering and watershed management designs.

Water quality data such as temperature, turbidity and suspended-sediment data are needed to:

- evaluate efforts at meeting Total Maximum Daily Load (TMDL) standards, and
- evaluate and prioritize restoration efforts.

Groundwater data are needed to:

- predict low and high streamflow at key springs in the lower watershed,
- design stormwater facilities,
- predict flooding around Holgate Lake,
- update groundwater elevation maps,
- evaluate the effects of regional development on groundwater levels,
- determine the direction of groundwater flow in the basin,
- monitor short and long-term changes in groundwater recharge, storage and flow direction, and
- monitor the effects of climate variability in the basin.

Previous studies and reports have detailed suspended sediment at the USGS gages 14211400 (Johnson Creek at Regner Road, at Gresham, Oregon), and 14211550 (Johnson Creek at Milwaukie, OR), but a more detailed investigation of basin-wide sediment transport would be beneficial. Some sediment data are collected by local agencies (Cities of Portland and Gresham, and the East Multnomah Soil and Water Conservation District), but these data are not currently incorporated into a basin-wide analysis. In addition, local agencies collect sediment by examining Total Suspended Solids (TSS). The method for determining TSS was originally analysis of wastewater, and research by the USGS has shown that TSS is "fundamentally unreliable" for the analysis of natural-water samples (Gray and others, 2000). An analysis is needed to examine and quantify the local relationship between TSS and Suspended-Sediment Concentration (SSC). In addition, little is known about the types of contaminants sorbed to suspended-sediment in Johnson Creek.

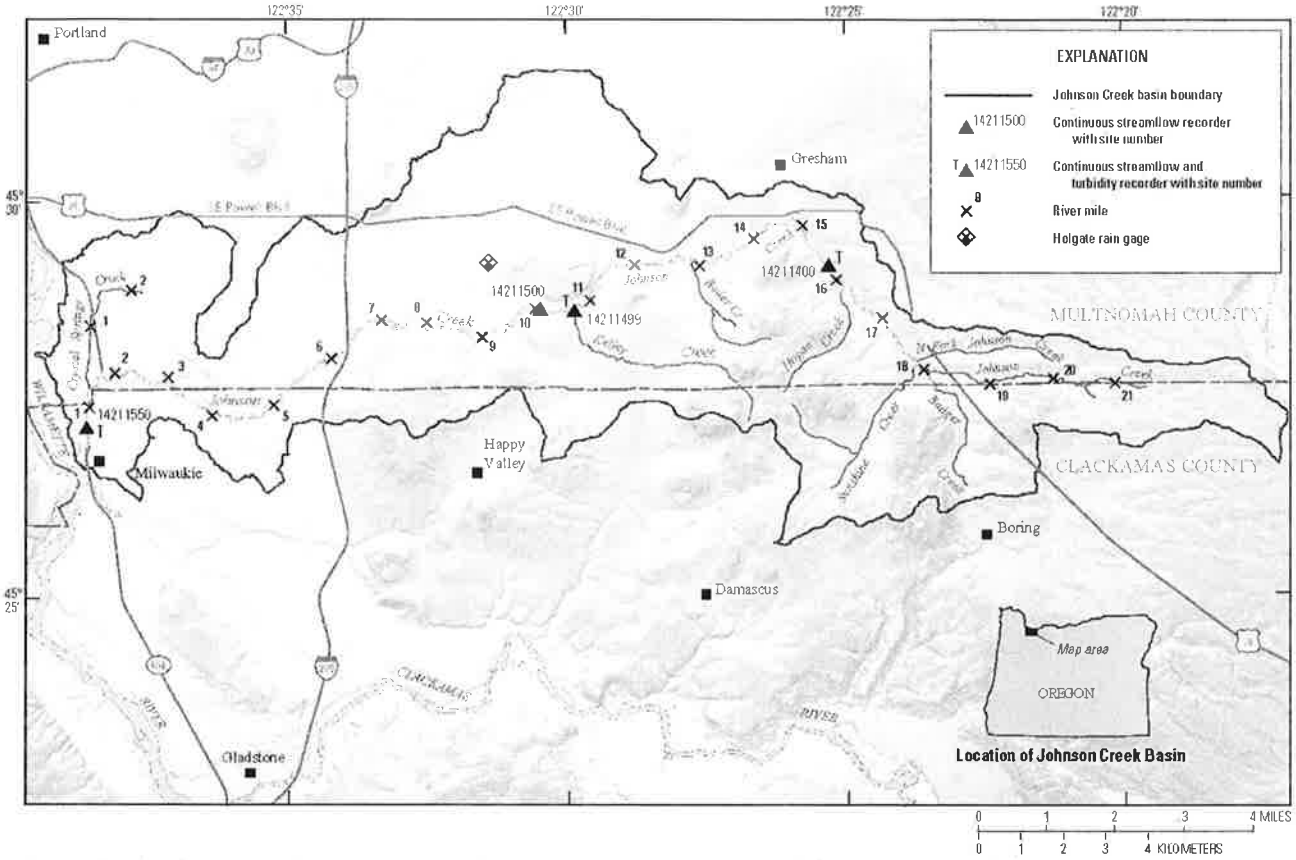

Figure 1. Location of study area and streamflow-gaging stations used for temperature and turbidity monitoring, Johnson Creek basin, Oregon.

OBJECTIVES

- Continue to collect streamflow data to assess flooding hazards real-time, and to further inform management decisions.
- Continue to collect temperature and turbidity data to assess restoration efforts and monitor stream health.
- Continue to collect groundwater data to predict spring streamflow, flooding at Holgate Lake, and to provide groundwater data to UIC Program/Stormwater WPCF Permit Programs .
- Collect sediment and turbidity data to further the understanding of processes that drive sediment transport in the Johnson Creek watershed, and to predict where restoration efforts may result in the greatest reduction in unwanted sediment transport.

CURRENT RELEVANCE AND BENEFITS

The project is relevant to the objectives of the USGS Federal-State Cooperative Program:

- HYDROLOGIC HAZARDS: One focus of the study in this highly urbanized basin relates to hydrologic hazards in an area that is undergoing significant changes in land use. Flooding, both from rainfall events and from rising ground-water levels has damaged properties. Real-time data from monitoring sites in the basin are being used by cooperating agencies to make decisions regarding these hazards.

- WATER QUALITY: Analysis of stream temperature and turbidity data provide insight into the effects of land-use practices. Stream and riparian-area restoration projects, conversion of agricultural land to urban uses, changes in land use that affect recharge (and eventual discharge to streams), and modification of the network of urban storm-drains may have effects on both stream temperature and turbidity.
- INTERACTION BETWEEN SURFACE WATER AND GROUND WATER: Understanding the groundwater flow system is necessary to analyze changes in streamflow in the basin. Spring flows have caused flooding in the lower part of the basin. Groundwater discharge to streams is the primary source of summertime streamflow. Understanding the movement of groundwater and its eventual discharge to streams helps maintain both the quantity and quality of summertime streamflow in the Johnson Creek basin.

The project is relevant to the objectives of the following municipalities:

City of Gresham

- Surface monitoring: to inform design and on-going effectiveness of restoration and engineering projects
- Groundwater monitoring: to determine effectiveness of stormwater management in developing communities
- Water quality: provides data to evaluate whether TMDL and other goals are being met.

City of Milwaukie

- Surface monitoring: to inform design and on-going effectiveness of restoration and engineering projects
- Flooding: real-time streamflow data used to predict and prepare for flood events.

City of Portland

- Sub-watershed planning: to provide baseline and ongoing data to determine effectiveness of restoration and stormwater management practices
- Continuation of data on surface and groundwater: to inform design and on-going effectiveness of restoration and engineering projects
- Water quality: provides data to evaluate whether TMDL and other goals are being met.
- Flooding: real-time streamflow data used to predict and prepare for flood events.

Clackamas County Water Environment Services

- Surface water monitoring: to inform design and on-going effectiveness of restoration and engineering projects
- Continue to collect groundwater data to support the Stormwater WPCF Permit Program
- Surface Water quality: provides data to assist with evaluating whether TMDL WLAs/LAs and Watershed Health goals are being met.

Multnomah County

- Water quality: understanding water quality impacts from rural unincorporated County areas for TMDL pollutants.
- Water quantity: understanding drainage issues and needs from rural areas and their impact on County road drainage systems.

- Watershed health: provides baseline and ongoing data to determine the effectiveness of coordinated restoration activities through the Interjurisdictional Committee of Johnson Creek.

East Multnomah Soil and Water Conservation District

- Water quality: understanding water quality impacts from rural unincorporated areas for TMDL pollutants.
- Water quantity: understanding drainage issues and needs from rural.
- Watershed health: provides baseline and ongoing data to determine the effectiveness of coordinated restoration activities through the Interjurisdictional Committee of Johnson Creek.

APPROACH

In general, the network of groundwater, streamflow, stream temperature and turbidity sites developed over the previous several years will be continued. Focused data-collection efforts occur in some years, and are followed by interpretive reports. All data and reports are available at: https://or.water.usgs.gov/proj/or175/index.html.

Groundwater data collection and analysis will build upon the work done in the Portland Basin Groundwater Study (McFarland and Morgan, 1996), by Snyder (2008), and specifically in the Johnson Creek basin by Lee and Snyder (2009), providing understanding of the interaction between the aquifer system, springs, and Johnson Creek. The groundwater data collection network will consist of two continuous water-level recorders, monitoring water-level changes that occur in response to specific precipitation (recharge) events and that may result in increased discharge to springs. The current network of recorders will be augmented by 10 observation wells.

Streamflow measurements are made to provide understanding of the temporal and spatial distribution of groundwater discharge to Johnson Creek and tributary streams. Streamflow measurements other than those made at stream gages for surface water records are typically made on an ad hoc basis, such as those made in the summers of 2012 and 2013 in support of the Johnson Creek Watershed Council/IJC bacteria study, and those made in conjunction with suspended-sediment studies.

The surface water network consists of streamflow sites on Johnson Creek at Regner Road in Gresham, Sycamore in Portland, and at SE Milport Road in Milwaukie, and on Kelley Creek. Another gage will be added at Crystal Springs Creek near Bybee Street in late FY 2019. Data from each site consists of real-time water level, streamflow, and stream temperature. Turbidity sensors are located at the Gresham and Milwaukie sites.

Continuation of the streamflow sites amounts to about one third of the budget for each year and is critical to understanding long-term trends in the basin. Streamflow data from the Sycamore site, operated continuously since 1940, represents one of the longest periods of record on an urban stream in Oregon. Streamflow data have been collected at the Milwaukie site since 1989. More recently, data collection began at Johnson Creek in Gresham (1998), and on Kelley Creek (2000). The streamflow monitors in the upper part of the Johnson Creek basin and on Kelley Creek are in place to track flow-response characteristics in areas undergoing (or expected to undergo) changes in land use. Annual streamflow volume at each site contributes to understanding of the water balance in the basin, and relative contribution of runoff and ground-

water discharge to the upper, middle, and lower parts of the Johnson Creek basin. As changes continue to occur in the basin, such as increases in impervious area, and routing of storm runoff to drywells and stormwater detention ponds, flow volume calculated at the streamflow sites will help identify the affects of these changes on the hydrology of Johnson Creek. Peak streamflow is used for calculation of flood frequency and assessment of the effect of ongoing land-use change in the basin. Low-flow streamflow data provide baseflow information, critical in understanding the contribution of groundwater to the stream. In real time, stream level is used for emergency planning and preparedness of residents and businesses in the area. Long-term stream temperature data will provide insight into the effectiveness of measures to mitigate the effects of stream warming that is characteristic of an urban setting. Modeling, both hydraulic (flow and water level), and water quality (primarily stream temperature) has been done in the basin over the past decades for multiple purposes by various agencies, researchers, and consultants. The foundation of successful modeling is the long-term data such as is collected in this project. Finally, streamflow data, especially from sites with relatively stable land-use patterns can be used to evaluate and track the effects of climate change.

In addition to the core data collection of surface water, groundwater and water quality data, other specific elements of the program for WY 2020-2024 are identified below:

WY 2020-2023

Sediment: Three 'roving' turbidity gages will be installed in the watershed and moved to new locations each year. These gages will provide 15-minute turbidity data and be placed in areas that either have known sediment issues, are of particular interest to one or more cooperators, provide insight into current, recent or future restoration efforts, or provide insight into the overall sediment budget of Johnson Creek or one of its main tributaries.

Suspended-sediment sampling will take place at the roving gages in order to develop a relationship between turbidity and suspended-sediment concentration (SSC). In addition, a select number of samples will also be analyzed for TSS in order to develop as TSS-SSC relationship, and to ascertain if this relationship is relatively constant throughout the watershed. The computed turbidity-SSC relations will be used to calculate suspended sediment loads at the roving gages. These loads will be compared against the sediment loading at the long-term stations (Regner Road at Gresham and Millport Road at Milwaukie) to ascertain how 'productive' each location is (pounds of sediment per square mile of drainage area), and to evaluate how much sediment was transported in Johnson Creek compared to average years.

WY 2024

Report: Sediment Analysis for the Johnson Creek Basin. This report will analyze the four years of sediment, turbidity and streamflow data collected in the Johnson Creek Watershed.

QUALITY ASSURANCE/QUALITY CONTROL

Streamflow data will be collected according to the Oregon Water Science Center Surface Water Quality Assurance/Quality Control Plan. Temperature, sediment and turbidity data will be collected according to Wagner and Others (2006). Groundwater data will be collected according to the Quality-Assurance Plan for District Groundwater Activities of the U.S. Geological Survey (Brunett and others, 1997). All data collected by volunteers will be reviewed by qualified USGS personnel.

REPORTING AND PRODUCTS

Progress will be relayed to the cooperators through regular meetings. The primary contact is through the Johnson Creek Interjurisdictional Committee, which meets monthly. Updates will occur as needed throughout the project. All data collected will be archived in the USGS National Water Information System, and through the interpretive report indicated above.

REFERENCES

Brunett, J.O., Barber, N.L., Burns, A.W., Fogelman, R.P., Gillies, D.C., Lidwin, R.A., and Mack, T.J., 1997, A quality-assurance plan for district ground-water activities of the U.S. Geological Survey: U.S. Geological Survey Open-File Report 97-11, accessed March 2004, at URL: http://water.usgs.gov/ogw/pubs/OFR9711/index.html

Buccola, N.L., and Stonewall, A.J., 2016, Development of a CE-QUAL-W2 temperature model for Crystal Springs Lake, Portland, Oregon: U.S. Geological Survey Open-File Report 2016–1076, 26 p., http://dx.doi.org/10.3133/ofr20161076.

Gray, J.R., Glysson, G.D., Turcios, L.M., and Schwarz, G.E., 2000, Comparability of suspended-sediment concentration and total suspended solids data: U.S. Geological Water Resources Investigations Report 00-4191, 14 p.

Lee, K.K., and Snyder, D.T., 2009, Hydrology of the Johnson Creek basin, Oregon: U.S. Geological Survey Scientific Investigations Report 2009–5123, 56 p.

McFarland, W.D., and Morgan, D.S., 1996, Description of the ground-water flow system in the Portland Basin, Oregon and Washington: U.S. Geological Survey Water-Supply Paper 2470-A, 58 p.

Risley, John, Stonewall, Adam, and Haluska, Tana, 2008, Estimating flow-duration and low-flow frequency statistics for unregulated streams in Oregon: U.S. Geological Survey Scientific Investigations Report 2008-5126, 22 p.

Snyder, D.T., 2008, Estimated depth to ground water and configuration of the water table in the Portland, Oregon area: U.S. Geological Survey Scientific Investigations Report 2008-5059, 40p.

Stonewall, Adam, 2014,Water levels at the 0.01 annual exceedance probability at the Glenwood Street and Bybee Boulevard crossings of Crystal Springs Creek, Portland, Oregon: U.S. Geological Survey Webpage, http://dx.doi.org/10.5066/F7ZK5DP0

Stonewall, A.J., and Beal, B.A., 2017, Developing flood-Inundation maps for Johnson Creek, Portland, Oregon: U.S. Geological Survey Scientific Investigations Report 2017–5024, 26 p., https://doi.org/10.3133/sir20175024.

Stonewall, A.J., and Bragg, H.M., 2012, Suspended-sediment characteristics for the Johnson Creek basin, Oregon, water years 2007–10: U.S. Geological Survey Scientific Investigations Report 2012-5200, 32 p.

Stonewall, Adam, and Hess, Glen, 2016, Evaluation of flood inundation in Crystal Springs Creek, Portland, Oregon: U.S. Geological Survey Open-File Report 2016-1079, 33 p., http://dx.doi.org/10.3133/ofr20161079.

Tanner, D.Q., and Lee, K.K., 2004, Organochlorine pesticides in the Johnson Creek Basin, Oregon, 1988-2002: U.S. Geological Survey Scientific Investigations Report 2004-5061, 36p.

Wagner, R.J., Boulger, R.W., Jr., Oblinger, C.J., and Smith, B.A., 2006, Guidelines and standard procedures for continuous water-quality monitors- Staion operation, record computation, and data reporting: U.S. Geological Survey Techniques and Methods 1-D3, 51 p. + 8 attachments; accessed May 12, 2014 at http://pubs.water.usgs.gov/tm1d3.

Williams, J.S., Lee, K.K., and Snyder, D.T., 2010, Hydrology of Johnson Creek basin, a mixed-use drainage basin in the Portland, Oregon, metropolitan area: U.S. Geological Survey Fact Sheet 2010-3030, 4 p.

TIMELINE

Standard time series of surface-water, water-quality and groundwater data will be archived on an annual basis. Sediment and turbidity data collection and the associated report will follow the proceeding timeline:

Calendar year	2020-2023				2024			
Federal Fiscal Year	2020-2023				2024			
Fiscal Year Quarter	1	2	3	4	1	2	3	4
Sediment/Turbidity Data Collection								
Technical Documentation								
In-house and Section Chief Review								

PERSONNEL

The project chief will be a Hydrologist with experience in collecting hydrology data and writing hydrology reports. The project chief will be assisted by Oregon Water Science Center staff including: Hydrologists, Hydrologic Technicians, the Surface-Water Specialist, the Water-Quality Specialist and the Groundwater Specialist.

BUDGET SUMMARY

Federal fiscal year/ Project element	2020 10/19 to 9/20	2021 10/20 to 9/21	2022 10/21 to 9/22	2023 10/22 to 9/23	2024 10/23 to 9/24
Streamflow and temperature sites: Johnson Creek at Gresham, Sycamore, Milwaukie, and Kelley Creek	$103,040	$107,080	$111,320	$114,560	$117,400
Turbidity (Gresham and Milwaukie)	$38,090	$39,610	$41,200	$42,850	$44,560
Groundwater sites: Periodic and continuous recorders	$8,820	$9,090	$9,360	$9,640	$9,930
Sediment Focus	$12,200	$12,200	$12,200	$12,200	
Report					$13,000
Project management	$12,150	$12,220	$11,920	$13,050	$13,710
Total	$174,300	$180,200	$186,000	$192,300	$198,600
Funding distribution					
USGS	$61,100	$63,300	$65,500	$67,800	$70,200
City Portland	$47,100	$48,700	$50,400	$52,200	$54,000
City Gresham	$24,400	$25,300	$26,200	$27,100	$28,000
City Milwaukie	$11,000	$11,400	$11,800	$12,200	$12,600
Water Environment Services (includes City of Happy Valley)	$10,000	$10,000	$10,000	$10,000	$10,000
Multnomah County	$8,100	$8,400	$8,600	$9,000	$9,300
East Multnomah SWCD	$12,600	$13,100	$13,500	$14,000	$14,500
Cooperator total	$113,200	$116,900	$120,500	$124,500	$128,400

INTERGOVERNMENTAL AGREEMENT BETWEEN THE CITY OF PORTLAND AND THE CITY OF GRESHAM REGARDING LABORATORY ANALYTICAL SERVICES

This agreement is entered into on July 1, 2007 by and between the City of Gresham, Oregon (Gresham) and the City of Portland, Oregon (Portland).

RECITALS

WHEREAS, the goal of this intergovernmental agreement is to provide laboratory analytical services for the City of Gresham by the City of Portland and;

WHEREAS, the City of Gresham was issued a National Pollutant Discharge Elimination System (NPDES) discharge permit. The NPDES permit requires the implementation of a stormwater management plan, monitoring requirements, and submittal of an annual report;

WHEREAS, the City of Gresham has been identified by Oregon Department of Environmental Quality (DEQ) as a designated management agency (DMA) and is required to comply with the Total Maximum Daily Load (TMDL) requirements for discharges to the Columbia Slough and Johnson Creek.

WHEREAS, the Columbia Slough, Fairview Creek, and Johnson Creek have been placed on the DEQ 1994/1996 and 1996/1998 303(d) list of water quality limited, impaired waterbody list for multiple parameters; and

WHEREAS, the City of Gresham is implementing a storm and surface water monitoring program to assess: instream baseline conditions, identification of pollutants and their sources, illicit connections and illegal dumping, long-term trends, and pollutant reduction effectiveness.

WHEREAS, the City of Gresham has submitted a request for both rule authorization and a Water Pollution Control Facility (WPCF) permit to comply with Underground Injection Control (UIC) rules. The UIC rules require implementation of a stormwater management plan and monitoring requirements.

WHEREAS, this intergovernmental agreement (IGA) is in conformance with the Columbia Slough monitoring IGA.

WHEREAS, this IGA is in conformance with a Memorandum of Agreement (MOA), which outlines an agreement with jurisdictions throughout the Johnson Creek watershed for cooperation, coordination, and support.

WHEREAS, the purpose of this Agreement is to detail the responsibilities, compensation and services to be provided by each party.

NOW THEREFORE, the parties agree to the following:

1. SCOPE OF PORTLAND'S SERVICES

A. Portland shall be responsible for providing laboratory analytical services (including methods and rates) to Gresham as shown in the attached fee schedule (Exhibit A).

B. Portland shall provide Gresham with all necessary sample bottles, ice-chests, and chain-of-custody documents.

C. Portland shall provide a 14-day turn-a-round time on all sample analyses results, except in the event of delay caused by conditions beyond Portland's reasonable control. In the event of delay, Portland shall promptly notify Gresham of the delay and provide an estimated time for turn-a-round of the delayed sample analyses.

D. Portland shall provide data reports listing the analyses results, detection limits, methods used and routine quality assurance/quality control documentation as requested.

E. Portland shall notify Gresham of changes in the attached fee schedule (Exhibit A) in writing no less than two months before implementation.

F. Portland shall annually provide Gresham with the lab analytical cost sheet for the upcoming fiscal year.

2. SCOPE OF GRESHAM'S SERVICES

A. Gresham shall be responsible for review and acceptance of all products prepared by Portland.

B. Gresham shall annually review the lab analytical cost sheet for the upcoming fiscal year supplied by Portland.

3. COMPENSATION

Gresham shall reimburse Portland promptly for costs incurred in accordance with Section 4 INVOICE AND PAYMENT PROCEDURE. Gresham shall pay Portland within 30 days of being invoiced. Gresham shall pay Portland for laboratory services incurred as shown in the attached schedule of rates (Exhibit A) which may be amended by Portland pursuant to section 1.E above.

4. INVOICE AND PAYMENT PROCEDURE

Portland's invoice and Gresham's payment procedures shall be as set out below.

Quarterly, Portland's project manager, shall submit to Gresham's project manager, a detailed statement describing analyses performed for approval. The invoice shall include all approved analytical costs related to this IGA. Portland will furnish Gresham such statements of expenditures as may be needed to satisfy fiscal requirements.

Payment of the amounts set out in paragraph 3 above shall be made to City of Portland, no later than 30 days of being invoiced, and shall be sent to:

City of Portland
Accounting Division, Office of Finance and Administration
Accounts Receivable
1120 SW Fifth Avenue, Room 1250
Portland, OR 97204

5. EFFECTIVE DATE

This agreement shall be effective as of July 1, 2007.

6. AMENDMENT OR TERMINATION OF AGREEMENT

A. Portland and Gresham, by mutual written agreement, may modify, amend, or terminate this Agreement at any time.

B. Either Portland or Gresham may terminate this Agreement in the event of a breach of the Agreement by the other. Prior to such termination, however, the party seeking the termination shall give to the other party written notice of the breach and of the party's intent to terminate. If the party has not cured the breach within thirty (30) days of the notice, then the party giving the notice may terminate the Agreement at any time thereafter by giving a written notice of termination.

C. Either Portland or Gresham may terminate this Agreement in the event of Portland's Water Pollution Control Laboratory is rendered inoperable by an Act of God.

D. Either Portland or Gresham may terminate this Agreement for convenience on 60 days prior written notice of intent to terminate

7. INDEMNIFICATION

To the extent permitted by the Oregon Tort Claims Act, Portland agrees to indemnify, defend, and hold harmless Gresham from any and all claims, demands, suits, and actions (including attorney fees and costs) resulting from or arising out of the acts of Portland and its officers, employees, and agents in performance of this intergovernmental agreement. To the extent permitted by the Oregon Tort Claims Act, Gresham agrees to indemnify, defend, and hold harmless Portland from any claims, demands, suits, and actions (including attorney fees and costs) resulting from or arising out of the acts of Gresham and its officers, employees, and agents in performance of this intergovernmental agreement.

8. FUNDS

Portland and Gresham certify that sufficient funds have been requested for the 2007-2008 fiscal year and when approved both Portland and Gresham are authorized to spend funds to cover the costs associated with this agreement for that fiscal year. Both Portland and

Gresham will use their best efforts to urge appropriation of funds to cover the costs of this agreement in the ensuing fiscal years.

9. NON-APPROPRIATION CLAUSE

This Agreement is subject to future appropriations by the Portland or Gresham City Councils.

Executed in five (5) copies by the duly authorized representatives of the parties.

CITY OF PORTLAND

By: _____
Sam Adams, Commissioner of Public Affairs

Date: 7/24/07

By: _____
Dean Marriott, Bureau Director

Date: 7/13/07

By: _____
Gary Blackmer, Auditor

Date: 7/26/07

CITY OF GRESHAM

By: _____
Mayor Shane Bemis

Date: 5/2/07

By: _____
Erik Kvarsten, City Manager

Date: _____

APPROVED as to form:

Portland City Attorney,
for City of Portland, Oregon

By: _____

Gresham City Attorney
for City of Gresham, Oregon

By: _____

ORDINANCE No. 181035

Authorize an Intergovernmental Agreement with the City of Gresham to provide Laboratory Analytical Services (Ordinance)

Section 1. The Council finds:

1. The City of Gresham was issued a National Pollutant Discharge Elimination System (NPDES) wastewater discharge permit. The NPDES permit requires implementation of a stormwater-monitoring program. The City of Gresham uses the services of contract laboratories as needed to comply with requirements of the stormwater monitoring program;

2. The goal of this intergovernmental agreement is to provide laboratory analytical services for the City of Gresham by the City of Portland, and;

3. The purpose of this agreement is to detail the responsibilities, compensation, and services to be provided by each party.

NOW, THEREFORE, the Council directs:

a. The Director of the Bureau of Environmental Services is authorized to execute an intergovernmental agreement with the City of Gresham for the purpose described in Section 1.

b. The Mayor and Auditor are hereby authorized to accept approximately $60,000 per year for revenues in the Bureau of Environmental Services Sewer Operating Fund, centercode 14713030, from the City of Gresham for the City of Portland providing laboratory analytical services.

Passed by the Council, JUN 13 2007
Sam Adams
Commissioner of Public Utilities

Gary Blackmer
Auditor of the City of Portland
By Susan Parsons
Deputy

[Duane Linnertz]
[5-23-07]

Appendix G: City of Portland Water Quality Manual
(contains its own Appendices A thru M)

QUALITY MANUAL

for

City of Portland, Oregon
Bureau of Environmental Services
Water Pollution Control Laboratory
6543 N. Burlington Avenue
Portland, Oregon 97203

Name	Function (Unit)	Signature	Date	Contact Information
Jennifer Shackelford	Laboratory Director	Jennifer Shackelford Digitally signed by Jennifer Shackelford Date: 2022.01.07 10:07:22 -08'00'		Ph. 503-823-5614, 503-865-6386 Jennifer.Shackelford@portlandoregon.gov
Cara Jung	QA Coordinator		01/07/2022	Ph. 503-823-9598 Cara.Jung@portlandoregon.gov
Jason Dahl	Technical Coordinator		1/7/22	Ph. 503-823-5677 Jason.Dahl@portlandoregon.gov

Revision Number:	11.0	Effective Date:	December 31, 2021
Document Number:			

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Section 3

INTRODUCTION AND SCOPE
(TNI V1:M2 – Sections 1,2,3)

The purpose of this *Quality Manual* is to outline the management system for the Water Pollution Control Laboratory (WPCL), a work section within the municipal government of the City of Portland, Oregon (City). The *Quality Manual* defines the policies, procedures, and documentation that assure analytical services continually meet a defined standard of quality that is designed to provide clients with data of known and documented quality and, where applicable, demonstrate regulatory compliance.

The *Quality Manual* sets the standard under which all laboratory operations are performed, including the laboratory's organization, objectives, and operating philosophy. The *Quality Manual* has been prepared to assure compliance with the 2016 TNI Environmental Laboratory Sector Standard – Volume 1 **–** Management and Technical Requirements for Laboratories Performing Environmental Analysis (EL-V1-M1 through M7-ISO-2009). This Standard is consistent with ISO/IEC 17025:2005 requirements that are relevant to the scope of environmental testing services and thus, the laboratory operates a quality system in conformance with ISO/IEC 17025:2005(E). In addition, the policies and procedures outlined are compliant with the general specifications of NPDES and EPA SW-846 analytical requirements.

3.1 Scope of Testing

The laboratory's scope of accredited analytical testing services includes analyses listed in Appendix F.

A full list of analyses performed at WPCL is found in Appendix K. Analyte lists for multi-analyte tests (mainly organics) are available in the LIMS and may be printed upon request.

3.2 Table of Contents, References and Appendices

The Table of Contents is in Section 2 and Appendices follow Section 28.

This *Quality Manual* uses the following referenced documents:

References included in Modules 1, 2, 4, and 5 in the 2016 TNI Environmental Laboratory Sector Standard – Volume 1 – Management and Technical Requirements for Laboratories Performing Environmental Analysis.

Standard Methods for the Examination of Water and Wastewater (Online Edition). APHA, AWWA, WEF

40 CFR Pt. 136

Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (SW-846 3rd Edition). U.S. EPA, Office of Solid Waste.

3.3 Glossary and Acronyms Used

3.3.1 Glossary

This laboratory adopts the definitions found in the *Terms and Definitions* sections of Modules 1-7 in the 2016 TNI Environmental Laboratory Sector Standard – Volume 1 – Management and Technical Requirements for Laboratories Performing Environmental Analysis. Additional and alternative terms (e.g., LOD / MDL) are also used in this document and in WPCL SOPs, as listed in Appendix E, *Glossary/Definitions*.

3.3.2 Acronyms

Acronyms used in this document and in WPCL SOPs are listed and defined in Appendix D.

3.4 Management of the *Quality Manual*

The Quality Assurance/Quality Control (QAQC) Coordinator and Laboratory Manager are responsible for reviewing and maintaining the currency of the *Quality Manual*.

The *Quality Manual* is reviewed annually to ensure it still reflects current practices and meets the requirements of any applicable regulations or client specifications. It may be reviewed and modified more frequently if procedural changes warrant it.

Each section is evaluated and edited as needed. The effective date is updated on the edited sections. If a section has no changes, the effective date remains the same. The revision number of the entire manual is updated at least every two years, unless no changes were made in the time since the most recent revision.

The cover sheet of the *Quality Manual* (Section 1) must be re-signed and the Table of Contents (Section 2) is updated whenever a Section is updated. The QAQC Coordinator prepares a written summary report of changes. This report is forwarded to the Laboratory Manager and reviewed with all staff. A copy is archived in the common S-drive.

The *Quality Manual* may not be altered in any way except by approval of the Laboratory Manager and QAQC Coordinator. If it is distributed to external users, it is for the purpose of reviewing WPCL's management system and may not be used for any other purpose without written permission.

Section 4

ORGANIZATION
(TNI V1:M2 – Section 4.1)

The Water Pollution Control Laboratory (WPCL) is a legally identifiable organization operating within the city of Portland, Oregon. The laboratory is responsible for carrying out testing activities that meet the requirements of the TNI Standard, the ISO/IEC 17025 Standard, and that meet the needs of the client. Through application of the policies and procedures outlined in this Section and throughout the *Quality Manual*:

- The laboratory assures that it is impartial and that personnel are free from undue commercial, financial, or other undue pressures that might influence their technical judgment.

- Management and technical personnel have the authority and resources to carry out their duties and have procedures to identify and correct departures from the laboratory's management system.

- Personnel understand the relevance and importance of their duties as related to the maintenance of the laboratory's management system.

- Ethics and data integrity procedures (see Appendix A*,* Section 5*, Management,* and Section 19, *Data Integrity Investigations*) ensure personnel do not engage in activities that diminish confidence in the laboratory's capabilities.

- Though WPCL data is generally considered public record, data generated for other municipalities are considered confidential and must be accessed through those municipalities.

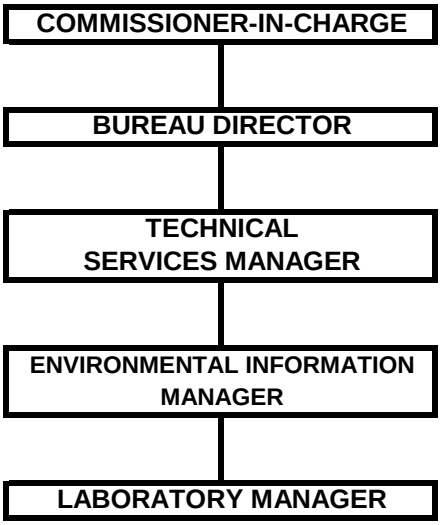
4.1 Organization

The WPCL operates as part of the City of Portland, Bureau of Environmental Services and functions as an "in-house" lab for the Bureau. It also accepts samples on a commercial basis from other Oregon municipalities under Inter-government Agreements (IGAs). The WPCL analyzes water, wastewater, and solids for the various missions of the Bureau and outside clients. The lab analyzes samples for compliance with the Clean Water Act, the Resource Conservation and Recovery Act, and any other applicable EPA or Oregon rules for which the lab has capacity. The Laboratory is responsible for carrying out its environmental testing activities in accordance with the Quality Manual and established Quality Systems so as to meet the requirements of current TNI Standards and of 40 CFR 136 and to satisfy the needs of its clients and appropriate regulatory authorities. The WPCL is not part of a larger organization that may have conflicting interests such as production, commercial marketing or financing. The laboratory is free from influence that may adversely affect the lab's ability to produce data of the highest integrity.

The laboratory functions as a Section of the Environmental Information Division of the Technical Services Group within the City's Bureau of Environmental Services.

The laboratory work group is responsible for generating, validating, and approving data from the analysis of water, wastewater, and solids. The overall organizational chart is provided in Figure 4-1. The laboratory organizational chart is provided in Appendix B.

Figure 4-1: City of Portland Organizational Hierarchy



Additional information regarding responsibilities, authorities, and interrelationship of personnel who manage, perform or verify testing is included in Section 5*, Management* and Section 20*, Personnel.* These Sections also include information on supervision, training, technical management, job descriptions, quality personnel, and appointment of deputies for key managerial personnel.

The WPCL staff includes: a manager, a production coordinator, a QA coordinator, a technical coordinator, analytical specialists, and analysts. The WPCL operates 7/365. Weekdays, the laboratory operates a single, staggered shift, with staff on site from 6:30 AM until 6:45 PM. There is a two-person shift Saturdays and Sundays. There is extensive cross training within the Metals, Organics, Nutrients, and Process Control Sections. In addition, all Analysts are cross-trained for the basic operations of the Microbiology Section.

The laboratory has the resources and authority to operate a management system that is capable of identifying departures from that system and from procedures during testing, and initiates actions to minimize or prevent departures.

4.2 Conflict of Interest and Undue Pressure

The organizational structure indicated above minimizes the potential for conflicting or undue interests that might influence the technical judgment of analytical personnel. In addition, procedures are in place to prevent outside pressures or involvement in activities that may affect competence, impartiality, judgment, operational integrity, or the quality of the work performed at the laboratory.

Arrangements, such as policies and procedures to prevent commercial, financial or other influences that may negatively affect the quality of the work or negatively reflect on the competence, impartiality, judgment or operational integrity are described in the Ethics and Data Integrity Policy in Appendix A.

Section 5

MANAGEMENT
(TNI V1:M2 – Section 4.2)

The laboratory maintains a management system that is appropriate to the scope of its activities.

5.1 Management Requirements

The City of Portland Water Pollution Control Laboratory (WPCL) is in the Environmental Information Division of the Technical Services Group of the Bureau of Environmental Services. The Division and Group managers support the Laboratory Manager but are not directly involved in compliance with ORELAP or TNI standards. Top management of the WPCL includes the Laboratory and Environmental Information Division Managers and the Laboratory Production, Technical, and QA Coordinators. Because all lab staff under the Manager are represented and work under a collective bargaining agreement (CBA), the Laboratory Coordinators technically cannot be called managers or supervisors. However, their duties include the administration of work processes and quality assurance/quality control throughout laboratory operations. Also, the designated Technical Director cannot be called director and is referred to in this Quality Manual as Technical Lead, which at least has a precedence in the CBA as "Lead Workers." For the sake of brevity only, managers and coordinators will be referred to in this section as managers or collectively as management.

Management's commitment to good professional practice and to the quality of its products is defined in Section 5.3*, Quality Policy Statement*.

Management has overall responsibility for the technical operations and the authority needed to generate the required quality of laboratory operations. Management ensures communication within the organization to maintain an effective management system and to communicate the importance of meeting customer, statutory, and regulatory requirements. Management assures that the system documentation is known and available so that appropriate personnel can implement their part. When changes to the management system occur or are planned, managers ensure that the integrity of the system is maintained.

Management is responsible for carrying out testing activities that meet the requirements of the TNI Standard, the ISO/IEC 17025 Standard, and that meet the needs of the client.

Managers implement, maintain, and improve the management system, and identify noncompliance with the management system of procedures. Managers initiate actions to prevent or minimize noncompliance.

Management ensures technical competence of personnel operating equipment, performing tests, evaluating results, or signing reports, and limits authority to perform laboratory functions to those appropriately trained and/or supervised. The

City of Portland WPCL seeks to hire persons who are well trained and qualified for their positions and responsibilities. All personnel requirements as per current TNI Standards, and ORELAP (Oregon Environmental Laboratory Accreditation Program) standards are met or exceeded. All employees receive extensive on-the-job training in the specific methods used by the laboratory and in the specific requirements of the Quality Manual. Personnel are not compensated to pass Quality Control tests or to test more samples than is normally expected in a given period of time. Laboratory personnel are impartial and are free from any undue commercial, financial and other pressures that may influence technical judgment.

Education and expected knowledge, skills, and abilities for each of the five laboratory staff classifications are detailed on the City's Bureau of Human Resources website under "Classification Specifications."

Training requirements are detailed in *Section 20, Personnel* of this QA Manual.

All WPCL laboratory staff meet or exceed the personnel requirements of Section 5.2.1 of the TNI 2016 Standard. Adequate supervision is provided by persons familiar with the methods, procedures, and the purpose of each analytical test. See Section 20, *Personnel*. The Laboratory Manager has overall responsibility for the technical operation and the provision of resources needed to ensure the required quality of laboratory operations. The Laboratory Manager certifies that personnel with the appropriate educational and technical background are hired and perform the tests for which the laboratory has ORELAP accreditation. The certification for each analyst is documented in the Initial Demonstration of Competency forms in individual training files.

The Laboratory Production Coordinator or Laboratory Manager may act as the Quality Assurance (QA) Coordinator during the absence of the QA Coordinator, and vice versa. Any of the three Lab Coordinators may act as the Laboratory Manager during the absence of the Laboratory Manager for more than five days. If any two positions are absent at the same time, the remaining two cover for the absences. If any three positions are absent at one time, the remaining position covers all duties. This is unlikely to occur for more than one or two days. See *Section 4, Organization* for an organizational chart.

Training is kept up to date as described in Section 20, *Personnel* by periodic review of training records and through employee performance reviews.

Management is responsible for maintenance of the management system. This includes defining personnel roles and responsibilities, approving documents, providing required training, providing a procedure for confidential reporting of data integrity issues, and periodically reviewing data, procedures, and documentation. The assignment of responsibilities, authorities, and interrelationships of the personnel who manage, perform, or verify work affecting the quality of environmental tests is documented in Section 20, *Personnel*. Management ensures that audit findings and corrective actions are completed within required time frames.

5.2 Management Roles and Responsibilities

5.2.1 Laboratory Manager/Laboratory Director

If the Laboratory Manager is absent for five (5) or more work days, a deputy (see Table 5-1 below) with appropriate qualifications will perform the Manager's duties. Beyond a thirty-five (35) calendar day absence, management will notify the primary accreditation body in writing of the absence of the Manager and the appointment of the deputy.

The Laboratory Director/Laboratory Manager is qualified as the Laboratory Director under current TNI standards and ORELAP and is responsible for the following activities:

5.2.1.1 Responsibilities

a. operation and management oversight of the laboratory
b. technical supervision of the laboratory
c. monitoring performance data and the validity of laboratory analyses
d. responsible for designating lab contacts to customers and for analytical excursion issues
e. ensuring the laboratory has the resources and personnel necessary to carry out the duties required to meet the goals of the Quality Manual
f. ensuring that people with the required skills are hired, and that all lab staff have demonstrated capability in the activities for which they are responsible
g. supervising all personnel employed within the laboratory work group.
h. leading the efforts of the laboratory work group in providing support services as needed to other Bureau work groups and outside agencies
i. investigating complaints from internal and external customers that are related to laboratory data operations. Complaints are handled on a case-by-case basis, and stakeholder identification and formal problem-solving procedures are used where appropriate.
j. overall technical supervision of all work areas
k. annual Management Audit
l. management of laboratory records
m. ensuring that personnel are free from any commercial, financial and other undue pressures that might adversely affect the quality of their work.
n. reviews and approves all SOPs and policies prior to their implementation and ensures all approved SOPs and policies are provided to laboratory personnel and are adhered to.

The Laboratory Manager provides the resources necessary to implement and maintain an effective quality and data integrity program.

5.2.2 Laboratory Quality Assurance Coordinator/Officer

The Laboratory Quality Assurance (QA) Coordinator is the Laboratory Quality Assurance Officer and is responsible for the oversight and review of all quality control procedures and data, but is independent from laboratory operations. See Section 4, *Organization* and the laboratory organizational chart in Appendix B. The QA Coordinator's training and proof of experience in QA/QC procedures, knowledge of analytical methods, and the laboratory's management system are available in the personnel files and training records. The QA Coordinator is responsible for ensuring

that the quality system requirements are implemented and followed at all times. The QA Coordinator has general knowledge of the analytical test methods for which data review is performed. See Section 20, *Personnel*.

5.2.2.1 Responsibilities

a. serves as a focal point for QA/QC and is responsible for the oversight and/or review of quality control data
b. arranges and conducts annual internal audits, reviews data objectively, and performs assessments without outside (e.g., managerial) influence
c. notifies management of deficiencies, and monitors corrective actions
d. final approval of samples analyzed by laboratory staff, as tracked electronically in the LIMS and/or in logbooks and as indicated by the Coordinator's signature on official copies of raw data to be archived
e. facilitates the maintenance of raw data archives
f. approves the results of PT samples and submits the results to the PT provider and subsequently to ORELAP
g. reviews all new laboratory work and ensures that the work is not undertaken unless the appropriate facilities and resources are available
h. arranges for and conducts internal audits annually and as needed
i. monitors corrective actions, audits and reviews
j. ensures that management system components related to quality are implemented and followed at all times
k. monitors and maintains laboratory certifications
l. maintains training records for DOC
m. reviews and approves all SOPs and policies prior to their implementation and ensures all approved SOPs and policies are provided to laboratory personnel and are adhered to
n. documents training and /or experience in QA/QC procedures and is knowledgeable in the quality system as defined under current TNI standards
o. has general knowledge of the analytical/microbiological test methods for which data review is performed
p. ensures compliance with current TNI standards, 40 CFR 136, and Standard Methods
q. keeps the *Quality Manual* current.

The Laboratory Quality Assurance Coordinator has the responsibility for ensuring that the quality system requirements are implemented and followed at all times and has direct access to the highest level of management at all times.

5.2.3 Laboratory Key Personnel Deputies

Table 5-1 defines WPCL titles, staff, and deputies for all TNI management positions.

TABLE 5-1 WPCL KEY PERSONNEL AND DEPUTIES

TNI TITLE	WPCL TITLE	WPCL STAFF	WPCL DEPUTY
Laboratory Director	Laboratory Manager	Laboratory Manager	Production or QA Coordinator
Laboratory Manager	Laboratory Manager	Laboratory Manager	Production or QA Coordinator
Technical Director	Lab Manager/Tech. Coord.	Lab Manager/Tech. Coord.	QA or Production Coordinator
---	Production Coordinator	Production Coordinator	QA Coordinator or Lab Manager
Quality Manager	QA Coordinator	QA Coordinator	Production Coordinator or Lab Manager

5.3 Quality Policy

Management's commitment to quality and to the management system is stated in the Quality Policy below, which is implemented through the application of related policies and procedures described in the laboratory's *Quality Manual* and SOPs.

The objective of the management system and the commitment of management is to consistently provide customers with data of known and documented quality that meet their requirements. WPCL policy is to use good professional practices, to maintain quality, to uphold the highest quality of service, and to comply with the TNI Standard. The laboratory ensures that personnel are free from any commercial, financial, and other undue pressures, which might adversely affect the quality of work. This policy is implemented and enforced through the unequivocal commitment of all management levels to the Quality Assurance (QA) principles and practices outlined in this manual. However, the primary responsibility for quality rests with each individual within the laboratory organization. Every laboratory employee must ensure that the generation and reporting of quality analytical data is a fundamental priority. Every laboratory employee is required to familiarize themselves with the quality documentation and to implement the policies and procedures in their work. All employees are trained annually on ethical principles and procedures surrounding the data that is generated. The laboratory maintains a strict policy of client confidentiality.

5.4 Ethics and Data Integrity System

The WPCL has an ethics and data integrity policy that is provided in Appendix A. The laboratory's ethics and data integrity program, training, and investigation procedures are discussed in Section 19, *Data Integrity Investigations*.

5.5 Documentation of Management / Quality System

The management system is defined through the policies and procedures provided in this *Quality Manual* and written laboratory Standard Operating Procedures (SOPs) and policies.

5.5.1 Standard Operating Procedures (SOPs)

Standard operating procedures (SOPs) represent all phases of current laboratory operations (they include an effective date, revision number, and signature of the approving authorities as detailed in the WPCL SOP QAQC-03, Preparation, Implementation, and Control of Standard Operating Procedures) and are available to all personnel. They contain sufficient detail such that someone with similar qualifications could perform the procedures. There are two types of SOPs used in the laboratory: (1) test method SOPs, which have specific requirements as outlined below; and (2) general use SOPs which document general procedures.

Each accredited analyte or method has an SOP. Sometimes an SOP is a copy of a method, and any additions are clearly described. The laboratory's test method SOPs include the following topics, where applicable:

i. identification of the method;
ii. applicable matrix or matrices;
iii. limits of detection and quantitation;
iv. scope and application, including parameters to be analyzed;
v. summary of the method;
vi. definitions;
vii. interferences;
viii. safety;
ix. equipment and supplies;
x. reagents and standards;
xi. sample collection, preservation, shipment and storage;
xii. quality control;
xiii. calibration and standardization;
xiv. procedure;
xv. data analysis and calculations;
xvi. method performance;
xvii. pollution prevention;
xviii. data assessment and acceptance criteria for quality control measures;
xix. corrective actions for out-of-control data;
xx. contingencies for handling out-of-control or unacceptable data;
xxi. waste management;
xxii. references; and
xxiii. any tables, diagrams, flowcharts and validation data.

5.5.2 Order of Precedence

In the event of a conflict or discrepancy between policies, the order of precedence is as follows unless otherwise noted:

1) Quality Manual
2) SOPs and Policy Statements
3) Other (Work Instructions, memos, flow charts, etc.).
4) Reference standards

5.5.3 Quality Manual

The *Quality Manual* contains the following required items:

i. document title;
ii. laboratory's full name and address;
iii. name and telephone number of individual(s) responsible for the laboratory;
iv. identification of all major organizational units which are to be covered by this quality manual and the effective date of the version;
v. identification of the laboratory's approved signatories;
vi. the signed and dated concurrence (with appropriate names and titles), of all responsible parties
vii. the objectives of the management system and references to policies and procedures;
viii. the official quality policy statement; and
ix. table of contents, and applicable lists of references, glossaries and appendices

This *Quality Manual* contains or references all required elements as defined by the TNI Standard - V1:M2.

Section 6

DOCUMENT CONTROL
(TNI V1:M2 – Section 4.3)

This Section describes how the laboratory establishes and maintains a process for document management. Procedures for document management include controlling, distributing, reviewing, and accepting modifications. The purpose of document management is to preclude the use of invalid and/or obsolete documents.

Documents can be SOPs, policy statements, specifications, calibration tables, charts, textbooks, posters, notices, memoranda, software, drawings, plans, analysis procedure notes or 'cheat sheets', etc. These may be on various media, whether hard copy or electronic, and they may be digital, analog, photographic, or written. Note that documents are most often statements, requirements, or explanations. Records are most often logs or tables of data or observations, such as refrigerator temperature tables and control charts. Notes kept by analysts for personal use are not considered controlled documents.

The laboratory manages three types of documents: 1) controlled, 2) approved, and 3) obsolete.

A controlled document is one that is uniquely identified, issued, tracked, and kept current as part of the management system. Controlled documents may be internal documents or external documents.

An approved document means it has been reviewed, and either signed and dated, or acknowledged in writing or by secure electronic means by the issuing authority(ies). Electronic signatures are used and accepted according to Policy Statement 56 Electronic Signatures.

Obsolete documents are documents that have been superseded by more recent versions or are no longer needed.

6.1 Controlled Documents – Standard Operating Procedures

The Water Pollution Control Laboratory procedures for control standard operating procedures (SOPs) are detailed in WPCL SOP QAQC-03. This SOP details WPCL procedures for all four requirements of Section 4.3 of V1:M2 of the 2016 TNI Standard.

6.2 Approved Documents – Policy Statements

Current WPCL policies can be found at GROUP 100 (\\BESFILE1) S:\LAB\Policy Statements.

6.3 Obsolete Documents

All invalid or obsolete documents are removed from general distribution, or otherwise prevented from unintended use.

Obsolete documents are identified as being obsolete by management. All copies of the obsolete document are collected from employees and clearly marked ”Obsolete” (or otherwise out of use) on the first page or destroyed. At least one copy of any retained obsolete document is kept in Room 129 on the main floor of the office portion of the WPCL. This room has restricted access, and only the Laboratory Manager, QA Coordinator, and MCA Manager have keys. Retention is as required by regulations or clients.

Section 7

REVIEW OF REQUESTS, TENDERS AND CONTRACTS
(TNI V1:M2 – Section 4.4)

The review of all new work assures that oversight is provided so that requirements are clearly defined, the laboratory has adequate resources and capability, and the test method is applicable to the customer's needs. This process assures that all work will be given adequate attention without shortcuts that may compromise data quality.

Contracts for new work may be formal bids, signed documents, verbal, or electronic. The client's requirements, including the methods to be used, must be clearly defined, documented and understood. Requirements might include target analyte lists, project specific reporting limits (if any), project specific quality control requirements (if any), turnaround time, and requirements for data deliverables. The review must also cover any work that will be subcontracted by the laboratory.

7.1 Procedure for the Review of Work Requests

7.1.1 Monitoring Coordination & Analysis (MCA) Section

All new work coming to the WPCL is managed by the MCA Section. Work may come from three sources: internal to the Bureau of Environmental Services (BES), other bureaus within the city, or other municipalities. Work for other municipalities is done under formal Intergovernmental Agreements (IGAs). See Section 7.1.5, below. All aspects of setting up, reviewing, and administering new work are delineated in formal documents written as part of the responsibility matrix prepared as part of the implementation of the Laboratory Information Management System (LIMS).

7.1.2 LIMS Responsibility Matrix

The LIMS Responsibility Matrix documents are available on the BES network at

\\BESfile1\LIMS_Element\Responsibility_Matrix.

The S-drive is labeled as

Grp100 (\\BESfile1) (S:).

The Responsibility Matrix folder contains flow charts, a table of responsibilities for key staff, a table of definitions, a spread sheet of all business practices organized to follow work flow throughout the enterprise, and finally a set of detailed procedures for each practice.

7.1.3 Responsibility Matrix Documentation

Individual documents relevant to this section include:

- Clients

- Project[s] and Samples
- Work Requests
- Analyses and Analytes
- Sample Log-in and Work Orders.

Documents cover the following topics:

- Lab capability to do the work
- Liaison with the WPCL contract laboratory
- Point of contact for client communication
- Detection limit issues (see also 7.1.4, below)
- Method appropriateness (see also 7.1.4, below)
- Review of project specifics with client.

Each document contains an introduction, a table of tasks and responsibilities (including a backup person for each task), an attestation that named staff must follow the business practice, and detailed step-by-step procedures. Also included are relevant computer screen shots and examples of all forms, with detailed instructions on how data are entered into the LIMS and how forms are to be filled out. Where appropriate, tables detail: work element type; who generates the document; who reviews the document; who distributes the document; distribution list; who is responsible for document format.

7.1.4 Method Selection and Non-Routine Analyses

One of the WPCL Coordinators or Lab Manager are the main technical resource for these two issues and for issues involving detection limits. Lab personnel involvement occurs at the earliest stages of the work request process and can involve both the MCA project manager and the client. The work flow details are in WPCL Policy Statement #12 – Method Appropriateness.

WPCL policy statements are available on the BES network at

S:\LAB\Policy Statements.

The S-drive is labeled as

Grp100 (\\BESfile1) (S:).

7.1.5 Intergovernmental Agreements (IGAs)

All IGAs are written and administered by the MCA manager in consultation with and under the review of the BES Contract Development and Review Administrator, who retains the original, signed document. The various steps in developing an IGA, including forms, dollar thresholds, and required concurrences, are detailed in city codes and guidance documents available on the city Procurement Services website. After all documents are signed, a copy is kept by the MCA manager, and the work set-up process is begun.

7.2 Documentation of Review

Records are maintained for every contract or work request, when appropriate. This includes pertinent discussions with a client relating to the client's requirements or the results of the work during the period of execution of the contract. All records are maintained and filed by the MCA Section, including records of all project-related communication with the client.

Section 8

SUBCONTRACTING OF ENVIRONMENTAL TESTS
(TNI V1:M2 – Section 4.5)

A contract or subcontract laboratory is defined as a laboratory that is external to and performs analyses for the City of Portland Water Pollution Control Laboratory (WPCL). All work sent outside by the WPCL is brokered to or through a single primary laboratory. This primary laboratory may further subcontract specialty analyses, either because the primary laboratory does not have the capability or because WPCL clients require a laboratory other than the primary lab. For the purposes of clarity in this QA Manual, the primary laboratory will be called the **contract lab**, and any other laboratory will be called a **subcontract lab**.

At the WPCL, ongoing contracted and subcontracted work is managed by the Monitoring, Coordination, and Analysis (MCA) section of the Bureau of Environmental Services in consultation with the Laboratory Manager and QA Coordinator. Responsibilities include: primary contact with the contract laboratory project manager for WPCL; communications regarding turnaround times, report production, difficult matrices, and any other issues impacting work flow or data quality; billing, including late charges or fast turnaround surcharges; issues involving subcontracting by the primary contract laboratory for specialty analyses, such as dioxins/furans and PCB congeners.

When contracting analytical services, the MCA Manager and the WPCL Laboratory Manager work together to ensure that work requiring accreditation is placed with an appropriately accredited laboratory or one that meets applicable statutory and regulatory requirements for performing the tests.

8.1 Procedure

The MCA Manager, Lab Manager, or QA Coordinator may request a list of the contractors' subcontractors and copies of the current certificates and analyte lists as evidence of compliance. Certificate and analyte lists are reviewed by the MCA Manager and the WPCL Lab Manager or QA Coordinator to ensure the contracting and subcontracting laboratories have the appropriate accreditation, as needed, to do the work.

The Laboratory Manager, in consultation with the MCA Manager, has the responsibility and authority to review subcontracting requests according to City of Portland purchasing requirements. When awarding contracts for environmental testing, the Laboratory Manager, in consultation with the QA Coordinator and MCA Manager, determines that the requirements, including the methods used, are adequately defined, documented and understood. The Laboratory Manager, in consultation with the QA Coordinator and MCA Manager, determines if the contract laboratory has the resources and capability to meet the defined requirements and is ORELAP accredited, where required. The purpose of this review is to determine if the laboratory possesses the necessary physical, personnel and information resources to perform the environmental tests and/or calibrations requested. The review may include results of earlier participation of interlaboratory comparisons and proficiency testing results as well as the current accreditation status of the laboratory.

When the WPCL contracts for new, project-specific laboratory work, it is with the request and agreement of the Project Manager for the particular sampling project. The laboratory performing the contracted work is indicated in all applicable sample results reports, and any non-ORELAP accredited work is clearly identified.

The contracted laboratory assumes responsibility to the WPCL for their work, except in the case where a Project Manager has specified a particular subcontractor for specialty work.

8.2 Approval of Contract and Subcontract Laboratories

The contract with the primary commercial laboratory is established using the requirements as put forth by the City of Portland's Purchasing and Procurement departments. An extensive Request for Proposal document is written by the Laboratory Manager that describes the nature of the contracted work, including expected volume of work, any required methods and quality assurance requirements, and any requirements for accreditation to perform the work. The invitation to bid (ITB) requires proposing labs have available, if required, copies of their quality manual, standard operating procedures, any proficiency testing results, accreditations, a statement of lab and staff qualifications, and a list the methods used for all work performed.

The City of Portland's Purchasing and Procurement officially makes the ITB available to commercial laboratories. Interested commercial laboratories must provide a proposal by the specified date. All proposals that are not received by the specified date and time are rejected and the laboratory is notified. All proposals that don't meet the stated requirements of the ITB are also rejected.

The proposals are received by the City of Portland Purchasing and according to City purchasing requirements, the contract is awarded to the qualified laboratory with the lowest bid. The final contract with the commercial laboratory is negotiated and established by the bureau's purchasing personnel and the Laboratory Manager.

The contract with the primary commercial laboratory is typically established for a period of five years. The City of Portland requires that contracts do not exceed five years in duration.

During the duration of the contract, the Laboratory Manager, in consultation with the QA Coordinator and MCA Manager, continues to ensure that the contracted lab consistently meets the required quality assurance and accreditation requirements. Contracts may be terminated at the discretion of the WPCL as per the terms of the contract and City of Portland purchasing rules.

Section 9

PURCHASING SERVICES AND SUPPLIES
(TNI V1:M2 – Section 4.6)

The laboratory ensures that purchased supplies and services that affect the quality of environmental tests are of the required or specified quality, by using approved suppliers and products.

The laboratory has procedures for purchasing, receiving, and storage of supplies that affect the quality of environmental tests.

9.1 Procedure

9.1.1 Non-Capital (<$5,000) Equipment and Supplies

All purchase requests are done in writing on the Bureau Request For Materials or Service form. All requests are reviewed for technical and business appropriateness and then approved by the Laboratory Manager or Designee. Signed request forms are turned in to the Stores Acquisition Specialist assigned to the WPCL facility.

Evaluation of suppliers and supplies occurs by laboratory staff before making the request using the requirements of particular SOPs or the agency methods themselves (EPA, SM, etc.). Note that for many procedures, WPCL staff have conducted in-house studies to determine best materials and/or suppliers.

Evaluation of suppliers is accomplished by ensuring the supplier ships the product or material ordered and that the material is of the appropriate quality by signing packing slips or other supply receipt documents. The purchasing documents contain the data that adequately describes the services and supplies ordered. The description may include type, class, grade, identification, specifications or other technical information.

WPCL Policy Statements 021*, Non-Capital Purchasing*, and 022*, Documentation of Reagents and Standards,* cover all aspects of ordering and receiving of all supplies (chemicals, labware, small equipment) under $5,000.00. Included are individual policies for: fitness for purpose; approved vendors; approvals and reviews; ordering; order tracking; receipt at WPCL; inspection of all goods; distribution of goods ordered and appropriate paperwork; filing of documentation. Included are special requirements such as immediate refrigeration, hazardous materials, and other issues such as short expiration dates of some standards.

Purchased supplies and reagents that affect the quality of the tests are not used until they are inspected or otherwise verified as complying with requirements defined in the test method.

9.1.2 Capital Equipment (>$5,000)

The purchase of capital equipment follows strict city of Portland purchasing procedures as detailed in Procurement Services Bureau documents and procedural guidelines, which may be accessed on the city's website for the Office of Management and Finance under "Procurement Services."

All capital purchases are under the direction of the Laboratory Manager, who is the lead for all of the many steps involved. Appropriate lab staff participate in vendor presentations and follow-up Q&A sessions and are consulted for technical specifications and requirements. They also may be involved in the writing of technical statements of work that are incorporated into formal solicitation documents.

9.1.3 Services

The WPCL currently has annual maintenance agreements (contracts) for many instruments and pieces of equipment, the house water purification system, and the laboratory information management system (LIMS). These contracts are off-the-shelf packages provided by the manufacturers and are administered by the Laboratory Manager following city Procurement Services documents and procedural guidelines. The packages include guaranteed call-back and on-site response times, detailed provisions of services and materials covered, and warrantees of equipment return to fitness-of-purpose.

The annual calibration of balances, weights, and thermometers is covered on a purchase order basis with a local metrology company. Specifications for this work are covered in Sections 23 and 24 of the QA Manual.

9.2 Approval of Suppliers

The Stores Acquisition Specialist maintains access to suppliers. A list of current suppliers is at Appendix M. Current suppliers are considered approved.

Evaluation and selection of suppliers and vendors is performed, in part, on the basis of the quality of their products (as assessed against method- or WPCL-specific requirements), their ability to meet the demand for their products, the overall quality of their services, their past history, and competitive pricing. This is achieved through evaluation of objective evidence of quality furnished by the supplier, which can include certificates of analysis, recommendations, or proof of historical compliance with similar programs for other municipal labs. To ensure that quality, critical consumables and equipment conform to specified requirements, all purchases from specific vendors are approved by the Laboratory Manager or Designee.

9.3 Laboratory Evaluation of Suppliers (non-capital)

Lab personnel will fill out a New Supplier/Vendor Evaluation Form (example in Appendix M) when purchasing an item or service from a new supplier. The form is stored in the Lab drive Forms folder. The evaluation form should accompany the

order form. The Laboratory Manager has final approval of the order and evaluation. The evaluation forms will be maintained by the Laboratory Manager.

Section 10

SERVICE TO THE CLIENT
(TNI V1:M2 – Section 4.7)

The Water Pollution Control Laboratory (WPCL) collaborates with customers in clarifying their requests and in monitoring laboratory performance related to their work. Each request is reviewed to determine the nature of the request and the laboratory's ability to comply with the request within the confines of prevailing statutes and/or regulations without risk to the confidentiality of other clients.

The WPCL has three types of clients: internal to the Bureau of Environmental Services, within the city of Portland but outside the Bureau, and other municipalities. The majority of the work is within the Bureau.

10.1 Client Confidentiality

The laboratory confidentiality policy is to not divulge or release any information to a third party without proper authorization.

All electronic data (storage or transmissions) are kept confidential, based on technology and laboratory limitations, as required by client or regulation.

The WPCL is part of the Bureau of Environmental Services of the city of Portland, a public agency. The city is thus required by law to comply with applicable public records laws and administrative rules and must provide data and records pertaining to work done for the city of Portland via official public record requests in accordance with those laws and rules. All laboratory data and reports for other municipalities are the property of those municipalities, and requests for such data and reports are referred to the municipalities.

10.2 Client Support

Communication with the client, or their representative, is maintained to provide proper instruction and modification for testing. Technical staff is available to discuss any technical questions or concerns the client may have.

The client, or their representative, may be provided reasonable access to laboratory areas for witnessing testing.

Delays or major deviations to the testing are communicated to the client immediately by the Laboratory Manager, QA or Production Coordinators, or by Monitoring Coordination & Analysis Services (MCA) staff.

The laboratory provides clients with all requested information pertaining to the analysis of their samples.

10.3 Client Feedback

The laboratory seeks both negative and positive feedback following the completion of projects and periodically for ongoing projects. Feedback provides acknowledgement, corrective actions where necessary, and opportunities for continuous improvement.

Negative customer feedback is documented as a customer complaint (see Section 11 – "Complaints").

Because the majority of clients are internal, the WPCL has historically not formally queried clients for feedback but has relied on close and frequent communication either directly by the Laboratory Manager, QA and Production Coordinators or by project managers in the MCA Section. Problems and their resolutions are communicated by either telephone or email.

WPCL has developed a list of feedback questions for external customers. The questions will be sent at least once per year in conjunction with quarterly invoicing.

Section 11

COMPLAINTS
(TNI V1:M2 – Section 4.8)

The purpose of this Section is to assure that customer complaints are addressed and corrected. This includes requests to verify results or analytical data. Complaints provide the laboratory an opportunity to improve laboratory operation and client satisfaction.

Complaints may be received from clients within the Bureau of Environmental Services, from other bureaus within the city, or from outside municipalities, as described in *Section 10, Service to Clients.* Complaints by customers or other parties are reviewed by either the QA or Production Coordinators or by Monitoring, Coordination, and Analysis (MCA) staff and an appropriate action is determined. All customer complaints are documented by the person receiving the complaint and are resolved in consultation with the responsible manager.

A complaint is a client communication expressing dissatisfaction with laboratory performance. Complaints to the WPCL are uncommon, but when they occur they usually concern timely reporting, higher than anticipated method reporting limits, or results flagged as estimated. Rarely, a permitted industrial discharger will challenge analytical results if those results trigger fines or an increase in fees such as extra strength charges.

Queries not finding fault with WPCL performance are not considered complaints and will not be logged for a formal root cause/corrective action procedure. These include questions regarding choice of methods, data interpretation, expanded explanations of flags and method reporting limits, requests for additional QC data that the client did not originally request, anticipated delivery of data or data reports within the nominal two week turnaround, etc.

If it is determined that the complaint has merit, the procedures outlined in *Section 14, Corrective Actions* are utilized. If it is determined that a complaint is without merit, it is documented, and the client is contacted by either one of the laboratory Coordinators or the appropriate MCA staff member.

A complaint such as a concern that data are repeatedly late is reviewed for preventive action to minimize a future occurrence. (See Section 15*, Preventive Action*.)

Section 12

CONTROL OF NON-CONFORMING ENVIRONMENTAL TESTING WORK
(TNI V1:M2 – Section 4.9)

Non-conforming work is work that does not meet acceptance criteria or requirements. Nonconformances can include departures from standard operating procedures or test methods or unacceptable quality control results. (See Section 27, *Quality Assurance for Environmental Testing*.) Identification of non-conforming work can come through customer communication, complaints, or requests; quality control, instrument calibration, evaluating consumable materials, staff observation, final report review, management reviews, and internal and external audits.

12.1 Exceptionally Permitting Departures from Documented Policies and Procedures

Requests for departures from laboratory procedures are approved by the Lab Manager or QA Coordinator and documented by hand-written comments on data, notations in the LIMS, work requests, and/or a non-conformance form. The client is notified in a case narrative or by using a data qualifier on the laboratory report. Planned departures from procedures or policies do not require audits or investigations.

Examples of permitted departures from policy or methodology include:

Reduction of matrix QC for process control (non-regulatory) samples.

Using a non-validated method for estimated results if requested by the client. There must be a reasonable expectation that the customer understands the potential effect on data quality and data usability.

Using a smaller sample volume when method-specified sample volume is not available.

Analysis after holding time is limited to situations where the results are unlikely to be affected, or when the client has already indicated that such analysis should proceed.

12.2 Non-Conforming Work

The lab policy for control of non-conforming work is to identify the non-conformance, determine if it will be permitted, and take appropriate action. All employees have the authority to stop work on samples when any aspect of the process does not conform to laboratory requirements.

The responsibilities and authorities for the management of non-conforming work rest with the QA Coordinator and Lab Manager. Corrective action for routine, non-recurring exceedances can be documented on raw data worksheets, logbooks, data print-outs, as comments in the LIMS, and/or a non-conformance form. More serious cases of non-conforming work require a more formal corrective action process that usually includes the use of a corrective action report. The procedure for

investigating and taking appropriate corrective actions of non-conforming work are described in Section 14, *Corrective Actions.* Section 14.3 describes procedures for Technical Corrective Actions. Formal corrective action procedures must be followed for non-conforming work that could reoccur (beyond expected random QC failures) or where there is doubt about the laboratory's compliance to its own policies and procedures.

The investigation and associated corrective actions of non-conforming work involving alleged violations of the laboratory's Ethics and Data Integrity policies must follow the procedures outlined in Section 19, *Data Integrity Investigations.*

The laboratory evaluates the significance of the non-conforming work and takes corrective action immediately. The laboratory allows the release of non-conforming data only with approval by the QA Coordinator on a case-by-case basis. Non-conforming data are clearly identified in the final report. (See Section 28, *Reporting the Results*.) Non-conformances that are resolved internally and prior to reporting, through re-analysis or other evaluation, are not reported to the customer.

The discovery of a nonconformance for results that have already been reported to the customer are immediately evaluated for significance of the nonconformance, its acceptability to the customer, and determination of the appropriate corrective action. (See Section 14, *Corrective Action*.) If it is determined that results are affected, the customer is notified and a revised reported is issued.

Nonconformances involving personnel performance may also be addressed as described in Section 14, *Corrective Action*.

12.3 Stop Work Procedures

Personnel notify a Lab Coordinator or Lab Manager of any significant nonconformance that may require stopping work.

The Coordinator reviews the significance of the nonconformance and works with the analyst to develop a course of action. When an investigation indicates that the cause of the nonconformance requires that a method be restricted or not used until modifications are implemented, the Coordinator will immediately notify all affected personnel of the suspension/restriction. The lab will hold all relevant reports to clients pending review. The Coordinator must verify that the issue is resolved and authorize resumption of work. Personnel are notified when resumption of work is authorized. The analyst and relevant Coordinator will document the issue, root cause and resolution using the corrective action procedures described in Section 14, *Corrective Action.*

Management may remove an analyst from the performance of analytical procedures until it is determined that the nonconformance associated with the analyst and the analytical procedures is corrected.

Section 13

IMPROVEMENT
(TNI V1:M2 – Section 4.10)

13.1 Laboratory Processes

Improvement in the overall effectiveness of the laboratory management system is a result of the implementation of the various aspects of the laboratory's management system: quality policy and objectives (*Section 5, Management*); internal auditing practices (Section 17*, Internal Audits*); the review and analysis of data (Section 27*, Quality Assurance for Environmental Testing*); the corrective action (Section 14*, Corrective Action*) and preventive action (Section 15*, Preventive Action*) process; and the annual management review of the quality management system (Section 18*, Management Reviews)* where the various aspects of the management/quality system are summarized, and evaluated and plans for improvement are developed.

13.2 Management System Performance Metrics

The Laboratory Manager monitors a number of performance metrics for the laboratory as a whole and for the various sections within the laboratory. Those regarding revenue and number of samples received or analyses requested are beyond the control of the laboratory. Number of samples/analyses is the only metric reported beyond laboratory management.

- Number of samples received
- Number of analyses performed
- Number of field analyses and contract analyses processed
- Turnaround time

The metrics below have been monitored in the past. Many of these metrics were possible because the Bureau operates the laboratory under a charge back system for city clients. These same prices are charged to outside municipalities. These metrics have included the following, but are not required.

- Gross revenue – monthly and total-to-date generated by the lab and sent out to contract laboratories

- Direct expenses (fully burdened salaries and supplies) – monthly and total-to-date for the lab as a whole and for each section of the lab

- Pro forma projections to the end of the fiscal year for total lab gross revenue and direct expenses (monthly from the end of the first quarter to the eleventh month of the fiscal year)

- Contracted work as percent of gross revenue (monthly and total-to-date)

- Supplies costs per full-time equivalent (FTE) for each section of the lab (monthly and total-to-date)

- Supplies costs per lab section broken out by category – repairs & maintenance, miscellaneous (shipping, licenses, fees, etc.), office supplies, chemicals, gases, QA/QC and commercial standards, labware & bottles, instrument supplies, safety, maintenance supplies, minor equipment (monthly and total-to-date)

- Gross revenue per FTE (monthly and total-to-date)

- Overtime hours spent on overhead (holiday and weekend vacation coverage) and actual production (monthly and total-to-date).

All metrics are compared to agreed-upon targets and reported monthly to upper management in a performance/financial executive summary. Results are used to assess and improve business practices throughout the laboratory.

Section 14

CORRECTIVE ACTION
(TNI V1:M2 – Section 4.11)

Corrective action is the action taken to eliminate the causes of an existing non-conformity, defect, or other undesirable situation in order to prevent recurrence.

Deficiencies cited in external assessments, internal quality audits, Proficiency Testing, data reviews, customer feedback/complaints, control of nonconforming work or managerial reviews are documented and require corrective action. Corrective actions taken are appropriate for the magnitude of the problem and the degree of risk.

14.1 General Procedure

The laboratory uses a Corrective Action Report (CAR) form to document and track event-specific corrective actions. An example of this form is shown in Figure 14-1. The form is also available in a format designed for electronic entry in the lab drive under QA Documents\Corrective Actions. A CAR is needed when the problem is systematic, cannot immediately be explained or resolved, or the reported results must be modified. All deficiencies are investigated and a corrective action plan is developed and implemented if determined necessary. The implementation is monitored for effectiveness.

For analytical nonconformances, the analyst is responsible for initiating corrective action where a nonconformance is found that could reoccur (beyond expected random QC failures) or where there is doubt about the compliance of the laboratory to its own policies and procedures. Personnel notify the QA Coordinator or Production Coordinator of a nonconformance that may require corrective action. The QA Coordinator generally oversees all corrective action resolutions.

For other types of significant nonconformances such as external assessments and customer complaints, the QA Coordinator or Lab Manager may initiate corrective action and may assign other personnel to participate. In general, a corrective action plan is developed, implemented, and documented through a CAR. Depending on the nonconformance, this may be a more extensive document that lists findings, planned corrective actions, and verification of implementation. The completed corrective action plan may incorporate individual CARs used for investigating specific findings.

14.1.1 Cause Analysis

When failures due to systematic errors have been identified, the first step of the corrective action process starts with the initial investigation and determination of root cause(s) of the problem. The CAR serves to show that the root cause(s) was investigated, and includes the results of the investigation. The CARs are kept as hardcopies and/or electronic copies on the S:Lab network drive, which are numbered and maintained by the QA Coordinator.

In the case of non-systematic errors in which either the initial cause is readily identifiable or in which random failures are expected (e.g. failed quality control), a formal root cause analysis is not performed and the process begins with selection and implementation of corrective action. (See also Section 14.3, *Technical Corrective Actions*.)

14.1.2 Selection and Implementation of Corrective Actions

Where uncertainty arises regarding the best approach for analysis of the cause of exceedances that require corrective action, appropriate personnel will recommend corrective actions that are appropriate to the magnitude and risk of the problem and that will most likely eliminate the problem and prevent recurrence.

A Lab Coordinator or Lab Manager authorizes appropriate corrective action and ensures that a corrective action is discharged within the agreed upon time frame.

14.1.3 Monitoring of Corrective Action

The QA Coordinator monitors implementation and documentation of the corrective action to assure that the corrective actions were effective. This is done through follow-up communication with the personnel involved in the corrective action or data review, and is documented through notes on the CAR.

14.2 Additional Audits

Where the identification of nonconformances or departures from normal lab procedures cast doubt on the laboratory's compliance with its own policies and procedures, or on its compliance with the TNI Standard, the laboratory ensures that the appropriate areas of activity are audited as soon as possible in accordance with Section 17, *Internal Audits*.

In many cases, the additional audits are follow-ups after the corrective action has been implemented to ensure it is effective. These are done when a serious issue or risk to the laboratory has been identified.

14.3 Technical Corrective Action

Sample data associated with a failed quality control are evaluated for the need to be reanalyzed or qualified. Unacceptable quality control results are documented, and if the evaluation requires cause analysis, the cause and solution are recorded. (See also Section 12, *Control of Nonconforming Environmental Testing Work*.)
Analysts routinely implement corrective actions for data with unacceptable QC measures. If the issue is solved during routine analysis, through actions already described in the SOP, or through instrument maintenance documented in a maintenance log, a formal CAR is not required. First level correction may include re-analysis without further assessment. If the test method SOP addresses the specific actions to take, they are followed. Otherwise, corrective actions start with assessment of the cause of the problem.

Corrective action for non-systematic errors or expected random failures are documented on raw data worksheets, logbooks, data print-outs and/or as comments in the LIMS. Corrective actions for nonconformances that may reoccur (beyond expected random QC failures) or where there is concern that the laboratory is not in compliance with its own policies and procedures require that a CAR be completed. (See Section 14.1.)

If the data reported are affected adversely by the nonconformance, the affected results are clearly identified in the report for the customer. (See Section 28, *Reporting the Results*.) If affected results were previously reported to the customer, a revised reported is issued with revisions clearly indicated.

CAR # _____
(assigned by QA Coordinator)

City of Portland
Water Pollution Control Laboratory

Corrective Action Report

This CAR form is to be utilized as documentation of a QA/QC non-conformance and subsequent corrective action. The CAR is initiated by the analyst and routed to the QA Coordinator. The CAR form should be submitted for QA approval before sample results are reported.

CAR initiated by: _____ Date: _____ Lab area / analysis: _____

Non-conformance:

Samples affected:

Corrective action:

Conclusion / Comments:

Comment required on sample report(s)? Yes / No Further action required? Yes / No

Corrective action executed by: _____ Completion date: _____

Other approval: _____ Date: _____

QA Coordinator Section Verification: _____ Date: _____

Comment required on sample report(s)? Yes / No Further action required? Yes / No

QA Coordinator comments:

rjc 12/13/12 Qadocs\CARform.doc

Figure 14-1. Corrective Action Report

Section 15

PREVENTIVE ACTION
(TNI V1:M2 – Section 4.12)

Preventive action is a pro-active process to identify opportunities for improvement, prepare for non-conformances, or plan for changes in procedures rather than a reaction to the identification of problems or complaints.

Preventive action includes, but is not limited to:

-routine instrument maintenance, both internal and vendor-provided
-evaluation of QC data and PT results for developing bias (trending)
-review of QA/QC issues at staff meetings, to ensure lab-wide understanding
-full consideration of client feedback to look for improvement opportunities
-maintaining awareness of new technology and methods for improved data

15.1 General Procedure

When improvement opportunities are identified or if preventive action is required, action plans are implemented and monitored to reduce the likelihood of the occurrence of nonconformities.

Procedures for preventive actions include the initiation of such actions and subsequent monitoring to ensure that they are effective.

The preventive action may be documented in a Preventive Action Report (PAR), similar to the Corrective Action Report (CAR).

15.1.1 Statement of Action

The reason for the PAR is listed. This may be a future non-conformance to address, a new method to implement, or any other cause for preventive action.

15.1.2 Reason for Action

Background of the issue, reasons, and/or root causes are investigated and indicated as needed.

15.1.3 Action Taken

The action to be taken is listed and tracked as needed. This may be corrective actions, a plan with responsibilities assigned, or a list of action items.

15.2 Responsibility

All personnel have the authority to offer suggestions for improvements and to recommend preventive actions. Laboratory Coordinators and Lab Manager are generally responsible for initiating PARs and directing the implementation of preventive actions. The QA Coordinator maintains the PARs and monitors and documents activities.

As a preventive action, a new technology or analytical method may be recommended by analytical staff as a means of improving data and/or reducing cost. The Laboratory Manager approves time and expenses for developing new methods and the QA Coordinator approves implementation based on completion of appropriate method validation procedures.

Section 16

CONTROL OF RECORDS
(TNI V1:M2 – Section 4.13)

Records are a subset of documents, usually data recordings that include annotations, such as daily refrigerator temperatures posted to a laboratory form, lists, spreadsheets, or analyst notes on a chromatogram. Records may be on any form of media, including electronic and hard copy. Records allow for the historical reconstruction of laboratory activities related to sample handling and analysis.

The laboratory maintains a records system appropriate to its needs, records all laboratory activities, and complies with applicable standards or regulations as required. Records of original observations and derived data are retained to establish an audit trail. Records help establish factors affecting the uncertainty of the test and enable test repeatability under conditions as close as possible to the original.

16.1 Records Maintained

Records are kept of all procedures to which a sample is subjected while in the possession of the laboratory. The laboratory retains all original observations, calculations and derived data (with sufficient information to produce an audit trail), calibration records, personnel records and a copy of the test report for a minimum of five years from generation of the last entry in the records. At a minimum, the following records are maintained by the laboratory to provide the information needed for historical reconstruction:

16.1.1 Analytical Data

Analytical data includes all raw data, whether hard copy or electronic, for calibrations, samples and quality control measures, including analysts' worksheets and data output records (chromatograms, quantitation reports, data summary sheets, and other instrument printouts). This includes documentation of sample preparation and cleanup protocols.

Specific information recorded for each analytical batch includes:

-laboratory sample ID numbers
-volumes and weights of samples and reagents
-reagent identifications (LIMS number)
-date of analysis
-time of analysis (may be a single time designation for a batch)
-analyst's initials/signature or electronic identification
-incubation periods
-all data used in calculations (including manual integrations)
-final calculated results for samples and QC
-data review and validation verification

For instrumental analysis, records include instrument identification. Print-outs of instrument operating conditions/parameters are maintained, with start and end dates indicated. Calibration results are maintained along with analytical data.

Depending on the analysis, raw data is maintained in laboratory notebooks, the LIMS, and/or instrument files and hardcopies of those files. Notebooks are initialed and dated when data are generated or reviewed. Packets of printed instrumental data are initialed and dated by the analyst and reviewer. For analyses that load raw data directly into the LIMS (e.g., balance readings for solids analysis), the benchsheets with the raw data and calculated results are printed and maintained. Copies of those benchsheets are also stored electronically as back-up. The LIMS has a status progression system that documents the process of sample login, batching, analysis, peer review and QA review, with the date/time and initials electronically recorded.

16.1.2 Sample Chain-of-Custody (COC) Records

All samples are documented on a chain-of-custody form. The form is electronically scanned so a copy is available in the LIMS. The original form is maintained with a copy of the final customer report. As of March 2020, printing of customer reports was phased out and only COCs are retained. (See Section 16.1.3.)

Sample transfers are documented on a separate chain-of-custody form. A copy of that form is maintained with the final customer report, usually incorporated into the data report from the subcontract laboratory.

16.1.3 Laboratory Reports to Customers

Laboratory reports are generated and stored electronically as .pdf files. Until March 2020, for most clients and projects, a final report was also printed and stored, with the original chain-of-custody form attached to the front. The exceptions were routine analysis for CBWTP and TCWTP, Pretreatment reports related to CBWTP and TCWTP, and internal laboratory QC reports (eg. filter blanks for dissolved metals). These reports were generated and stored as .pdf files, but not printed. Reports were filed by client and/or project.

April 2020 was a transition period with some reports printed and filed as indicated above. After this time, reports were not printed and COCs were filed by work order number.

Correspondence relating to laboratory projects is handled by the MCA section. Records of e-mail, telephone, and hardcopy correspondences are managed by MCA.

16.1.4 QA Records

QA documents are maintained in hardcopy and/or electronic form. For example, standard and reagent preparation are only required to be documented in the LIMS, and printed summaries are then available as needed. QA records include the following:

-copies of all current and historical laboratory SOPs and *Quality Manual*s

-written policies and guidance documents
-alternative test procedure and other method modification approvals
-standard and reagent origin, receipt, certificates of analysis, and preparation
-temperature records for sample storage refrigerators, ovens, and incubators
-equipment calibration records (e.g., balances, weights, pipettors)
-testing records for new supplies and equipment
-personnel qualification, experience and training records
-records of demonstration of capability for each analyst
-a list of names, initials, and signatures for laboratory staff
-proficiency testing results
-interlaboratory comparison study results
-copies of internal and external audits including audit responses
-corrective action reports
-management reviews
-data archive records

When electronic spreadsheets are used for calculating and storing results, the calculation cells are locked whenever possible to prevent inadvertent change to the calculations.

16.2 Records Management and Storage

The laboratory maintains a record management system for control of all forms of laboratory data, sampling records, reports and QC records.

Where both electronic and hardcopy records are maintained, the hardcopy is considered the primary medium for long-term storage.

Analytical data is recorded immediately and legibly in permanent ink, or recorded electronically. Major instrument systems have computerized data collection. Corrections to manually entered data or printed hardcopies are initialed and dated with the reason noted for corrections other than transcription errors. A single line strikeout is used to make corrections so that the original record is not obliterated. Changes to data in the LIMS are documented through an electronic audit trail. Comments may be added in the audit trail spreadsheet. Manually integrated chromatographic peaks are flagged either manually or by the instrument data system.

Records, including electronic records, are easy to retrieve, legible, and protected from deterioration or damage; and are available to accrediting bodies for a minimum of five years or as required by regulation or contract. Records that are stored only on electronic media are supported by the hardware and software necessary for their retrieval. Access to protected records is limited. Printed records are stored within the laboratory or in a locked file room to prevent unauthorized access or amendment.

Electronic records are stored on computer hard drives and servers. The server share is commonly known as the S-drive. Portable media are not used for data or records storage. Three types of electronic records are maintained:

Instrumental raw and calculated results are maintained at the instrument for a period of time. In some cases the hard drives can store at least five years of data. Where that is not possible, the data are stored on a remote City network server computer called BESFILE1, which is managed by City IT professionals. This server is backed up every weekday, Monday to Friday, at 6 PM.

The LIMS database is on a remote server computer called the SQL server, which is managed by City IT professionals. The server is backed up six nights a week, Sunday to Friday. Each backup file is saved for 5 days before being automatically deleted. Additionally, a transaction log backup is run every two hours on Monday to Friday between 6 AM and 6 PM. This allows recovery from a major outage with a loss of no more than two hours worth of work.

The LIMS active database storage capacity depends upon the number of records. Thus it is impossible to predict capacity in terms of years of data. The LIMS documentation library contains a policy and procedure for truncating the active database and transferring it to an archive. Data are stored in a read-only mode, and access to the archived (truncated) database is under the control of the Laboratory LIMS Administrator. The policy and procedure are in the document "Element Database Truncation" on the S-Drive at:

\\BESfile1\LIMS_ELEMENT\Installation_and_Updates\Element.Database.Truncation.doc

Laboratory documents and reports derived from the LIMS reside on a remote City network server computer called BESFILE1, which is managed by City IT professionals. This server is backed up every weekday, Monday to Friday, at 6 PM. The laboratory files stored on this server include:

-controlled documents (QM and SOPs)
-policy statements
-notebook forms
-audit responses and CARs
-PT results
-benchsheets
-reports to clients (in .pdf format)
-data transfer files
-scanned chain-of-custody forms

Additional information regarding control of data is included in Section 22.5, *Control of Data*.

After five years or more, physical records are transferred to the City of Portland archive center. The City defines laboratory records as permanent records. The City archive program has specific protocols for identifying and indexing all boxes of records to ensure that records can be readily retrieved. Laboratory records are divided into five categories: raw data records, outside lab reports, sampling records and reports, electronic data (media), and QA records. Each archive shipment is logged on specific forms provided by the archive center. Boxed records are

transferred to the archive center by City personnel from Printing and Distribution Services. Copies of the logs are maintained at the laboratory and are available from the archive center. Archived information and access logs are protected against fire, theft, loss, environmental deterioration, vermin, and in the case of electronic records, electronic or magnetic sources. Archived records have limited access and are checked out through an access log.

Appropriate regulatory and state legal requirements concerning laboratory records shall be followed.

16.3 Legal Chain of Custody Records

Not applicable.

Section 17

AUDITS
(TNI V1:M2 – Section 4.14)

Audits measure laboratory performance and verify compliance with accreditation and project requirements. Audits specifically provide management with an on-going assessment of the management system. They are also instrumental in identifying areas where improvement in the management/quality system will increase the reliability of data. Audits are of four main types: internal, external, performance, and system. Section 17.5 discusses the handling of audit findings.

17.1 Internal Audits

Annually, the laboratory prepares a schedule of internal audits to be performed during the year. These audits verify compliance with the requirements of the management/quality system, including analytical methods, SOPs, the *Quality Manual*, the ethics and data integrity policy, other laboratory policies, and the TNI Standard. Internal audits are scheduled throughout the year for different laboratory sections. The QA Coordinator or Lab Manager plans and organizes audits as required by the schedule and requested by management. The audit schedule is available to all staff. The TNI checklist, or a modified version, is used for management system audits. The TNI checklist, or a modified version, or a prepared checklist is used for analysis audits. These audits are carried out by trained and qualified personnel who are, wherever resources permit, independent of the activity to be audited.

To begin an analysis audit, the auditor reviews data and supporting documentation for specific samples. The auditor reviews the information to verify traceability of results and conformance with SOPs and reference methods. The auditor also goes into the work area to verify that QA protocols are consistently applied (i.e, refrigerator temperatures are monitored, equipment calibration checks are documented, etc.).

In addition to the scheduled internal audits, it may sometimes be necessary to conduct special audits as a follow-up to corrective actions, PT results, complaints, regulatory audits or alleged data integrity issues. These audits address specific issues.

The area audited, the audit findings, and corrective actions are recorded. Audits are reviewed after completion to assure that corrective actions were implemented and effective. This review generally occurs within one month after corrective actions are in effect. For non-analytical corrective actions that do not directly impact data validity, the review may occur during the next scheduled audit.

17.2 External Audits

It is the laboratory's policy to cooperate and assist with all external audits, whether performed by clients or an accrediting body. Management ensures that all areas of the laboratory are accessible to auditors as applicable and that appropriate personnel are available to assist in conducting the audit.

17.3 Performance Audits

The main performance audits at WPCL are Proficiency Test Samples (PTs). PTs are discussed in Section 27, *Quality Assurance for Environmental Testing.* The laboratory analyzes two sets of PTs per year for accredited analytes. Additional PTs may be analyzed as part of the corrective action when a routine PT result is unacceptable.

Internal single-blind samples are occasionally used as part of method start-up procedures, for training, or to help resolve an analytical problem. To assure accuracy, these samples are purchased from an accredited PT provider whenever possible.

WPCL may participate in other outside studies when invited.

17.4 System Audits

The Laboratory's management system is audited though annual management reviews. Refer to Section 18, *Management Reviews* for further discussion of management reviews.

17.5 Handling Audit Findings

Internal or external audit findings are responded to within the time frame agreed to at the time of the audit. The response may include action plans that could not be completed within the response time frame. A completion date is established by management for each action item and included in the response.

Developing and implementing corrective actions to findings is the responsibility of Lab Coordinators and the Lab Manager. Corrective actions are documented through the corrective action process described in Section 14, *Corrective Actions*.

Audit findings that cast doubt on the effectiveness of the laboratory operation to produce data of known and documented quality or that question the correctness or validity of sample results must be investigated. Corrective action procedures described in Section 14, *Corrective Action* must be followed. Clients must be notified in writing if the investigation shows the laboratory results have been negatively affected and the clients requirements have not been met. The client must be notified within five working days after the laboratory determines that results have been affected. Laboratory management will ensure that this notification is carried out within the specified time frame.

All investigations that result in findings of inappropriate activity are documented and include any disciplinary actions involved, corrective actions taken, and all

appropriate notifications of clients. See Section 19, *Data Integrity Investigations* for additional procedures for handling inappropriate activity.

Section 18

MANAGEMENT REVIEWS
(TNI V1:M2 – Section 4.15)

The laboratory manager reviews the management system on an annual basis and maintains records of review findings and actions. Management reviews are of two types: ongoing and periodic.

18.1 Ongoing Management Review

Ongoing management reviews consist of regularly scheduled weekly meetings with all lab staff on Tuesdays. The meetings follow a typical agenda:

- Announcements
- Safety
- QA
- Production (incoming work)
- Old/new business.

Other meetings with staff are scheduled as needed when laboratory needs require discussion with fewer staff. Meeting may include any staff with potential input. Discussions are typically more technical than those covered in all-staff meetings. Topics may include:

- Instrument purchases or problems and corrective actions
- Existing and proposed protocols
- Work flow issues

The Lab Manager might meet with Coordinators or Specialists only to discuss topics regarding laboratory planning and organization and may include:

- Work assignments of analysts
- Training
- Strategic planning for future instrumentation and new analyses
- Operational changes resulting from root cause/corrective actions.

Taking into account the meeting contents and number over the course of any one calendar year, all of the management review topics listed in V1-1.4 of the 2016 TNI Standard are addressed.

The Lab Manager meets with division management approximately biweekly with updates on the above topics and others related to laboratory operations and management.

18.2 Periodic Management Review

Periodic review or check-ins are held with each analytical and operational section of the laboratory:

- Metals
- Organics
- Microbiology
- Nutrients
- Process/General Chemistry
- Sample Receiving
- Quality Assurance
- Production

A separate meeting is scheduled for each analytical/operational section. Participating staff include Analysts and Specialists who work in that section plus the QA and Production Coordinators. The Technical Coordinator may also attend. Discussion items include:

- Current staff, including work schedules and demonstrations of capabilities (DOCs)
- Methods, including instruments, matrices, reference protocols, and SOPs
- Workflow issues
- Root cause/corrective action initiatives, recommendations for improvement
- Internal audits
- Policy/procedure suitability or needed changes
- Recent analytical advances and/or regulations potentially impacting operations
- Strategic planning as to future instrument purchases and new methods
- Customer feedback/complaints

Periodic meetings of the Element Core Team (LIMs) are held to address issues specific to the LIMs operation and maintenance.

18.3 Reporting

A written report is prepared annually and electronically sent to the Division Manager. Overview topics include:

- Personnel, including training gaps and anticipated changes, if any
- Workload, including recommendations for possible changes
- Capital equipment, both new or replacement
- Physical plant, including all safety appliances
- Summary of biannual performance testing results
- Performance measures, number of samples and analyses
- Customer feedback and complaints, if any
- Corrective actions
- Recommendations for improvement

An electronic copy is kept on the WPCL Group 100 S-Drive, and a hard copy is kept in a binder in the office of the Laboratory Manager. Management will determine appropriate completion dates for action items and ensure they are completed within the agreed upon time frame.

Section 19

DATA INTEGRITY INVESTIGATIONS
(TNI V1:M2 – Section 4.16)

In addition to covering data integrity investigations, this Section covers all topics related to ethics and data integrity policies, procedures and training.

The City of Portland Water Pollution Control Laboratory (WPCL) is committed to ensuring the integrity of its data and providing valid data of known and documented quality to its clients. Elements in the WPCL Ethics and Data Integrity program include:

- Documented ethics & data integrity procedures signed and dated by top management.
- A written Mission Statement.
- An Ethics and Data Integrity Policy signed by all management and staff at the annual data integrity training. (See Appendix A.) This policy and the annual signature page are signed and dated by all laboratory personnel. The original signature pages are scanned and kept electronically in the lab Ethics Training folder.
- Annual data integrity training.
- Procedures for confidential reporting of alleged data integrity issues.
- An audit program that monitors data integrity and procedures for handling data integrity investigations and client notifications. (See Section 17, *Audits*.)

19.1 Ethics and Data Integrity Procedures

The Ethics and Data Integrity Policy provides an overview of the program. Written procedures that are considered part of the Ethics and Data Integrity program include:

- An ethics and data integrity policy (see Appendix A)
- A written manual integration standard operating procedure (WPCL SOP QAQC-10, Manual Integration)
- Written procedures for corrective actions (see Section 14)
- A written policy on corrective action reports
- Written procedures for data integrity investigations (see Section 19.4, below)
- Training for laboratory ethics and data integrity (see Section 19.2, below)

Management reviews data integrity procedures yearly and updates these procedures as needed.

19.2 Training

19.2.1 Overview

Data integrity training is provided as a formal part of new employee orientation and a refresher is given annually for all employees. Employees are required to understand that any infractions of the laboratory data integrity procedures shall result in a detailed investigation that could lead to very serious consequences up to and including termination for cause and/or civil or criminal prosecution. This is discussed in the WPCL Code Of Ethics that every employee is required to read and sign annually as part of the WPCL Laboratory Ethics And Data Integrity training. Attendance at this training is attested by a signature attendance sheet.

19.2.2 Training Agenda

At the beginning of the training session, the WPCL Code of Ethics and Mission Statement are reviewed. Attendees are required to sign a concurrence page attesting that they have read and understand the WPCL Code of Ethics. An agenda and list of topics to be covered are provided to each trainee prior to the training class. Data integrity training emphasizes the importance of proper written narration on the part of the analyst with respect to those cases where analytical data may be useful, but are in one sense or another partially deficient. The following topics and activities are covered:

- organizational mission and its relationship to the critical need for honesty and full disclosure in all analytical reporting;
- how and when to report data integrity issues;
- record keeping;
- training, including discussion regarding all data integrity procedures;
- data integrity training documentation;
- in-depth data monitoring and data integrity procedure documentation; and
- specific examples of breaches of ethical behavior such as improper data manipulations, adjustments of instrument time clocks, and inappropriate changes in concentrations of standards.

The training has included a PowerPoint in the public domain developed by Mr. Dennis Wells and Dr. Charles Lytle, both former members of the Oregon Environmental Accreditation Program (ORELAP) Technical Advisory Committee (OTAC), and has been used for “train the trainer” sessions at the annual Pacific NW Clean Water Association Short School.

Additional training PowerPoints presentations have been developed by both Keith Chapman (formerly of OTAC, Oregon Environmental Laboratory Association OELA, and City of Salem) and Kristen Thomas, formerly City of Portland WPCL.

All are acceptable for laboratory ethics/data integrity training and may be modified to include applicable and more current materials and examples.

19.2.3 Records

All attendees are required to sign an attendance sheet, which is kept electronically in the WPCL Ethics Training Log lab S-drive folder. The concurrence page for the Code of Ethics is kept in the same folder. An electronic copy of the training PowerPoint presentation along with several others from various public organizations are kept on the WPCL Group 100 S-Drive.

19.2.4 Absent Staff

The Laboratory Manager will follow-up with staff not present at the formal group training to review the WPCL Mission Statement and Code of Ethics and to sign the Code of Ethics concurrence page. They will then either view the ethics training PowerPoint at a convenient computer or go through it with the Manager, and then sign the training log.

19.3 Confidential Reporting of Ethics and Data Integrity Issues

Confidential reporting of data integrity issues is assured through the "Duty To Report" section of the WPCL Code of Ethics. Both confidentiality and a receptive environment are assured so that employees can discuss ethical issues in private. Management is immediately informed so that further action, if necessary, can be taken.

19.4 Investigations

All investigations resulting from data integrity issues are conducted confidentially. They are documented and notifications are made to clients who received any negatively affected data that did not meet the client's data quality requirements. Because of the potential of disciplinary action, all investigations involving the potential of ethics violations are conducted under the rules and direct oversight of the City of Portland Bureau of Human Resources in consultation with the City Attorney's Office.

Section 20

PERSONNEL
(TNI V1:M2 – Section 5.2)

The Water Pollution Control Laboratory (WPCL) employs competent personnel based on education, training, experience, and demonstrated skills. The laboratory's organization chart is provided in Appendix B.

20.1 Overview

All personnel are responsible for complying with all quality and data integrity policies and procedures that are relevant to their area of responsibility.

All personnel who are involved in activities related to sample analysis, evaluation of results or who sign test reports, must demonstrate competence in their area of responsibility. Appropriate supervision is given to any personnel in training, and the trainer is accountable for the quality of the trainee's work. Personnel are qualified to perform the tasks they are responsible for based on education, training, experience, and demonstrated skills as required for their area of responsibility.

The QA Coordinator and Lab Manager ensure the competence of all lab personnel who operate specific equipment, perform environmental tests, evaluate results, and sign test reports. When staff are undergoing training, appropriate supervision is provided by a lab Coordinator, experienced lab analyst or specialist. Personnel who are performing specific tasks are qualified on the basis of appropriate education, training, experience, and demonstration of capability. The laboratory currently has sufficient personnel with the necessary education, training, technical knowledge, and experience for their assigned functions. All staff are responsible for complying with specified quality assurance/quality control requirements that are related to their technical function. Each member of the analytical staff has a combination of experience and education to adequately demonstrate a specific knowledge of their particular function and a general knowledge of laboratory operations, test methods, quality assurance/quality control procedures and records management. Laboratory Analysts have cross training in the Process Control, General Chemistry, Sample Receiving, Microbiology, and Nutrients Sections.

In consultation with the drinking water lab and the WPCL, the city has detailed job classification descriptions that include specific requirements for each classification rank (Analyst I and II, Analytical Specialist, Laboratory Coordinator, and Laboratory Manager) with respect to education, training, skills, and abilities. (See Section 20.2, below).

Training needs are identified and addressed by the Laboratory Manager and Lab Coordinators. Regular training meetings are scheduled whenever policies or procedures have changed. Training needs are identified at the time of employment and when personnel are moved to a new position or new responsibilities are added

to their job responsibilities. Ongoing training, as needed, is also provided to personnel in their current jobs. The effectiveness of the training must be evaluated before the training is considered complete.

The WPCL only uses personnel who are employed by the City of Portland. Contracted personnel, when used, must meet the same competency standards and follow the same policies and procedures that laboratory employees must meet.

The laboratory maintains current job descriptions for all personnel who manage, perform or verify work affecting the quality of environmental tests. The Laboratory Manager authorizes specific personnel to perform particular types of sampling, environmental tests, to issue test reports, to give opinions and interpretations, and to operate particular types of equipment. The laboratory maintains records of the relevant authorizations, competence, educational and professional qualifications, training, skills and experience of all currently employed technical personnel. These records are maintained in personnel training files, which also include records of demonstrated proficiency for each laboratory test method.

20.2 Job Descriptions

Job descriptions are available for all positions that manage, perform, or verify work affecting data quality, and are located on the city of Portland website, portlandoregon.gov, on the Human Resources page under “Classification Specifications.”

These classification specifications include detailed requirements for education, experience, knowledge base, and responsibilities for each position. An overview of top management’s responsibilities are included in Section 5*, Management*.

20.3 Training

All personnel are appropriately trained and competent in their assigned tasks before they contribute to functions that can affect data quality. It is management’s responsibility to assure personnel are trained. Training records are used to document management’s approval of personnel competency. The date on which authorization and/or competence is confirmed is included.

20.3.1 Overview

The goals of training at WPCL are to: (1) provide information and practice to the trainee under supervision of a skilled trainer; and (2) verify and document the analyst’s skill in the procedure through analysis of known samples and a demonstration of capability (DOC).

20.3.2 Trainer Qualifications

The trainer must be a person qualified to do the analysis and should have at least three months experience performing the procedure. Because method details change over time, the trainer should be currently active in performing the analysis. Whenever possible, the laboratory employee most experienced with the procedure will train the new analyst.

20.3.3 Training Opportunities and Trainee Qualifications

Training opportunities are based on the principle of progressive advancement. An analyst must be successful at simpler tasks before training on complex methods. Being successful means consistently performing an analysis with good results.

An analyst must demonstrate a thorough understanding of assigned bench methods before progressing to instrumentation, and must master the simpler instruments before advancing to complex instrument systems. Evaluation of progressive advancement includes verified experience at another laboratory. Other factors that affect cross-training assignments include the analyst's interest in learning the method, proven aptitude for the type of task, ability to meet the time requirements of the task, and the cross-training needs of the laboratory.

Note that the idea of progressive advancement does not require that every analyst take the same route of analytical experience. Quality of work is the most important factor in evaluating analytical success. Reliability and thoroughness indicate an ability to move on to other tasks. Solving analytical problems is an indication of understanding and mastery of an analysis. Taking the initiative to fix a problem, improve a procedure, or work on a new method demonstrates independent motivation to do higher level work.

20.3.4 General Training Protocol

Training for a specific analysis or laboratory protocol is the same for a new employee or an established analyst learning a new method (cross-training). However, for new analysts with little or no experience, Section 20.3.7 below provides an outline of basic training topics that must be covered before focusing on a particular analysis. During cross-training, it is important not to make assumptions about the trainee's abilities. While the trainee may be an experienced co-worker, they may not know the specific requirements of the new analysis. All the training steps should be followed for cross-training, including discussion of the specific safety precautions.

The following steps for training serve as a guideline. They are generally applicable for bench methods and for initial training phases of instrumental analyses. Emphasis is on hands-on experience for the trainee, but it is also important that the chemical basis of the analysis and the reason for each step in the procedure is explained. Depending on the method, more or less time may be spent on certain steps, extra practice may be required, or the training steps may be ordered differently.

● The trainee observes the trainer perform the procedure. The trainer should explain each step as it is done. Point out any special techniques that produce the best results, discuss the QC requirements for the method, and point out safety concerns throughout the procedure. The trainee should take written notes.

● The trainee reads the reference method, the laboratory SOP, and the SDS sheets for the reagents. The trainee should also have access to equipment/instrument manuals and other resources that explain the theory and applications of the method.

● Depending on the complexity of the analysis, the trainee may need to observe the procedure again, with further discussion of theory and equipment.

● The trainee performs the procedure on a known sample while the trainer observes. It is important that the trainer watch every detail of this first attempt, correct any errors or technique deficiencies, and answer questions as they come up.

● When the trainee feels comfortable with the method, they perform the procedure on one or more additional batches of practice samples, including method blanks and other standard QC samples. The trainer compares these practice results to the expected values. The cause of any poor results must be determined and corrected.

● When the trainee has independently performed the analysis on practice and QC samples with correct results, the formal demonstration of capability (DOC) can be done. The DOC requires analysis of 4 replicates of a known sample. The DOC sample is usually a laboratory control sample (blank spike) prepared by the trainer, with the true concentration unknown to the trainee. If a blank spike or other reference material is not available, a real sample that was previously analyzed by a qualified analyst may be used. The Production Coordinator and/or QA/QC Coordinator should be consulted in deciding when the trainee is ready to try the 4-replicate DOC.

● If the DOC results meet the method acceptance criteria for accuracy (%R) and precision (RPD), the training data and checklist are submitted to the QA/QC Coordinator. When the trainer, trainee, Production Coordinator, and QA/QC Coordinator are all confident that the trainee understands the analysis and can produce valid results, the trainee will be considered qualified to analyze real samples.

● If the DOC results do not meet the acceptance criteria, more practice samples must be analyzed, with the trainer closely evaluating the trainee's analytical technique. The trainee may not analyze and report results for real samples until proficiency has been demonstrated through a successful 4-replicate DOC.

● Even after the trainee is considered proficient in the procedure, the trainer or another qualified analyst should still be available to answer questions. Any difficult or unusual samples should be discussed with another qualified analyst or the Production Coordinator, until the trainee's experience is adequate to allow independent resolution of analytical problems.

- At some time during the training process, key method-related procedures must be explained and demonstrated. These include preparation and storage of reagents and standards, method-specific glassware cleaning procedures, instrument maintenance, etc., as applicable. The trainer should closely supervise the trainee during the initial performance of these procedures.

20.3.5 Training Considerations for Instrumental Methods

The general training steps used for bench methods -- observation, reading, practice, discussion, and a DOC -- are also applicable for instrumental analysis. Training for a complex instrumental analysis is partitioned into phases that include sample preparation, routine calibration and analysis, data interpretation, reporting, maintenance, troubleshooting, and handling non-routine samples and data. An analyst may become certified in sample preparation only. An analyst may be considered qualified to analyze routine samples if proficient in sample preparation, calibration and analysis, routine data interpretation, and reporting. For specialist-level certification, it is necessary to demonstrate skills in troubleshooting, instrument maintenance, non-routine analysis, and advanced data interpretation.

It may take several months before an analyst can independently generate results on a complex instrument system. A common approach to training for a complex analysis is for the trainee to first learn sample preparation. Then the trainer and trainee can work together on the instrument until the trainee understands all aspects of the analysis. The trainee should refer to the instrument manual, reference method, SOP, and other resources throughout the training process. It is important that the trainee fully understand the instrument and the data system, as well as the chemical/physical principles of both sample preparation and analysis. Close supervision during the training process is essential for the trainee to learn how to successfully analyze real samples. The trainer can use his/her judgment to determine when the trainee is ready to do certain steps such as instrument set-up, entering the sample queue, preparing standards, etc. The trainee may not process samples independently until proficiency has been demonstrated in sample preparation, calibration and analysis, and data interpretation.

20.3.6 Re-training and Recertification

In general, if an analyst has been trained to perform an analysis, but has not done so within the previous 12 months, the analyst must analyze 4 new acceptable DOCs before performing the analysis. See Section 20.3.4 for DOC requirements.

It is up to the discretion of the Manager, QA/QC Coordinator, and/or Laboratory Production Coordinator to determine if an analyst should analyze DOCs even if the time gap since the last analysis is less than 12 months. In addition, an analyst may be required to undergo complete retraining as outlined in Section 20.3.4.

If an analyst has been removed from participation in any analysis, the completion of successful DOCs will be required before the analyst is allowed to analyze actual samples. Complete retraining may also be required, at the discretion of the Manager or Coordinators.

20.3.7 Training for New Staff (Entry-Level Analysts)

A trainer must be aware of the educational background and experience of the trainee. A person with no lab experience will be lacking in some knowledge and technique skills that are fundamental to good analysis. These skills should be taught to the trainee, independent of a particular analytical method. That is, teach the trainee how to use laboratory equipment before teaching the analysis that requires the equipment. The trainer should ask a trainee, "Have you used this equipment before?" If no, then training and practice are necessary. If the answer is yes, the trainee should demonstrate correct usage to the trainer. The following types of laboratory equipment require specific training and time to develop skill in their use.

- Graduated glassware -- discuss the meniscus, how to estimate the final digit, TD vs. TC glassware

- Transfer techniques -- use of pipette bulbs, automatic pipettors, how to avoid contaminating reagents, quantitative transfer of samples

- Volumetric flasks -- how to fill to the meniscus, not to heat in oven or on hotplate, liquid should be at room temperature for final measurement

- Volumetric pipettes -- touching the tip to inside surface of container, reading the meniscus, care not to break tip, volumetrics are TD (do not blow out)

- Burettes -- removing air bubbles, managing the last drip on tip, the "quick-flip" to release minimal volume at endpoint, removing the stopcock to clean, pre-rinsing with titrant

- Filtering -- pre-wet filter paper in funnel, use of appropriate type of filter paper, how the vacuum works and how to release it

- Glassware -- fitting ground-glass joints, cleaning, never heat or scratch volumetrics

- Probes -- rinsing, appropriate storage conditions

- Top-loading balances -- how to use, taring to zero, cleanup, limits of sensitivity

- Analytical balance -- calibration checks, frequent zeroing, doors closed for weighing, the effects of fingerprints, absorbed moisture and drafts, sensitivity. Anyone using an analytical balance should have full knowledge of its functions and the care required to maintain its precision.

In addition to laboratory skills, a new technician must learn a number of concepts that are essential to the production of good laboratory data. Knowledge of the following procedures is required.

- Solutions -- normality vs. molarity, standardization, handling exothermic reactions

- Titrations -- use of indicators, determining the endpoint, $N_1V_1 = N_2V_2$

● Instrumentation -- all instrumental conditions must be maintained throughout an analytical batch, instrument warm-up/stabilization period, calibration checks

● Analytical documentation -- recording all data in permanent laboratory notebooks or appropriate log sheets, making written comments about unusual sample matrix or analytical response, filing of instrument and computer print-outs as permanent records, use of specific units for final reporting, documenting preparation of reagents and standards

● Use of standard methodology -- SOPs based on published analytical methods must be used whenever possible, methods must be referenced with the data

● Chain-of-custody -- understanding of the sample chain-of-custody procedures and the purpose of limited access to the laboratory / sample handling area

● Units -- metric units, conversions, equivalencies (μg/mL = mg/L, mg/Kg = ppm, etc.), fundamental relationships for water (1L = 1Kg, 1g = 1mL)

● Calculations -- use of calculation formulas, canceling out units to final reporting units, dilution factors, QC calculations (%R, RPD, etc.)

● Significant figures -- standard rules for determining significant figures and rounding-off, number of significant figures to report for specific analyses

● Standard curves and linearity -- standard curve coefficients of linearity, expected linear ranges for specific analyses, determining required dilutions

● Consistency -- the importance of a consistent analytical procedure and technique to ensure valid and reproducible results

● QA/QC measures -- system calibration, analysis of calibration checks, control samples, blanks, duplicates, and spikes to support the validity of sample results

● Sample preservation -- use of the proper sample bottle with correct preservation for a specific analysis, performing analysis within method-prescribed holding time

● Aliquots -- must attain a representative sample, shake liquids before each aliquot is taken, mix solids well

● Reagents and standards -- the importance of fresh reagents and standards, documentation of reagents and standards preparation, use of proper bottles and storage, periodic re-standardization of acids and bases, use of second-source QC checks to verify working standards

The following safety topics must be reviewed:

● Habitual use of routine safety equipment such as safety glasses, gloves, and fume hoods; understanding conditions which require additional protection such as goggles, rubber apron, etc.

- Knowledge of the locations of emergency equipment, including eyewash station, fire blanket, emergency showers, spill kits

- Knowledge of all lab safety rules

- Knowledge of emergency escape routes and thorough familiarity with the building Fire and Life Safety Plan

- Thorough familiarity with the Chemical Hygiene Plan, SDS sheets, spill response for lab chemicals, waste disposal

Section 21

ACCOMMODATIONS AND ENVIRONMENTAL CONDITIONS
(TNI V1:M2 – Section 5.3)

21.1 Environmental

The Water Pollution Control Laboratory (WPCL) was commissioned in 1997 and was designed specifically for the testing of environmental samples. The entire building is known as the Water Pollution Control Laboratory even though the laboratory itself comprises about half the total square footage. The laboratory is serviced by a dedicated heating/ventilating/air conditioning (HVAC) system working in consort with a centralized exhaust unit such that conditioned air is supplied to the laboratory at a slightly greater rate than that removed by the exhaust unit. The triple-filtered supply air is nominally set at 68 °F with a stability target of $\pm$ 2 °F across the lab. The laboratory itself is kept at negative pressure in relation to the rest of the facility, with a ΔP target of -0.05 inches of water. Large-face thermometers are placed throughout the lab. The differential pressure between the laboratory and the rest of the building is continuously monitored via a magnahelic gauge on the south wall of Process Control Room 135. Any problems with lab temperature or HVAC are reported to the Lab Manager and subsequently to general services/facilities personnel.

Back up power is provided by a diesel powered generator with an amperage capacity to run the entire facility. Full current is available within two seconds of power loss to the building. Emergency and safety lighting, the facility security system, the exhaust system, and most instruments are on the emergency power tie-in. Because the instrument computers will shut down within this short time period, most major instruments (ICP, ICP/MS, GC, GC/MS, etc.) are connected to a central uninterruptable power supply (UPS) capable of running both the instruments and any ancillary equipment (turbo vacuum pumps, chillers, etc.) for a long enough time period to complete a controlled shut down of the instrument system. The UPS is also equipped with a power conditioning transformer.

The HVAC and hood systems are monitored during the annual sash hood survey per the Fume Hood Monitoring SOP.

The laboratory has a named Chemical Hygiene Officer and operates under a Chemical Hygiene Plan (CHP) written following the model plan published by the American Chemical Society. A copy of the CHP is kept on the Group 100 common drive at

GROUP 100 (\\BESFILE1) S:/LAB/CHP DOCUMENTS/CHP.

21.2 Work Areas

Work areas may include access and entryways to the laboratory, sample receipt area, sample storage area, sample process area, instrumental analysis area, chemical and waste storage area and data handling and storage area.

Access to, and use of, areas affecting the quality of the environmental tests is controlled by restriction of areas to authorized personnel only. See Section 21.4, below.

The laboratory work spaces are adequate for their use, and appropriately clean to support environmental testing and ensure an unencumbered work area. A summary of the work parameters for the laboratory are provided in Table 21-1.

Table 21-1. Laboratory Workspace & Physical Plant

ROOM	FUNCTION	BENCH SPACE (LINEAR FEET)	HOODS SASH	HOODS CANOPY	SINKS	REFRIGERATORS
134	Nutrients	85	2	1	3	4
135	Process I	85	2	2	4	2
136	Organics I	107	2	0	3	3
138	Metals	79	3	0	3	2
139	Metals/Organics①	0	0	0	0	1
140	Organics II	69	2	2	2	4
141	Microbiology②	68	0	2	3	3
142	Gen Chem I③	77	1	1	3	3
143	Gen Chem II	100	3	0	3	2
153	Utililty	0	0	0	0	3
155	Sample Receiving	55	1	2	1	1
156	Utililty	48	0	0	2	0
---	Lab Corridor	30	0	0	0	0
	TOTALS	803	16	10	27	28

① this area also has an 8-ft, all plastic, laminar flow sash hood & a mobile ductless fume hood
② this area also has a 6-ft laminar flow sash hood
③ this area also has a dual snorkel vent system

The laboratory is an open module design in which each type of analysis (organics, metals, nutrients, etc.) is done in its own room. The rooms are open to a common hallway down the center of the lab. Laboratory space is arranged to minimize cross-contamination between incompatible areas of the laboratory. For example, the volatiles GC/MS is situated in the NW corner of Room 139, well away from the two rooms (136 & 140) in which organics extractions may occur. The laboratory is included in the duties of the contracted building janitorial services. These duties are limited to daily floor sweeping, emptying the regular trash and recycling containers, and removing any large cardboard flats.

21.3 Floor Plan

A floor plan of the laboratory is provided in Appendix C.

21.4 Building Security

The building and the laboratory section are locked 24/7, and access is via a card lock system. The laboratory portion of the building is separately card locked, and only laboratory staff and personnel whose duties require entering the laboratory have access cards. The door card lock system is tied into a general alarm package that includes fire and intrusions alarms throughout the facility. All alarms are local (sight and sound) and by automatic telephony to a local security company that dispatches either a private security patrol (door or intrusion alert) or first responders (fire or medical). Laboratory security is summarized in Policy Statement #20 – Lab Access. Security system problems are brought to the attention of the WPCL designated Facility Manager.

A visitor's log is maintained on the counter of the main reception area for every visitor to sign in and out. Persons requesting lab access MUST identify themselves and MUST be approved for admittance and then escorted into the lab by someone pre-authorized for lab entry. Examples include instrument repair engineers, supply vendors, and vendors on site in conjunction with general services/facilities building projects (electricians, HVAC engineers, etc.). If access is granted by a non-lab person, a member of the lab staff MUST be notified upon entry. The lab staff person will then serve as escort within the laboratory proper.

Signs are used to designate secure areas.

Section 22

ENVIRONMENTAL METHODS AND METHOD VALIDATION
(TNI V1:M2 – Section 5.4 and Sections 1.4, 1.5 and 1.6 of Technical Modules TNI V1:M 3-7)

Methods and/or procedures are available for all activities associated with sample analysis including preparation and testing. For purposes of this Section, "method" refers to both the sample preparation and determinative methods. Analytical methods performed at WPCL are listed in Appendix K.

Before being put into use, a test method is confirmed by a demonstration of capability or method validation process.

All methods are published or documented. Deviations from the methods are allowed only if the deviation is documented, technically justified, authorized by management and accepted by the customer.

22.1 Method Selection

A reference method is a method issued by an organization generally recognized as competent to do so. When the laboratory is required to analyze a parameter by a specified method due to a regulatory requirement, the parameter/method combination is recognized as a reference method. At WPCL, the source of most reference methods is either the U.S. EPA or *Standard Methods for the Examination of Water and Wastewater*.

The laboratory uses methods that meet the needs of the customer. Such methods are based on the latest revision of the method, within 1 year of approval, unless it does not meet the needs of the customer. For example, a client's NPDES permit may specify an older method version.

The laboratory selects methods that are appropriate to the customer needs. When the regulatory authority mandates or promulgates methods for a specific purpose, only those methods will be used.

If a method proposed by a customer is considered to be inappropriate or out-of-date, the customer is informed and the issue is resolved before proceeding with analysis of any samples. (See Section 7, *Review of Requests, Tenders and Contracts*.) The MCA project manager has direct contact with the customer to explain method requirements and resolve discrepancies and concerns.

If a method is not specified by the customer, an appropriate method will be selected based on regulatory requirement. For NPDES permit work, the method will be selected from those specified in 40 CFR Part 136. When methods are specified in a Sampling and Analysis Plan (SAP) and/or Quality Assurance Project Plan (QAPP) approved by Oregon DEQ and/or U.S. EPA

prior, the project-specified methods are used. For environmental clean-up projects, methods from EPA SW 846, or listed in 40 CFR Part 136, and/or state-approved hydrocarbon methods are used.

If the end use of the data is not regulatory and the customer does not specify a method, the laboratory will determine the customer needs in terms of reporting level, requirements for precision and specificity (screening vs. quantitative), need for batch/matrix QC, and laboratory capabilities. The laboratory will use a standard method which has been validated for use at WPCL, if one is available. If a non-standard screening procedure is used, it will be clearly stated in a case narrative included on the analysis report.

22.2 Laboratory-Developed Methods

WPCL does not create new methods but may modify standard chemistry methods for improved performance. If the method will be used to analyze samples under regulatory requirements and the standard method is significantly modified, the laboratory applies to U.S. EPA for Alternative Test Procedure (ATP) approval.

If the laboratory significantly modifies a method, the process is planned and documented. All personnel involved in the process are in communication during all stages of development. The U.S. EPA ATP protocols for method validation are followed. Depending on the ATP approval requested, the laboratory Manager, Technical Manager, and/or QA Coordinator assemble and submit the ATP application. The laboratory Manager and QA Coordinator are responsible for internal approval.

22.3 Method Validation

Validation is the confirmation, by examination and objective evidence, that the particular requirements for a specific intended use are fulfilled.

At a minimum, reference methods are validated by performing an initial demonstration of capability. This may be sufficient for simple methods or where the analyst has performed the analysis previously using the same or similar reference method. When an unfamiliar method is to be implemented, additional validation procedures are employed. Likewise, when a standard method is modified within the scope of acceptable modifications (ATP not required), validation procedures are used to ensure that sample results will be at least as accurate and precise as those produced by the pre-modified method.

Method validation is designed so that the laboratory can demonstrate that the method is appropriate for its intended use. All records (e.g., planning, method procedure, raw data and data analysis) shall be retained while the method is in use. To document completion of acceptable method validation procedures for a new method, the QA Coordinator prepares a memorandum to state the intended use of the method and assert that validation requirements have been met.

22.4 Estimation of Analytical Uncertainty

Analytical Uncertainty: A subset of Measurement Uncertainty that includes all laboratory activities performed as part of the analysis.

For each test measurement, uncertainly is characterized by the bias and precision targets as stated in the method and as determined by the analysis of appropriate QC check samples.

22.5 Control of Data

To ensure that data are protected from inadvertent changes or unintentional destruction, the laboratory uses procedures to check calculations and data transfers (both manual and automated).

22.5.1 Computer and Electronic Data Requirements

The laboratory assures that computers, user-developed computer software, automated equipment, or microprocessors used for the acquisition, processing, recording, reporting, storage, or retrieval of environmental test data are:

- documented in sufficient detail and validated as being adequate for use;
- protected for integrity of data entry or collection, data storage, data transmission and data processing;
- maintained to ensure proper functioning and are provided with the environmental and operating conditions necessary to maintain the integrity of environmental test data; and
- held secure including the prevention of unauthorized access to, and the unauthorized amendment of, computer records. Data archive security is addressed in Section 16, *Control of Records*, and building security is addressed in Section 21, *Accommodations and Environmental Conditions*.

The LIMS (Element DataSystem®) is a purchased program from a reputable vendor (Promium, LLC). The LIMS system includes a data transfer tool (DataTool) to transfer data from laboratory instruments into the LIMS. These programs were pre-validated by the vendor. When a LIMS software revision is to be implemented, basic funtions are checked by assigned IT and laboratory staff prior to laboratory-wide use of the new software version.

The laboratory controls access to the LIMS and all programs that are used to acquire, process, record or report data. An employee is granted access depending on assigned responsibilities and job description.

Instrumental data can be accessed at the instrument or instrument user's business network desktop computer, which requires unique password-protected log-in for qualified analysts.

Each staff member has a unique identification and password for the LIMS. In the LIMS, analytical staff may modify data and change analysis status only for methods

for which they are certified as analysts. The Lab Manager and Coordinators have privileges for final QA review for all methods. This includes the ability to modify results and analysis information, and add qualifiers. Programmers are IT professionals and have full access to the LIMS.

Changes to entries in the LIMS are allowed only for technically valid reasons. The LIMS audit trail function tracks changes that are made after the analyst has finalized and locked the data, i.e., changes made by a reviewer or by the analyst after initially locking the data. An internal comment (Q flag) may be added to explain changed data, or a comment may be added to the automatic audit trail entry. A data reviewer should change results only with approval of the analyst or another reviewer. If an obvious correction is needed, or if the analyst is not available, a change may be made without approval.

The LIMS has a system for tracking analysis status, which allows users to know whether results are in process or final. The general status progression is "Received", "Batched", "Analyzed", "Peer Reviewed", "QA Reviewed". Results that are not yet locked by the analyst and updated to "Analyzed" status are not considered reportable even as preliminary data. After set at "Analyzed," the data undergoes peer review by another analyst or a laboratory coordinator. This is a full review of the data, as described in Section 27.4, *Data Review*. If an analyst has performed the peer review, the laboratory coordinator need only perform the final QA review.

All analytical results in the LIMS are eventually updated to status "QA Reviewed", indicating that the results are final. This status designation electronically locks the data, minimizing the chance of inadvertent changes to the data. If corrections are needed, a coordinator may make the corrections or may change the status back to "Analyzed," allowing an analyst to make corrections. After the corrections are reviewed, the status is re-set to "QA Reviewed" by a laboratory coordinator. The LIMS audit trail function tracks data changes and status changes.

In cases in which the laboratory uses spreadsheets external to the LIMS to calculate final results from the raw data, results are manually entered into the LIMS. Before reporting any results derived from these programs, the laboratory validates the underlying calculations by comparing results of the spreadsheet with manually calculated results. Because all analytical results are reviewed for accuracy, the spreadsheet calculations are routinely verified in the data review process. (See Section 27.4, *Data Review*.) If changes are made to a spreadsheet program, the changes are validated immediately by comparison with manual calculations. Lab-created spreadsheets have locked calculation cells to guard against inadvertent changes.

Electronic data back-up is discussed in Section 16, *Control of Records*.

22.5.2 Data Reduction

The laboratory has manual integration procedures that must be followed when integrating chromatographic peaks during data reduction. Refer to SOP QA/QC-10 Manual Integration Guideline.

The analyst calculates final results from raw data, or appropriate computer programs provide the results in a reportable format. In most cases the LIMS calculates final results from data that are imported or manually entered into the system. The test methods provide required concentration units, calculation formulas and any other information required to obtain final analytical results, and these factors are programmed into the LIMS.

Analytical results are rounded to a specified number of significant figures for reporting. The number of significant figures reported depends on the analysis and on the precision of measurements that contribute to the final value. Laboratory policies for rounding and reporting significant figures are described in Appendix J.

All raw data is retained in printed hardcopies of instrument output, printed LIMS bench sheets, and/or laboratory notebooks. Instrument raw data is also retained electronically where applicable. Data records are maintained as described in Section 16, *Control of Records*.

22.5.3 Data Review Procedures

All analytical results are subject to multi-level data review procedures. Data review procedures are described in Section 27.4, *Data Review*.

Section 23

CALIBRATION REQUIREMENTS
(TNI V1:M2 – Sect 5.5 and Section 1.7 of Technical Modules TNI V1:M 3-7)

23.1 General Equipment Requirements

The laboratory provides all the necessary equipment required for the correct performance of the scope of environmental testing performed by the laboratory.

All equipment and software used for testing and sampling are capable of achieving the accuracy required for complying with the specifications of the environmental test methods as specified in the laboratory SOPs.

Equipment is operated only by authorized and trained personnel. (See Section 20, *Personnel.)*

The laboratory has procedures for the use, maintenance, handling and storage of equipment and they are readily available to laboratory personnel. Manuals provided by the manufacturer of the equipment provide information on use, maintenance, handling, and storage of the equipment.

The laboratory maintains an equipment list that include information on equipment location. (See Appendix H, Tables H-1 and H-2). Planned maintenance and calibration procedures for support equipment ensure proper functioning of the equipment and prevent contamination or deterioration. SOPs on the use of support equipment include maintenance and calibration procedures. Analytical instruments are maintained according to manufacturer and vendor recommendations. Routine maintenance activities for instruments are listed in Tables H-3a through H-3f of Appendix H. The method SOPs contain specific requirements and protocols for calibration of analytical instruments.

All equipment is calibrated or verified before being placed in use to ensure that it meets laboratory specifications and relevant standard specifications. New equipment is installed according to manufacturer instructions. Complex analytical instrumentation is installed by the vendor.

Support equipment such as refrigerators, ovens, incubators and balances are monitored each day of use. Daily readings for monitored parameters are documented on worksheet forms, which are retained as laboratory records.

All equipment, including hardware and software, are safeguarded from adjustments that would invalidate the test result measurements by limiting access to the equipment and using password protection where possible. (See Section 22.5, *Control of Data*.) In general, laboratory equipment is protected from inappropriate handling by limiting access to the locked laboratory and through training protocols that include demonstration and discussion of correct equipment usage.

Equipment that has been subject to overloading, mishandling, given suspect results, or shown to be defective or outside specifications is taken out of service. The equipment is isolated to prevent its use or clearly labeled as being out of service until it has been shown to function properly. If it is shown that previous tests are affected, then procedures for nonconforming work are followed and results are documented. (See Section 12, *Control of Nonconforming Environmental Testing Work* and Section 14, *Corrective Action*.)

The laboratory does not use equipment that is not in the permanent control of the laboratory.

Each item of equipment and software used for testing and significant to the results is uniquely identified. Records of equipment and software are maintained. This information includes the following:

a) identity of the equipment and its software;

b) manufacturer's name, type identification, serial number or other unique identifier;

c) checks that equipment complies with specifications of applicable tests;

d) current location;

e) manufacturer's instructions, if available, or a reference to their location;

f) dates, results and copies of reports and certificates of all calibrations, adjustments, and acceptance criteria;

g) maintenance plan where appropriate, and maintenance carried out to date; documentation on all routine and non-routine maintenance activities and reference material verifications;

h) any damage, malfunction, modification or repair to the equipment;

i) date received, if available.

23.2 Support Equipment

Support equipment includes, but is not limited to: fume hoods, balances, ovens, refrigerators, freezers, incubators, water baths, autoclaves, temperature measuring devices, volumetric dispensing devices, centrifuges, blenders, shakers, rotary extractors, ultrasonic disruptors, hot block digesters, and microwave digesters.

All support equipment is maintained in proper working order. Records are kept for all repair and maintenance activities, including service calls.

Records are retained to document equipment performance. These records include maintenance logbooks, calibration logbooks, and/or copies of vendor service records. In some cases, dated stickers are applied to the equipment to verify annual or other periodic maintenance.

23.2.1 Support Equipment Maintenance

Regular maintenance/calibration of calibrated support equipment, such as balances and spectrophotometers, is conducted at least annually. The HEPA fume hood filters are replaced as needed, based on flow. Rotary extractors, shakers, and centrifuges are cleaned and oiled as needed. Maintenance for temperature-monitored equipment, such as ovens and refrigerators, is conducted if daily checks indicate a problem.

A building mechanic is responsible for maintaining and servicing instrument power backup batteries and laboratory refrigerators, and may repair or oversee repair of other mechanical functions such as the fume hoods or ovens. The uninterruptable power supply (UPS) batteries are replaced every four years, based on the manufacturer's estimated five-year lifetime.

Records of maintenance to support equipment are documented in maintenance logs, or copies of vendor maintenance records are kept in binders. Each piece of support equipment does not necessarily have its own logbook but must be documented. Maintenance logbooks may be shared with equipment that is housed in the same laboratory area. For some basic maintenance, a dated sticker is applied to the equipment to verify annual or other periodic maintenance.

For all microbiology equipment, detailed procedures for maintenance, calibration and documentation are found in the SOP called QA/QC for Microbiology.

23.2.2 Support Equipment Calibration

Support equipment calibration, verification, and acceptance criteria are described in SOPs for each type of equipment.

Balances, weights, and reference thermometers are calibrated annually by an A2LA-accredited calibration service provider. The equipment is calibrated over the entire range of use using NIST traceable references. Microwave digesters are serviced and calibrated annually by the vendor. Fume hoods are checked for flow. Rotary extractors that require method-specified rotation frequency are checked annually.

If the results of the calibration of support equipment are not within specifications, the equipment is removed from service until repaired, or a correction factor is applied. If correction factors are used this information is clearly marked on or near the equipment. Calibration procedures and results are documented on vendor calibration reports and/or in laboratory maintenance logbooks. The vendor also affixes a sticker to the equipment indicating the calibration date.

Balances, ovens, refrigerators, freezers, incubators, and water baths are verified with a NIST traceable reference each day prior to use, to ensure operation is within the expected range for the application for which the equipment is to be used. The daily readings are written on log sheets that are posted on or near the equipment.

Volumetric dispensing devices (except Class A glassware and glass microliter syringes) are checked for accuracy on a quarterly basis or if measurement

accuracy is in question. These checks are documented in a logbook. Automatic pipets are sent to the vendor for repair and calibration as needed.

For all microbiology equipment, detailed procedures for calibration and maintenance are found in the SOP named QA/QC for Microbiology.

23.3 Analytical Equipment

23.3.1 Maintenance for Analytical Equipment

All analytical equipment is properly maintained, inspected, and cleaned. All vendor supplied and in-house (routine) maintenance is detailed in the tables in Appendix H.

Maintenance of analytical instruments and other equipment may include regularly scheduled preventive maintenance or maintenance on an as-needed basis. Records of maintenance to analytical instruments are documented in instrument maintenance logs, or copies of vendor maintenance records are kept in binders. Instrument malfunction is documented and becomes part of the laboratory's permanent records. A description of what was done to repair the malfunction and proof of return to control are also documented in the log.

23.3.2 Instrument Calibration

Information on instrument calibration can be found in method SOPs. Initial instrument calibration and continuing instrument calibration verification are an important part of ensuring data of known and documented quality. Generally, procedures and criteria regarding instrument calibrations are specified in the reference methods or associated guidelines (e.g., EPA SW846 chapters and general methods). Specific concentrations may be modified but the calibration procedures used are at least as stringent and specific as those listed in reference methods. Prior to use, new analytical equipment is calibrated during method validation procedures, and ongoing calibration is verified according to method SOPs. Analytical calibration documentation is filed with other analytical data.

Section 24

MEASUREMENT TRACEABILITY
(TNI V1:M2 – Section 5.6)

Measurement quality assurance comes in part from traceability of standards, reference materials and reagents to certified materials.

Note: The term "reference standard" refers to a physical entity used as a measurement reference, such as a reference weight or thermometer. The term "reference material" refers to a chemical reference solution (analytical standard) or microbiological culture.

The laboratory has procedures for purchase, receipt and storage of standards, reference materials and reagents. Purchase procedures are described in Section 9, *Purchasing Services and Supplies*.

All equipment affecting the quality of test results are calibrated using reference standards or materials prior to being put into service and on a continuing basis. (See Section 23, *Calibration Requirements* and method SOPs.) These calibrations are traceable to national standards of measurement where available.

If traceability of measurements to SI units is not possible or not relevant, evidence for correlation of results through interlaboratory comparisons, proficiency testing, or independent analysis is provided.

24.1 Reference Standards

Reference standards are standards of the highest quality available at a given location, from which measurements are derived.

Reference Standards, such as ASTM Class 1 weights, are used for calibration only and for no other purpose. The WPCL does not have these reference standards.

Reference standards are calibrated by an entity that can provide traceability to national or international standards. The following reference standards are sent out to be calibrated to a national standard as indicated in Section 23, *Calibration Requirements*:

- Class 1 and Class S weights
- NIST traceable reference thermometers

Additional working standards such as internal thermometers are checked using the protocol and frequency listed in the relevant SOP (e.g., Thermometer Calibration).

24.2 Reference Materials

Reference materials are substances that have concentrations that are sufficiently well established, both qualitatively and quantitatively, to use for calibration or as a frame of reference.

Reference materials, where commercially available, are traceable to national standards of measurement, or to Certified Reference Materials, usually by a Certificate of Analysis.

Purchased reference materials require a Certificate of Analysis where available. If a reference material cannot be purchased with a Certificate of Analysis, it is verified by analysis and comparison to a certified reference material and/or demonstration of capability for characterization.

Internally prepared reference materials, such as working analytical standards or intermediate stock solutions, are checked as far as is technically and economically practical. Working analytical standards are checked against a second source at first time of use. When a second source is not available, a vendor-certified different lot is accepted as a second source. In general, the analysis of an Initial Calibration Verification (ICV) standard is used as a second source confirmation for reference materials.

Working standards and intermediate stock solutions are given expiration dates when they are prepared based on method or regulatory requirements. These standards are generally either used up or disposed of by the expiration date. Expiration dates can be extended if the reference standard or material's integrity is verified. The extended date may not be beyond the expiration date of the reference standards used to re-verify. If the standard meets CCV recovery criteria and the ICV (second source) recovery is also acceptable, the standard is considered re-verified. If standard concentration validation is part of the analytical procedure, the standard may be used past the expiration date as long as the validation is performed as required (for example, cyanide analysis).

Preparation, storage and expiration of intermediate and working solutions are discussed in the method SOPs.

24.3 Reagents

In methods where the purity of reagents is not specified, American Chemical Society (ACS) reagent grade is used. If the purity is specified, that is the minimum acceptable grade. Purity is verified and documented according to Section 9, *Purchasing Services and Supplies*. Purchased reagents are inspected upon receipt to verify acceptable quality. The label and packing list are checked to insure the correct product/grade was received, and the container is checked for damage.

Reagents are verified to meet the requirements of the test method at the time of initial use. If the analytical standards respond typically and the method blank and LCS results are acceptable, then the new reagent is assumed acceptable.

24.4 Transport and Storage of Reference Standards and Materials

The laboratory handles, stores and transports reference standards, reference materials and reagents in a manner that protects their integrity. Their integrity is protected by separation from incompatible materials and/or minimizing exposure to degrading environments or materials.

Reference standards are stored in appropriate containers and according to manufacturer's recommendations. Reference standards are handled with care when in use, to avoid physical jarring, scratching or other potential damage. If the integrity of a reference standard is potentially impaired, it is tested to determine whether reliability and accuracy have been affected.

Reference materials and reagents are stored according to manufacturer's recommendations and method SOP requirements. Reference materials and prepared dilutions used in trace analytical methods are stored separately from samples. This includes metals, organics, and nutrients standards.

24.5 Labeling of Reference Materials and Reagents

24.5.1 Purchased Reference Materials, Reagents and Media

Records for all reference materials, reagents and media include:

- the manufacturer/vendor name (or traceability to purchased stocks or neat compounds)
- the manufacturer's Certificate of Analysis or purity (if supplied)
- the date of receipt
- recommended storage conditions

Purchased reference materials, reagents and media are logged into the LIMS. The LIMS assigns and stores a unique identification number and labels are printed for each container. The labels contain the unique ID number, product name, expiration date, and preparer's name (vendor name, for purchased stock). A hardcopy record can be printed from the LIMS for each standard, reagent, or media logged in.

If the original container does not have an expiration date provided by the manufacturer or vendor it is not required to be labeled with an expiration date. If an expiration date is provided, it must be labeled with the expiration date, and the expiration date is entered in the LIMS.

Due to LIMS limitations, an expiration date must be entered for every standard, reagent, or media logged into the system. If no expiration date is available, choose the date farthest into the future that the system will allow. Also, the LIMS considers a material expired at time 00:00 on the expiration date given. However, it is allowable to use the material on the expiration date, though the LIMS may indicate that the material is expired.

24.5.2 Prepared Analytical Standards, Reagents and Media

Records for analytical standards, reagents and media preparation include:

- traceability to purchased stock or neat compounds
- preparation weights/volumes or reference to the method of preparation
- date of preparation
- an expiration date after which the material shall not be used (unless its reliability is verified by the laboratory)
- preparer's name or initials (if prepared)

Prepared analytical standards, reagents and media are logged into the LIMS. The information listed above is entered into the LIMS, including the ID number of the stock standard (reference material). The LIMS assigns a unique identification number and labels are printed for each container. The labels contain the unique ID number, product name, expiration date, and preparer's name. A hardcopy record can be printed from the LIMS for each prepared standard, reagent, or media.

Section 25

COLLECTION OF SAMPLES
(TNI V1:M2 – Section 5.7)

WPCL provides limited sampling services for one customer, discussed below. Otherwise, the laboratory's responsibility in the sample collection process lies in supplying samplers with the necessary coolers, reagent water, sample containers, preservatives, sample labels, custody seals, chain of custody (COC) forms, ice, and packing materials required to properly preserve, pack, and ship samples to the laboratory. The Field Operations (FO) section organizes sampling supplies for their sampling events. MCA prepares project COC forms and works with the lab to provide customers with necessary sample containers, coolers, and other supplies.

WPCL collects samples from the Columbia Boulevard Wastewater Treatment Plant (CBWTP) using procedures detailed in WPCL SOP QAQC-02.

25.1 Sampling Containers

The laboratory offers clean sampling containers for use by clients. For trace-level water sample and soils, appropriately certified clean containers are purchased for one-time use.

25.1.1 Preparing Container Orders

Containers (containing any required preservatives) are provided to the client upon request. See WPCL SOP QAQC-01.

25.1.2 Sampling Containers, Preservation Requirements, Holding Times

Sampling container, preservation and holding time requirements are provided in Appendix L.

If preservation or holding time requirements are not met, the procedures in Section 12, *Control of Nonconforming Environmental Testing Work* are followed.

25.2 Sampling Plan

The laboratory personnel are not responsible for collecting samples or providing sampling plans except as noted for CBWTP. Sampling plans are the responsibility of work groups outside the laboratory's purview.

25.3 Sampling Records

The following relevant sampling data are recorded on the COC: the date and time of sampling, the identification of the sampler, the sampling location, analyses requested, and any special considerations regarding the analyses.

Section 26

HANDLING SAMPLES AND TEST ITEMS
(TNI V1:M2 – Section 5.8 and Section 1.7 of Technical Modules TNI V1:M 3-7)

26.1 Sample Receipt

When samples are received at the laboratory, chain-of-custody is reviewed, condition is documented, and the samples are given unique identifiers, logged into the laboratory information management system (LIMS), and processed as required for the analyses requested.

26.1.1 Chain of Custody

The chain of custody (COC) from the field are reviewed. This documentation is completed in the field and provides a written record of the handling of the samples from the time of collection until they are received at the laboratory. Section 25, *Collection of Samples* and SOP QAQC-01 outline what information is needed on this record. The COC also provides information on what type of testing is being requested and can act as an order for laboratory services in the absence of a formal contract. An example COC is provided in Figure 26-1. Chain of custody and any additional records received at the time of sample submission are retained by the laboratory as hard copies filed with final data reports or in COC files maintained in a secure storage area. All COCs are scanned and entered into the LIMS.

26.1.1.1 Legal Chain of Custody

The WPCL does not accept samples identified for legal/evidentiary purposes.

26.2 Sample Acceptance

Procedures for opening shipping containers and examining samples are provided in SOP QAQC-01. Procedures for sample receiving during off hours or when the Sample Custodian is absent are provided in Policy Statements #10, *Late Arriving Samples*, #13, *Indirectly Relinquished Samples*, and #34, *Emergency Sample Receiving Instructions*. A responsibility flow-down list is provided in Policy Statement #11, *Sample Receiving*.

The laboratory sample acceptance policy is detailed in Section 8.1 of SOP QAQC-01. A checklist is used to check samples for the conditions detailed in the SOP. An example is provided in Figure 26-2. This checklist may vary depending on the type of samples received. In addition the laboratory has nonconformance/corrective action procedures to handle samples that don't meet the requirements or show signs of damage, contamination, or inadequate preservation. Guidelines are provided in Policy Statement #4, *Compromised Samples* and #40 *Microbiology Sample Bottle Acceptance*. Data are appropriately qualified when samples are reported that do not meet sample acceptance requirements.

If these requirements are not met, the client is contacted prior to any further processing, then 1) the sample is rejected as agreed with the client, 2) the decision to proceed is documented and agreed upon with the client, 3) the condition is noted on the Chain of Custody form and/or lab receipt documents, and 4) the data are qualified in the report.

26.2.1 Preservation Checks

The following preservation checks are performed and documented upon receipt:

26.2.1.1 *Thermal preservation:*

a) For temperature preservation, the acceptable range is from just above freezing to 6 °C.

b) Samples that are delivered to the lab the same day as they are collected are likely not to have reached a fully chilled temperature. This is acceptable if the samples were received on ice and the chilling process has begun.

c) Record on the receipt form if ice is present and the temperature.

d) Samples are not rejected based on temperature.

26.2.1.2 The pH of samples requiring acid/base preservation is checked upon sample receipt or upon initiation of analysis.

26.3 Sample Identification

Samples, including subsamples, extracts and digestates, are uniquely identified by the LIMS in a permanent chronological order to prevent mix-up and to document receipt of all sample containers.

Samples are assigned sequential numbers that reference more detailed information kept in the LIMS.

The following information is included in the LIMS:

- Client and project name
- Date and time of receipt at lab
- Unique laboratory identification number
- Signature or initials of person making the entries

In addition, the following information is maintained and linked to the log-in record:

- Date and time of sampling linked to the date and time of laboratory receipt.
- Unique field identification number linked to the laboratory sample ID
- Sample type/matrix
- Analyses requested (including applicable approved method numbers) linked to the laboratory sample ID.
- Comments regarding rejection (if any).

All documentation received regarding the sample, such as memos or chain of custody, are retained in project folders and electronically in the LIMS.

26.4 Sample Aliquots / Subsampling

In order for analysis results to be representative of the sample collected in the field, the laboratory has subsampling procedures. Procedures are detailed in Section 8.5, *Sample Compositing and Subsampling*, in SOP QAQC-01.

26.5 Sample Storage

Samples that require thermal preservation are stored under refrigeration. For samples with a specified storage temperature of 4 °C, storage at a temperature just above freezing to 6 °C is acceptable. Refer to SOPs QAQC-08 and QAQC-09.

Samples are held secure, as required. Samples are accessible only to laboratory personnel.

Samples are stored apart from standards, reagents, food or potentially contaminating sources, and such that cross-contamination is minimized. All portions of samples, including extracts, digestates, leachates, or any product of the sample are maintained according to the required conditions.

26.6 Sample Disposal

Samples are retained for various times depending upon the matrix and analysis. For example, all soil samples and water samples analyzed only for metals are stored for three months after the report is sent out, unless other arrangements have been made with the client.

Samples are disposed of according to federal, state and local regulations. Procedures for the disposal of samples, digestates, leachates, and extracts are described in SOP QAQC-14, *Waste and Sample Disposal*.

26.7 Sample Transport

Samples that are transported under the responsibility of the laboratory, where necessary, are done so safely and according to storage conditions. This includes moving bottles within the laboratory. Specific safety operations are addressed outside of this document.

The WPCL does not handle shipping samples except under special request or for special projects. MCA generally handles these shipping details. Samples for outside analyses are picked up daily or on an as-needed basis by the contract laboratory, whose personnel pack the samples and transport them back to their premises.

Rarely, lab personnel may need to transport samples to a contract lab. If so, the samples are packed in coolers with cooling material (freezer packs or ice) for transport.

Figure 26-1

Example Chain-of-Custody

Date: _____

Water Pollution Control Laboratory
6543 N. Burlington Ave.
Portland, Oregon 97203-4552
Sample Custodian: (503) 823-5696
General Lab: (503) 823-5681

City of Portland
Chain-of-Custody
Bureau of Environmental Services

Work Order #: _____
Collected By: _____

Client Name: _____ Project Number (if applicable): _____
Project Name: _____ Project Contact: _____

Requested Analyses

Special Instructions:

Turn-Around-Time Request:
- ☐ Standard (10 business days)
- ☐ Rush (5 business days)
- ☐ Other: _____

Lab Number	Location ID	Sample Date	Sample Time	Grab or Comp	Sample Matrix		# of Containers	Remarks
01								
02								
03								
04								
05								
06								
07								
08								
09								
10								

Relinquished By:	Received By:	Relinquished By:	Received By:
Signature: Date:	Signature: Date:	Signature: Date:	Signature: Date:
Printed Name: Time:	Printed Name: Time:	Printed Name: Time:	Printed Name: Time:

Blank Element COC.xls

Page _____ of _____

Figure 26-2

WPCL Cooler Receipt Form

Work Order Number: _____ **Cooler Receipt Form Filled Out By:** _____

Project: _____

Sample transport: Received on ice__ Courier_____

Received from CBWTP fridge_____ Directly from field_____

Temperature (°C): _____

	Yes	No	N/A
Is the COC present and signed?			
Are sample bottles intact?			
Do the COC and sample labels match?			
Are the appropriate containers used?			
Are samples appropriately preserved?			
Do VOA vials or alkalinity bottles have Headspace?			
Are samples received within holding times?			

Pres. #	Preservative	LIMS ID	Standard Preservation Amounts
1	**HNO_3 (1:1) to pH <2**		0.5mL/250mL; 1.0mL/500mL; 4-5 drops/50mL centrifuge tube
2	**H_2SO_4 (18N) to pH <2**		0.4mL/250mL; 0.8mL/500mL ; 1.6mL/1000mL
3	**HCl (1:1) to pH <2**		1.0mL/500mL; 2.0mL/1000mL
4	**HCl (1:1) to pH 2-3**		For TOC: 2-5 drops/250mL
5	**NaOH (pellets) to pH >12**		4-10 pellets/500mL; 8-20 pellets/1000mL

Date	Time	Analyst	Sample LIMS ID	Bottle ID	Pres. #	Comments

Comments:_____

Section 27

QUALITY ASSURANCE FOR ENVIRONMENTAL TESTING*(TNI V1:M1, V1:M2 – Section 5.9 and Section 1.7 of Technical Modules TNI V1:M 3-7)*

The City of Portland WPCL has procedures for monitoring the validity of the testing it performs. Quality control (QC) metrics (e.g., targets for percent recovery of independent standards and relative percent difference of duplicates) are entered into the Laboratory Information Management System (LIMS), and the LIMS software compares these targets to analytical results. Data are used to identify metric excursions and, where applicable, to identify trends via control charting. To evaluate the quality of test results, the laboratory utilizes:

- Certified reference materials and internal quality control using secondary reference standards
- Participation in interlaboratory comparison testing programs
- Tests to define the variability and/or repeatability of laboratory tests, such as the analysis of replicates
- Retesting of retained samples
- Correlation of results for different characteristics of a sample (for example total phosphate should be greater than or equal to orthophosphate.)
- Positive and negative controls such as blanks, spikes, etc.
- Measures to evaluate the accuracy of the test method, including calibration, continuing calibrations, use of certified reference materials, proficiency test samples
- Measures to evaluate test method capability such as LOD/MDL and LOQ/MRL determinations, linear ranges, spectral interference studies
- Selection of appropriate formulae to reduce raw data to final results, such as regression and other statistical analyses
- Measures to ensure constant and consistent test conditions, both instrumental and environmental

In addition to procedures for calibration, the laboratory monitors quality control measurements such as blanks, laboratory control samples (LCS), duplicates, matrix spikes (MS), matrix spike duplicates (MSD), surrogates, and internal standards to assess precision and accuracy. Proficiency testing samples are also analyzed to assess laboratory performance.

Quality control data are analyzed and, when found to be outside pre-defined criteria, action is taken to correct the problem and to prevent incorrect results from being reported. Results associated with quality control data outside of criteria but still deemed reportable are qualified

so the end user may make a determination of data usability. (See Section 28 – "Reporting of Results.")

Quality control procedures as specified in the QA Manual and in analytical standard operating procedures (SOP) are followed by all laboratory personnel. These QC procedures are as detailed in the following:

- The NELAC Institute (TNI) 2016 Standard
- 40 *CFR* 136.7
- *Standard Methods for the Examination of Water and Wastewater*
- Individual protocols published by regulatory agencies, such as the EPA, or by recognized authorities, such as ASTM.

27.1 Essential Quality Control Procedures

The quality control procedures specified in test methods are followed by laboratory personnel. The most stringent of control procedures is used in cases where multiple controls are offered. If it is not clear which is the most stringent, that mandated by test method or regulation is followed.

For test methods that do not provide acceptance criteria for an essential quality control element or where no regulatory criteria exist, acceptance criteria are developed in-house and are included in the relevant SOPs.

If samples are considered process control-only or otherwise non-regulatory, matrix QC samples are not required. This is done in consultation with the client.

Written procedures to monitor routine quality controls, including acceptance criteria, are located in the test method SOPs, except where noted, and include such procedures as:

- use of laboratory control samples and blanks to serve as positive and negative controls for chemistry methods
- use of laboratory control samples to monitor test variability of laboratory results
- use of calibrations, continuing calibrations, certified reference materials and/or PT samples to monitor accuracy of the test method
- measures to monitor test method capability, such as limit of detection, limit of quantitation, and/or range of test applicability, such as linearity
- use of regression analysis, internal/external standards, or statistical analysis to reduce raw data to final results
- use of reagents and standards of appropriate quality and use of second source materials as appropriate
- procedures to ensure the selectivity of the test method for its intended use

- measures to assure constant and consistent test conditions, such as temperature, humidity, rotation speed, etc., when required by test method;
- use of sterility checks for equipment, media and dilution water for microbiology
- use of positive and negative culture controls for microbiology.

27.2 Internal Quality Control Practices

Analytical data generated with QC samples that fall within all prescribed acceptance limits indicate the test method is in control.

QC samples that fall outside QC limits indicate the test method is out of control (nonconforming) and that corrective action is required and/or that the data must be qualified. (See Section 12, *Control of Nonconforming Environmental Testing Work* and Section 14, *Corrective Actions*.)

Detailed QC procedures and QC limits are included in test method standard operating procedures (SOPs), or where unspecified in the SOPs, are detailed in the QA Manual.

All QC measures are assessed and evaluated on an on-going basis, so that trends are detected.

27.2.1 General Controls

The following general controls are used:

27.2.1.1 Positive and negative controls such as:

a) Blanks (negative)
b) Laboratory control sample (positive)
c) Sterility checks and control cultures (positive and negative).

27.2.1.2 Selectivity is assured through:

a) absolute and relative retention times in chromatographic analyses;
b) two-column confirmation when using non-specific detectors;
c) use of acceptance criteria for mass-spectral tuning (found in test method SOPs);
d) use of the correct method according to its scope assessed during method validation; and
e) use of reference cultures (positive and negative) from a recognized manufacturer (where applicable).

27.2.1.3 Consistency, variability, repeatability, and accuracy are assured through:

a) proper installation and operation of instruments according to manufacturer's recommendations or according to the processes used during method validation;

b) monitoring and controlling environmental conditions (temperature, access, proximity to potential contaminants);

c) selection and use of reagents and standards of appropriate quality; and

d) cleaning glassware appropriate to the level required by the analysis as demonstrated with method blanks (glassware cleaning protocols are detailed in individual SOPs. If there is no SOP guidance, glassware is cleaned with lab detergent and hot tap water and rinsed with cold tap water, with a final DI rinse if necessary).

e) For microbiology, glassware care includes use of borosilicate glassware, use of detergents designed for laboratory use, testing for alkaline or acid residue with bromothymol blue, and conduct of the Inhibitory Residue test when the detergent is changed or annually, whichever is more frequent.

f) following SOPs and documenting any deviation, assessing for impact, and treating data appropriately;

g) testing to define the variability and/or repeatability of the laboratory results, such as replicates;

h) use of measures to assure the accuracy of the test method, including calibration and/or continuing calibrations, use of certified reference materials, proficiency test samples, or other measures; and

i) use of duplicate plate counts on positive samples (microbiology only).

27.2.1.4 Test method capability (see also Section 22, *Environmental Methods and Method Validation*) is assured through:

a) establishment of the limit of detection where appropriate;

b) establishment of the limit of quantitation or reporting level; and/or

c) establishment of the range of applicability such as linearity.

27.2.1.5 Data reduction is assured to be accurate by:

a) selection of appropriate formulae to reduce raw data to final results such as regression;

b) following specific procedures for data reduction such as manual integration procedures;

c) periodic review of data reduction processes to assure applicability

d) microbiological calculations, data reduction, and statistical

e) interpretations specified by each test method.

27.2.1.6 Sample specific controls are used to evaluate the effect of sample matrix on the performance of the selected analytical method (not a measure of laboratory performance). Examples include:

- Matrix Spike and Matrix Spike Duplicate (MS/MSD)
- Surrogate Spikes
- Sample Duplicates

27.2.1.7 The following tables summarize the key elements of a quality control system for a laboratory performing chemistry and microbiology testing.

Table 27-1 Essential Quality Control Elements for Chemistry

Item	Frequency	Acceptance Criteria	Corrective action
Negative Control (Method Blank)	1/batch	Method specific or reporting limit	Qualify data and take corrective action
Positive Control (Laboratory Control Sample)	1/batch	Method specific or determined by laboratory	Reprocess, reanalyze, or qualify data.
Matrix Spike; Matrix Spike Duplicates *Note : Samples are designed as data quality indicators for a specific sample using the designated method. These controls alone are not used to judge a laboratory's performance.*	Per method requirement	Method specific or determined by laboratory	Corrective action and qualify data.
Surrogate spikes *See note above.*	Per method requirement	Method specific or determined by laboratory	Corrective action and qualify data
Matrix Duplicates *See note above.*	Per method requirement	Method specific or determined by laboratory	Corrective action and qualify data
Continuing Calibration Verification	Per method requirement	Method specific or determined by the laboratory	Reanalyze standard immediately; Corrective action
Initial calibration Verification	Start of each analytical run, after calibration	Method specific or determined by laboratory	Reanalyze standard immediately; Corrective action

Table 27-2 Essential Quality Control Requirements for Microbiology – All Methods

Item	Frequency	Acceptance Criteria	Corrective Action[2]
Sterility check	Each lot of media prior to first use	No growth	Investigate cause
Sterility check containers	One container (bottle) for each lot or batch sterilized (NSGM)[3]	No growth	Investigate cause
Sterility check dilution water	One per batch of dilution water (NSGM)[3]	No growth	Investigate cause
Sterility check filters	One filter for each new lot of membrane filters (NSGM)[3]	No growth	Investigate cause
Positive control[1]	pure culture of target organisms/ each lot or batch of medium (prior to first use of medium)	Positive reaction	Investigate cause If necessary reject the medium
Negative control[1]	Pure culture of non-target organisms/each lot or batch of medium (prior to first use of medium)	Negative reaction	Investigate cause If necessary reject the medium
Duplicate colony counts (For numeric results only)	Monthly on one positive sample for each month performed.	Same analyst <5% difference between counts[4] Two analysts <10% difference between counts[4]	Investigate cause Qualify data

1) Microorganisms may be single use preparations or cultures maintained by documented procedures that demonstrate the continued purity and viability of the organism.
2) Corrective Action may include the need to retrain.
3) NSGM = non-selective growth media
4) Calculated by the QA Coordinator

Table 27-3 Essential Quality Control Requirements for Microbiology – Pour Plate Methods Only

Item	Frequency	Acceptance Criteria	Corrective action
Method Blank	Minimum of one plate per batch Done as part of test, use method media	Internally defined Suggest 1 cfu/plate	Investigate cause, qualify/ reject data

Table 27-4 Stock Cultures		
Item	**Frequency**	**Handling**
Reference cultures	Single use	Preserved and handled per mfg. specifications
Reference culture Reference stock	Culture stocks to make working stocks	Preserved and not refrozen Handling per mfg specs
Working stocks	Not transferred more than five times. Not sub-cultured to replace reference stocks	

27.2.2 Specific Controls

See Appendix E for definitions. The ICV is a second source standard to indicate if the initial calibration is valid. The continuing instrument calibration verification (CCV) is used to confirm the continued validity of the initial calibration. The CCV can be either the calibration standard or a second source standard. Specific details for instrument calibration, continuing calibration verification and Laboratory Check Standards are listed in the Standard Operating Procedure for each analytical test. Generally, the following items are the essential elements:

27.2.2.1 Method Blanks

A method blank must be analyzed at a minimum of one per batch. The matrix of the method blank must be similar to the associated samples and be free from any analytes of interest. Method blanks are not required for some analyses such as pH, conductivity, flashpoint, and alkalinity.

Contaminated blanks are identified according to the acceptance limits in the test method SOPs or laboratory documentation.

When a blank is determined to be contaminated, the cause must be investigated and measures taken to minimize or eliminate the problem.

Data that are unaffected by the blank contamination (non-detects, or other analytes) are reported unqualified. Samples with results greater than 10 times the blank concentration are not qualified although the blank is qualified.

Sample data that are suspect due to the presence of a contaminated blank are re-analyzed or qualified.

27.2.2.2 Initial Instrument Calibration:

Refer to V1M4-1.7.1.1 for specific TNI calibration requirements regarding number or standards and removal of specific calibration points.

The details of the initial instrument calibration procedures, including calculations, integrations, acceptance criteria and associated statistics are

included and referenced in the SOP for each analytical method. Where initial instrument calibration procedures are referenced, the referenced material is retained and readily available to analysts.
Sufficient raw data records are retained to permit reconstruction of initial instrument calibration. The raw data records include:

Calibration date
Test method
Instrument
Analysis date
Each analyte name
Analyst's initials or signature
Calibration concentration and response
Calibration curve or response factor

Sample results are quantitated from the initial calibration and are not quantitated from any continuing instrument calibration verification unless otherwise required by regulation, method or program.

All initial instrument calibrations are verified with a standard (ICV), obtained from a second manufacturer or lot if the lot can be demonstrated from the manufacturer as prepared independently from other lots. Traceability is to a national standard where available. Certificates of analysis are required where available and are maintained as part of the QA records.

Criteria for the acceptance of initial instrument calibration (such as correlation coefficient, RPD, or RSE) are established for each analytical test method. The criteria used are appropriate to the calibration technique used in the method.

Generally, the lowest calibration standard is the lowest concentration for which quantitative data are reported. Any data reported below the lower limit of quantitation are considered to have an increased quantitative uncertainty and are not reported or are reported using a qualifier. The low calibration standard is usually at least 3-5 times the Method Detection Limit (MDL).

The highest calibration standard is the highest concentration for which quantitative data are reported. Any data reported above the highest standard are considered to have an increased quantitative uncertainty and are not reported or are reported using a qualifier with a narrative explanation.

Results for samples above the concentration range established by the initial calibration are diluted and run again so as to achieve results within the calibration range.

If the initial instrument calibration results do not meet established acceptance criteria, corrective actions are initiated before any samples are analyzed.

Calibration standards include concentrations at or below the regulatory limit where applicable.

The SOP for each analytical test method details the number of calibration points necessary for establishing the initial instrument calibration. The minimum number of calibration standards is two where mandated methods do not specify the number of calibration standards, where one standard is at the quantitation limit.

27.2.2.3 Continuing Calibration Control Samples

Intermediate checks are used to maintain confidence in the calibration status of an instrument using a continuing instrument calibration verification standard (CCV) and, where required, a low-level CCV (LLCCV) for each analytical run. The essential elements of the CCV and LLCCV are detailed below:

The details of the CCV and LLCCV procedures, calculations, and associated statistics are included in the SOPs for each analytical test method.

A CCV and LLCCV are repeated at the beginning and end of each analytical batch. The concentration of the CCV is generally set at the midpoint of the calibration range, and the LLCCV concentration is set at the lowest calibration standard.

Raw data records are retained to allow reconstruction of the CCV and LLCCV, for example: test method, instrument, analysis date, analyte name, concentration and response, calibration curve, CCV and LLCCV records explicitly connect the CCV and LLCCV data to in initial instrument calibration.

Criteria for the acceptance of the CCV and LLCCV are established in each SOP for analytical test methods.

If CCV or LLCCV results are outside established acceptance criteria, corrective actions are performed specific to the test method as specified in the SOPs. If routine corrective actions fail to produce a second consecutive (immediate) CCV or LLCCV within acceptance criteria, the Laboratory demonstrates performance after corrective action with two consecutive successful calibration verifications or a new initial calibration is performed. If acceptable performance can not be demonstrated, sample analysis does not occur until a new calibration curve is established and verified. Samples associated with unacceptable CCV/LLCCV are re-analyzed with acceptable CCV/LLCCV, not reported, or may be reported as qualified data under the following special conditions:

When the high limit of acceptance criteria for the CCV or LLCCV is exceeded (high bias), and there are associated samples that are non-detects, then the non-detects may be reported. Otherwise, the samples affected by the unacceptable CCV or LLCCV are reanalyzed after a new

calibration curve has been established, evaluated and accepted.

When the low limit of acceptance criteria for the CCV or LLCCV is exceeded (low bias), those sample results may be reported if they exceed a maximum regulatory limit/decision level. Otherwise, the samples affected by the unacceptable CCV or LLCCV are reanalyzed after a new calibration curve has been established, evaluated and accepted.

If reanalyzing the samples is not possible, data associated with an unacceptable initial instrument calibration are not reported, or are reported with appropriate data qualifiers.

Where calibrations include a correction factor, the SOPs for each analytical method include procedures for updating analytical and reporting software. Each item of equipment, both hardware and software includes safeguards to prevent adjustments that would invalidate the test and/or calibration results.

27.2.2.4 Laboratory Control Samples

Laboratory control samples are analyzed at a frequency mandated by method, regulation, or client request, whichever is more stringent. The standard frequency of LCS preparation and analysis is one per analytical batch or as otherwise stated in a laboratory SOP. Exceptions would be for those analytes where spiking is impossible (pH) or no spiking solution is available (e.g., Volatile Solids, Total Solids on solids, chlorophyll, flashpoint, etc.)

The analytes to be spiked in the LCS are specified in the test method SOP. In some cases a client may specify a list of analytes for spiking and the request is handled using the laboratory's nonconformance procedures. The LCS may also be used as the ICV, when it is from a source separate from that used for calibration.

The results of laboratory control samples (LCS) are calculated in percent recovery or other appropriate statistical technique that allows comparison to established acceptance criteria. The laboratory documents the calculation in the test method SOPs, LIMS and below.

$$\%R = \frac{AV}{TV} \times 100$$

Where:
AV = Analyzed Value
TV = True Value

The individual LCS is compared to the acceptance criteria as published in the mandated test method, or where there are no established criteria, the laboratory either uses the mean plus or minus three standard deviations as the control limits or as otherwise stated in the method SOPs.

27.2.2.5 Matrix Spikes and Matrix Spike Duplicates

The laboratory procedure for MS/MSD includes spiking appropriate analytes at appropriate concentrations, calculating percent recoveries and relative percent difference (RPD), and evaluating and reporting the results. The procedure can be found in the method SOP, LIMS and the formulas below:

$$\%R = \frac{AV}{TV} \times 100$$

Where:

AV = Analyzed Value – Sample Result
TV = True Value

$$RPD = \frac{|S - D|}{\frac{(S + D)}{2}} \times 100$$

Where:

S = Sample Concentration
D = Duplicate Concentration

Where there are no established criteria, the laboratory uses the mean plus or minus three standard deviations as the control limits for MS/MSD.

For MS/MSD results outside established criteria corrective action is documented or the data are reported with appropriate data qualifying codes. Only the data from the spiked sample is qualified, unless evaluation of other samples in the batch indicate the need for qualifiers.

27.2.2.6 Surrogate Spikes

Surrogate recovery results are compared to the acceptance criteria as published in the mandated test method. Where there are no established criteria, the laboratory uses the mean plus or minus three standard deviations as surrogate control limits.

For surrogate results outside established criteria, data are evaluated to determine the impact. Corrective actions could include trouble shooting instrument for non compliance, remaking of standards, and rerunning of samples. Refer to test method SOPs for appropriate actions.

27.3 Proficiency Test Samples or Interlaboratory Comparisons

27.3.1 Compliance to Accreditation Requirements

The City of Portland Water Pollution Control Laboratory (WPCL) currently holds accreditation by the Oregon Environmental Laboratory Accreditation Program (ORELAP). The WPCL has accreditation for solids and non-potable water. Analyses are found in Appendix K.

The successive PTs are analyzed at least five months apart and no more than 7 months apart unless the PT is being used for corrective action to maintain or reinstate accreditation, in which case the dates of successive PT samples for the same accreditation FoPT is at least fifteen days apart.

If drinking water accreditation was requested by the Portland Water Bureau, WPCL would request immediate accreditation from ORELAP.

27.3.2 Proficiency Testing (PT) Sample Handling, Analysis and Reporting

The laboratory does not share PT samples with other laboratories, does not communicate with other laboratories regarding current PT sample results, and does not attempt to obtain the assigned value of any PT sample from the PT provider.

PT samples are treated as typical samples in the normal production process where possible, including the same analysts, methods, preparation, calibration, quality control and acceptance criteria, sequence of analytical steps, number of replicates, and sample log-in. PT samples are not analyzed multiple times unless routine environmental samples are analyzed multiple times. Analyzing in duplicate is not considered as multiple analyses since samples are analyzed in duplicate. Where PT samples present special problems in the analysis process, they will be treated as laboratory samples where clients have special requests.

PT samples may occasionally be in a LIMS batch as the only sample, especially if there are no other samples available for that analysis. PT samples are not required to be held until other samples are available. Often, the LIMS batching is for organization and convenience. Even if a PT is in a batch by itself, it is often not the only sample prepared or analyzed at that time.

The type, composition, concentration and frequency of quality control samples analyzed with the PT samples are the same as with typical samples. If the PT sample is in a batch by itself, it might not have matrix quality control samples if the sample volume is limited. An LCS and LCS duplicate may be analyzed instead. When possible, PT samples are not chosen for matrix quality control.

The laboratory uses only PT providers that have been approved by TNI.

PT studies consist of analyzing unknown samples for all accredited analytes using each analytical method for which the laboratory is seeking accreditation, when PTs are available.

Samples are analyzed and the results reported to the PT provider by the closing date of the PT study.

In most circumstances, the WPCL MRL is below the PT provider PTRL. When this is not the case, the WPCL will report PT results as follows:

If the PTRL is below the lab MRL:
Report results below PTRL as <PTRL
Report results between PTRL and MRL as the numerical result OR reanalyze the sample using an adjusted calibration curve and report the new result.

For each program, method and analyte, ongoing accreditation is contingent upon passing two out of the last three PT studies. Failure to meet the semi-annual schedule is also regarded as a failed PT study. Repeat PT studies may be conducted for any failed analytes, but are not scheduled sooner than 30 calendar days from the last analysis, except as noted in 27.3.1 regarding corrective action and reinstatement of accreditation.

Official copies of PT study results may be provided by the WPCL. However, the current WPCL PT provider transmits all reports directly to the ORELAP Administrator.

Continued accreditation is dependent on the accurate analysis of PT samples and other criteria as specified by ORELAP. Interim accreditation for a given analyte is assigned by ORELAP when the reported PT results for any analyte are outside established limits.

A laboratory may withdraw from a PT study for an analyte(s) or for the entire study if the laboratory notifies both the PT provider and the ORELAP Administrator before the closing date of the PT study.

The laboratory institutes corrective action procedures for failed PT samples following the guidelines in Section 14 – "Corrective Action."

- Whenever a PT study is failed for an analyte(s), lab staff investigates, determines the cause for failure, and takes necessary corrective action. Corrective action is documented in the laboratory's internal records in the form of a written corrective action report. The corrective action report is also provided to the ORELAP administrator upon request.

- If a second PT study is failed out of the most recent three, then ORELAP takes action within 60 calendar days to determine the accreditation status of all methods for the unacceptable analyte(s) for that program and matrix. WPCL removes the analyte or analysis from accredited status and this is noted on client laboratory reports.

The laboratory maintains copies of all written, printed, and electronic records from PT studies for a minimum of five years. This includes, but is not limited to LIMS records, bench sheets, instrument strip charts or printouts, data calculations, and data reports. These records are made available to ORELAP assessors during on-site assessments.

Prior to the closing date of a study, laboratory personnel do not:

- Subcontract analysis of a PT sample to another laboratory being run for accreditation purposes.

- Knowingly receive and analyze a PT for another laboratory being run for accreditation purposes.

- Communicate with an individual from another laboratory concerning the analysis of the PT sample.

- Attempt to find out the assigned value of a PT from the PT Provider.

PT samples usually must be diluted prior to analysis to fall within our curves. Refer to test method SOPs for proper PT handling.

27.4 Data Review and Validation

The laboratory reviews all data generated in the laboratory for compliance with method, laboratory and, where appropriate, client requirements.

Initially, the analyst reviews data for acceptability of quality control measures and accuracy of the final result(s). The analyst assembles a data packet including all data necessary to generate a final result. The final result is then hand-entered into the LIMS, or transferred to the LIMS from an instrument or spreadsheet.

- All calibration data, quality control data and sample data are recorded in electronic instrument files, or in the appropriate Laboratory Analysis notebooks. The LIMS has been configured so as to minimize manual data entry to reduce the possibility of data entry errors.
- The analyst performing the analysis checks that all quality control criteria have been achieved according to the data acceptance criteria for each analytical test and produces the sample results.
- Analysts are responsible for performing and recording the results of quality control tests and laboratory control check samples, and reporting problems to the Production or QA Coordinator.
- Analysts enter manually or electronically download the data into LIMS for subsequent validation of each analytical batch.

A second reviewer (another analyst or Lab Coordinator) reviews any hand calculations, manual data entry, and checks the data packet for completeness and acceptability of QC measures. The reviewer also spot-checks electronic transfers of data. Only the Coordinators and Lab Manager may designate data as “QA Reviewed”, which is the final LIMS status before reporting. Other reviewing analysts designate data as “Peer Reviewed”. Before moving data to “QA Reviewed”, the data is considered in more detail by the second reviewer or QA Coordinator. Raw data is also occasionally compared to data entry as part of auditing.

- The second reviewer performs the second level of data validation by checking to see that all data entered in LIMS are free from transcription and calculation errors.
- The QA Coordinator reviews sample login before samples are reported to confirm collection date, receipt, analysis times, analyses requested, etc.
- The second reviewer is responsible for checking all analytical data for transcription or reporting errors, for insuring that all internal quality control checks were performed by the analyst as required, and for verifying the accuracy and completeness of all data awaiting final approval. This reviewer signs the data as reviewed.
- A Coordinator or the Lab Manager validates each analytical batch in LIMS, as"QA Reviewed".

Final reports are compared to raw data through the above reviewed steps. Final reports are reviewed by a Coordinator or the Lab Manager for completeness. The Coordinator or Lab Manager generates final reports. The reports are electronically signed by the generator.

- The Coordinator or Lab Manager performs the third level of data validation by checking the sample reports for completeness.
- Only the Coordinators and Lab Manager may designate data as "QA Reviewed".
- When the completed samples are approved, reports are generated and distributed to clients as requested, and the results are stored in the database.

Section 28

REPORTING THE RESULTS
(TNI V1:M2 – Section 5.10)

The result of each analysis performed is reported accurately, clearly, unambiguously, and objectively and complies with all specific instructions contained in the test method.

Laboratory reports include all the information requested by the customer and necessary for the interpretation of the analytical results and all information required by the method used. All information associated with an analytical result and laboratory sample are readily available in LIMS.

Data are reported without qualification if they are greater than the lowest calibration standard, lower than the highest calibration standard, and without compromised sample or method integrity.

28.1 Reports

Report formats have been designed to accommodate each analysis performed and to minimize the potential for misunderstanding or misuse. Report format presentation may vary according to client needs.

Each analytical report contains the following information:

a) cover page (for external clients or upon request) that contains the work order number, project name, and name and phone number of a contact person.

b) title

c) the name and address of the laboratory and name of a contact person;

d) unique identification of the report on each page, such as a work order number and a pagination system that ensures that each page is recognized as part of the report and a clear identification of the report total number of pages, e.g. 3 of 10;

e) the client and project name;

f) the identification of the method used;

g) a description of, and unambiguous identification of the sample(s) analyzed, including the client identification code;

h) the date of sample receipt, date and time of sample collection, dates the analyses were performed,

i) the analysis results, units of measurement, an indication of when results are reported on any basis other than as received (e.g. dry weight), failures identified (See Appendix G for a list of laboratory qualifiers);

j) the name, function, and signature or an equivalent electronic identification of the person authorizing the report, and the date of issue;

k) where relevant, a statement to the effect that the results relate only to the samples;

l) any non-accredited tests or parameters shall be clearly identified as such to the client when claims of accreditation to this Standard are made in the analytical report or in the supporting electronic or hardcopy deliverables

28.2 Supplemental Report Information

When necessary for interpretation of the results or when requested by the client, test reports include the following additional information:

a) deviations from, additions to, or exclusions from the test method, information on specific test conditions, such as environmental conditions, and any non-standard conditions that may have affected the quality of the results, and any information on the use and definitions of data qualifiers;

b) a statement of compliance/non-compliance when requirements of the management system are not met, including identification of test results that did not meet the laboratory and regulatory sample acceptance requirements, such as holding time, preservation, etc.;

c) where appropriate and needed, opinions and interpretations. When opinions and interpretations are included, the basis upon which the opinions and interpretations are documented. Opinions and interpretations are clearly marked as such in the test report.

d) additional information which may be required by specific methods or client;

e) qualification of results with values outside the calibration range as appropriate.

f) identifying statement that the report is a draft, partial, or amended or changed in some way, as necessary

28.3 Environmental Testing Obtained from Subcontractors

Test results obtained from tests performed by subcontractors are clearly identified on the test report by subcontractor name and/or accreditation number.

The subcontractors report their results in writing or electronically. A copy of the subcontractors report is attached to the WPCL report.

Data from any subcontractors are electronically downloaded into the LIMS system repository tables, but not into the LIMS database. The data in the repository is exported to another City database. See the WPCL Element Responsibility Matrix documents entitled Lab Reports and Outside Labs for information regarding the data export process.

Currently the lab manager is responsible for reviewing subcontract reports and notifying the subcontract lab of any errors or concerns regarding the data reports. Subcontractor data is identified in LIMS by different test codes and a status of Subcontracted within the work order.

28.4 Electronic Transmission of Results

All test results transmitted by telephone, fax, telex, e-mail, or other electronic means comply with the requirements of the TNI Standard and associated procedures to protect the confidentiality and proprietary rights of the client (see Section 22- "Environmental Methods and Method Validation").

28.5 Amendments to Reports

Material amendments to a test report after it has been issued are made only in the form of another document or data transfer. All supplemental reports meet all the requirements for the initial report and the requirements of this *Quality Manual*.

Amended analytical reports include a statement to assure they can be differentiated from other analytical reports.

28.6 Exceptions

When opinions and interpretations are included, the laboratory documents the basis upon which the opinions and interpretations have been made. Opinions and interpretations are clearly marked as such in a test report.

Appendix A

A.1 City Of Portland Code Of Ethics

All employees of the City of Portland are subject to the City Code of Ethics at Section 1.03 of the City Code. The City Code of Ethics addresses trust, objectivity, accountability, and leadership and applies to all City personnel including elected officials, employees, appointees to boards and commissions, and citizen volunteers authorized to act on behalf of the City. Sections 2.2 and 2.3 of this document list requirements of the City Code of Ethics most relevant to laboratory employees. WPCL employees must follow all the items in the City Code of Ethics.

The City Code of Ethics made be found at

Chapter 1.03 Code of Ethics | Portland.gov

A.2 Laboratory Ethics And Data Integrity

A.2.1 Introduction

The production of analytical data requires more detailed and focused ethics guidelines in addition to the broad, over-arching items found in the City Code of Ethics. By signing the concurrence page of the WPCL Ethics and Data Integrity Policy, laboratory employees agree to follow all of the ethical guidelines and prohibitions enumerated in this policy. Noncompliance with this policy is considered to be contrary to personnel regulations. Any laboratory employee who does not comply with this policy may be subject to the City's disciplinary process, up to and including termination. This policy does not apply to unintentional human errors that may occur from time to time. The laboratory's Ethics and Data Integrity program, training and investigations are discussed in Section 19, Data Integrity Investigations.

A.2.2 General Ethics

All WPCL employees are charged with meeting the City's and Laboratory's standard of ethical conduct in the performance of their duties and are further charged to report data, test results, and conclusions that are accurate to the best of their knowledge and that are obtained using sound laboratory practices. All WPCL employees are expected to follow established written protocols as detailed in the laboratory standard operating procedures and quality manual. Adherence to the WPCL ethics requirements is fundamental to maintaining data integrity.

A.2.3 Duty To Report

All WPCL employees must immediately report any accidental or intentional reporting of inauthentic data. Such reporting may be done to a Laboratory Coordinator, the Laboratory Manager, or Division Manager. If any WPCL employee is asked by another to engage in an activity that compromises data integrity, that employee has the duty and the right to refuse any such request and to immediately appeal the request to a Laboratory Coordinator, the Laboratory Manager, or Division Manager.

If the lab management is asking or requiring an employee to compromise data integrity, management outside the lab may be contacted.

A.2.4 Management Coercion/Retaliation Prohibited

The Laboratory Manager or laboratory employee with oversight responsibility may not instruct, direct, or request any other laboratory employee to perform a practice that would violate the City or WPCL standards of ethical conduct. In addition, they may not discourage, intimidate, or inhibit a laboratory employee who refuses to follow an order to engage in unethical conduct and may not retaliate against the employee.

A.2.5 Specific Unethical Laboratory Practices

The following behaviors are prohibited and are considered improper and unethical, and, in certain instances, illegal. These activities are in opposition to concepts of data integrity.

- Falsification of data by reporting results other than those obtained by analysis.
- Falsification of data by reporting results for a sample that was not analyzed (dry labbing).
- Falsification of quality control results.
- Intentional contamination of samples bottles or omission of preservative.
- Intentional improper manipulation of a sample during sample handling procedures.
- Intentional improper manipulation of a sample or QC sample during analysis.
- Improper manipulation of data to produce a more desirable result.
- Re-analysis solely for the purpose of producing a more desirable result.
- Intentional deviation from established protocols or regulatory requirements.
- Non-reporting of an error or deviation from protocol that affects the analysis result.
- Failure to manually adjust computer-generated results that are in error.
- Any action intended to misrepresent, distort, or conceal analysis results.
- Reporting of dates and times of analyses different from the actual dates and times at which the analyses were performed.

- Intentional reporting of another's work as one's own or vice versa.

- Attesting to the review of analysis results (via initialing and dating) without actually performing the appropriate data checking protocols.

- Intentional improper treatment of PT samples or failure to observe the requirements for PT sample handling, analysis, and reporting, as listed in the promulgated TNI standard.

A.2.6 Acceptable Data Manipulation

Manual manipulation of computer-generated results may be necessary to correct errors in automated data processing. In some instances, re-analysis may be justified and preferable to reporting original data. The ethical limitation is that data manipulation and/or re-analysis are applied for purposes of determining a correct analytical result, not a more desirable result. Following are examples of acceptable post-analytical procedures.

- For chromatography methods, manual peak integration is sometimes necessary due to matrix interference or another condition that causes the computer to improperly integrate a peak. Refer to the WPCL SOP on Manual Integration.

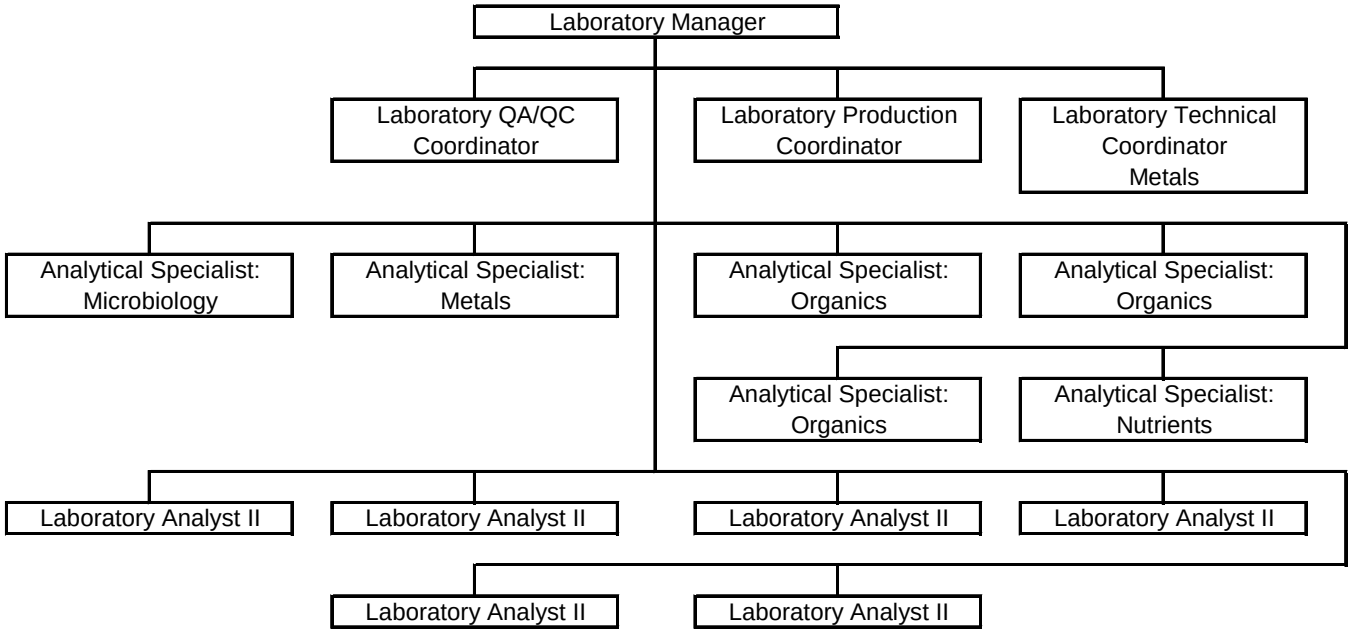
- In some instances, analytical parameters may be changed to alleviate interference. All calibration and QC criteria must be met using the secondary parameters, and the reason for using alternative parameters must be documented. Example: In ICPMS analysis, a secondary mass may be used to quantify an element if a recognized interference affects the primary mass.

- Re-analysis may be performed to verify a result if the result is unusual. If the re-analysis result is similar to the original (<20% RPD), report the original. If the results are significantly different, the cause must be investigated. Document all steps in resolving the discrepancy. It is not acceptable to simply choose one result as being "better" than the other.

- For regulated industry wastewater samples, re-analysis may be performed to verify a permit limit exceedance. If the re-analysis result does not support the exceedance, investigate and document the cause of the discrepancy.

Appendix B

Figure B-1. Laboratory Organizational Chart



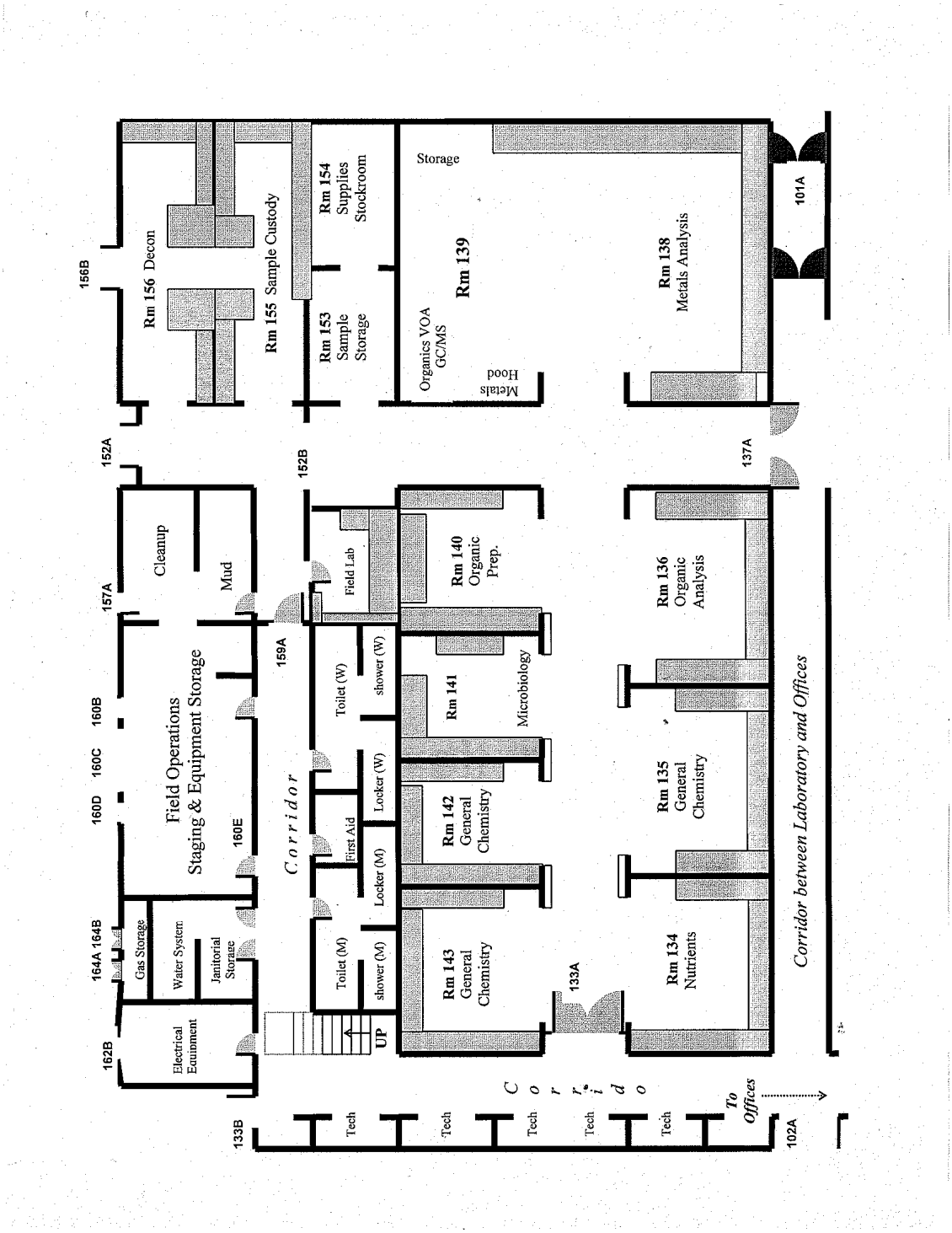
Appendix C

Laboratory Floor Plan

The Laboratory occupies approximately 12,000 square feet in the City of Portland WPCL building at 6543 North Burlington Avenue, Portland, Oregon. The building, built in 1996, is a steel and masonry structure of approximately 39,000 square feet that houses the Laboratory and a two-story office area. The Laboratory is equipped with a computer-controlled HVAC system for temperature, humidity, and ventilation control. Numerous built-in safety features include fume hoods, safety showers, and eye washes.

The laboratory design is open modular, with each area being dedicated to a particular type of analysis: metals, semi-volatile organics, volatile organics, microbiology, nutrients, general chemistry, process control, and sample receiving. The modules are open to a common corridor, which improves ventilation control and facilitates communication and sharing of resources. The floor plan is shown below.

Figure C-1. Laboratory Floor Plan



Appendix D

Acronyms and Abbreviations

This list includes acronyms and abbreviations used in this document and in SOPs. Other acronyms may be used and are defined in the pertinent document.

AB	-	accrediting body
ANSI	-	American National Standards Institute
ASQC	-	American Society for Quality Control
ASTM	-	American Society for Testing and Materials
ATP	-	alternative test procedure
BES	-	Bureau of Environmental Services (City of Portland)
BOD	-	biochemical oxygen demand
BS	-	blank spike
°C	-	degrees Celsius
CAS	-	Chemical Abstract Service
CBWTP	-	Columbia Boulevard Wastewater Treatment Plant
CCB	-	continuing calibration blank
CCV	-	continuing calibration verification
CFR	-	*Code of Federal Regulations*
CHP	-	chemical hygiene plan
CoC	-	chain of custody
COD	-	chemical oxygen demand
DI	-	deionized (water)
DCM	-	dichloromethane
DO	-	dissolved oxygen
DOC[1]	-	demonstration of capability
DOC[2]	-	dissolved organic carbon
ECD	-	electron capture detector
EICP	-	extracted ion current profile
EPA	-	Environmental Protection Agency
°F	-	degrees Fahrenheit
FoPT	-	field of proficiency testing
GC	-	gas chromatography
GC/MS	-	gas chromatography/mass spectrometry
IC	-	ion chromatography
ICP-AES	-	inductively coupled plasma-atomic emission spectrometry
ICP-MS	-	inductively coupled plasma-mass spectrometry
ICV	-	initial calibration verification
IDOC	-	initial demonstration of capability
IS	-	internal standard
ISO/IEC	-	International Organization for Standardization/International - Electrochemical Commission
LCS	-	laboratory control sample
LFB	-	laboratory fortified blank
LIMS	-	laboratory information management system
LLCCV	-	low-level continuing calibration verification
LLICV	-	low-level initial calibration verification
LOD	-	limit of detection
LOQ	-	limit of quantitation

MB	-	method blank
MCA	-	Monitoring, Coordination, and Analysis section
MDL	-	method detection limit
mg/Kg	-	milligrams per kilogram
mg/L	-	milligrams per liter
MRL	-	method reporting limit
MS[1]	-	matrix spike
MS[2]	-	mass spectrometer
MSD[1]	-	matrix spike duplicate
MSD[2]	-	mass selective detector
NELAC	-	National Environmental Laboratory Accreditation Conference
NELAP	-	National Environmental Laboratory Accreditation Program
ng/Kg	-	nanograms per kilogram
ng/L	-	nanograms per liter
NIST	-	National Institute of Standards and Technology
NPDES	-	National Pollutant Discharge Elimination System
ORELAP	-	Oregon Environmental Laboratory Accreditation Program
PB	-	preparation blank
PT	-	proficiency testing
PTP	-	proficiency testing provider
PTPA	-	proficiency testing provider accreditor
QA	-	quality assurance
QC	-	quality control
QM	-	*Quality Manual*
RL	-	reporting limit
RO	-	reverse osmosis (water)
RPD	-	relative percent difference
RSD	-	relative standard deviation
RT	-	retention time
SM	-	*Standard Methods for the Examination of Water and Wastewater*
SOP	-	standard operating procedure
SPLP	-	Synthetic Precipitation Leaching Procedure
SRM	-	standard reference material
TCLP	-	Toxicity Characteristic Leaching Procedure
TCWTP	-	Tryon Creek Wastewater Treatment Plant
TDS	-	total dissolved solids
TIC [1]	-	total ion chromatogram
TIC [2]	-	tentatively identified compound
TKN	-	total Kjeldahl nitrogen
TNI	-	The NELAC Institute
TOC	-	total organic carbon
TS	-	total solids
TSS	-	total suspended solids
TVFS	-	total, volatile, fixed solids
ug/Kg	-	micrograms per kilogram
ug/L	-	micrograms per liter
UV	-	ultraviolet
VOA	-	volatile organics analysis
VOC	-	volatile organic compound
WPCL	-	Water Pollution Control Laboratory (of the City of Portland, Oregon)

Appendix E

Glossary / Definitions

The following definitions are applicable to the terms used in the WPCL Quality Manual and Laboratory SOPs.

Acceptance Limits: The minimum and/or maximum values for a QC result that meet established requirements for precision, accuracy, or other QC parameter. Also called Control Limits.

Accreditation: The process by which an agency or organization evaluates and recognizes a laboratory as meeting certain predetermined qualifications or standards, thereby accrediting the laboratory.

Accuracy: The degree of agreement between a measured value and the true or expected value. Accuracy of an analysis is generally determined from spiked (fortified) samples and is expressed in terms of percent recovery (%R).

Analyst: An individual who performs analytical methods and related protocols and who is responsible for applying the associated quality control requirements for the methods and protocols. If capitalized, the term refers to a member of the Laboratory staff who holds the specific rank of Analyst.

Analytical System: The sum of the components required to effect sample analysis, including preparative steps. The analytical system includes instrumentation, equipment, glassware, reagents, standards, sample containers, and the analyst.

Analytical Uncertainty: A subset of Measurement Uncertainty that includes all laboratory activities performed as part of the analysis.

Assessment: The evaluation process used to measure or establish the performance, effectiveness, and conformance of an organization and/or its systems to defined criteria (to the standards and requirements of laboratory accreditation).

Audit: A systematic and independent examination of facilities, equipment, personnel, training, procedures, record-keeping, data validation, data management, and reporting aspects of a system to determine whether QA/QC and technical activities are being conducted as planned and whether these activities will effectively achieve quality objectives.

Batch: A group of samples that are prepared and/or analyzed together by the same personnel and using the same lot(s) of reagents. A **preparation** or **extraction batch** is a specified number of samples (often 10 or 20) of the same matrix which are processed together, along with certain QC samples processed at the same time. An **analytical batch** is a set of prepared samples and associated QC samples that are analyzed as a group. The samples in an analytical batch may differ in matrix, and may exceed 20 in number. A **LIMS batch** is usually equivalent to a preparation batch but may exceed the typical time limitation. Individual samples analyzed over the course of several days may be batched together if the associated QC is required only once per week.

Bias: The systematic deviation of a measured value from the true value. Bias is inherent in a method or in the measurement system, or caused by matrix effects. Matrix spike results are a key indicator of matrix bias. At WPCL, sample results are not bias-corrected.

Blank: See **Method Blank** and **Reagent Blank**.

Blank Spike: Another name for Laboratory Control Sample. The term **Blank Spike** is commonly used in organics and nutrients analysis.

Blind QC Sample: A sample with an established concentration of target analyte that is known to the submitter but not known to the analyst. The analyst may or may not be aware that the sample is a QC sample. A blind QC sample is used to test the analyst's analytical proficiency.

Calibration: A procedure that establishes the relationship between analyte concentration and analytical response. The term is most commonly used in reference to instrument response to standard solutions of known concentrations (calibration standards).

Calibration Blank: A zero standard, used in metals analysis. The Cal Blank is prepared using the same matrix of acidified water as for Calibration Standards, except no target elements are added.

Calibration Standards: Solutions of known concentrations which are used to standardize the measurement procedure. Calibration standards are used to establish the relationship between analyte concentration and analytical response.

Calibration Curve: A graphical plot of the concentrations of the calibration standards *versus* analytical response (e.g., peak area, counts, absorbance). The curve must meet certain correlative criteria in order for the calibration to be considered acceptable.

Certification: A documented statement that an analyst is fully trained to perform an analytical method. Certification requires a Demonstration of Capability, and agreement among the trainee, the trainer, and QA/QC Coordinator that the trainee understands the method and is capable of performing it accurately and precisely.

Certified Reference Material (CRM): A reference standard traceable to NIST, and documented as traceable in an accompanying certificate.

Chain-of-Custody Form (COC): A paper record that documents the collection and possession of samples. It generally also includes the requested analyses.

Check Standard: Another name for Laboratory Control Sample. The term **Check Standard** is commonly used in wet chemistry methods.

Comparability: The degree to which one data set can be compared to another. Comparability is achieved by use of consistent analytical methods and by traceability of standards to a reliable source.

Confirmation: Qualitative verification of an analyte by use of an alternative analytical practice. Examples include a second chromatographic column, an alternative wavelength or detector, or an alternative analytical procedure.

Continuing Calibration Blank (CCB): A zero standard (matrix-matched blank) run periodically throughout an analytical batch in metals analysis, usually directly after each CCV. If target elements are detected in the CCB above the reporting limit, the run must be stopped and evaluated for contamination.

Continuing Calibration Verification (CCV): A single standard, usually at the mid-point concentration of the calibration range, used to verify calibration throughout an analytical batch and/or quantify drift in instrument response. The CCV solution may be one of the same solutions used for the calibration curve. CCV analysis is generally required after every 10 samples in the analytical batch. The typical response requirement is ±10% of the true value. (Also see **Low Level Calibration Verification**.)

Control Chart: A graphical representation of accuracy or precision data, allowing for visual detection of trends and biases. The chart includes statistical evaluations of the data, marking upper and lower control limits (see Warning Limit and Control Limit) that are based on the standard deviation of responses or statistics.

Control Limits: Acceptance limits determined on a control chart, usually ±3s distant from the mean value. When a QC result falls outside the control limits, steps must be taken to identify the source of the problem.

Corrective Action: The action taken to eliminate the cause of a nonconformance and prevent its recurrence. Corrective actions are usually taken in response to failed quality control results. They sometimes require a significant investigation and should be documented using a Corrective Action Report (CAR) form.

Data Audit: A review of the documentation and procedures associated with an analysis to verify that they comply with the stated protocols and the QC results meet the specified acceptance criteria.

Data Reduction: The process of transforming a number of data items by arithmetic or statistical calculation, standard curves, and concentration factors, and collating them into a more useful form.

Demonstration of Capability (DOC): A procedure to establish the ability of an analyst to generate data of acceptable accuracy and precision. The DOC usually consists of analysis of four replicates of an LCS containing all target analytes for the method, with acceptable accuracy and precision.

Detection Limit: See Method Detection Limit

Deionized (DI) Water: Water that has been treated in a specific way in order to remove impurities to a level that no positive or negative interferences are detectable when subjected to defined analytical procedures for target analytes. At WPCL, four types of DI water are generated: **Milli-Q RO** water is prepared from tap water that is treated in a Millipore water purification system that utilizes reverse osmosis (RO). **Elix** (e-pod) water is also treated by the Millipore system, though without the final filtration of Milli-Q RO water. **Milli-Q RO** water serves as reagent water for all analytical tests performed. **Organic Free Reagent (or DI) Water** is DI water that has been passed through a special final filter to remove organic contaminants.

Duplicate: A separate aliquot of sample, treated and analyzed identically to the original aliquot. Comparison of duplicate results is the basis for precision measurement. Laboratory duplicates (or replicates) are aliquots taken from the same sample bottle. Field duplicates are from the same sample source but are labeled, stored, and analyzed as discrete samples.

Field of Accreditation: A matrix, technology/method, and analyte combination for which the accreditation body offers accreditation.

Field of Proficiency Testing (FoPT): Analytes for which the laboratory is required to successfully analyze a PT sample in order to obtain or maintain accreditation, collectively defined as: matrix, technology/method, analyte.

Finding: An assessment conclusion referenced to a laboratory accreditation standard and supported by objective evidence that identifies a deviation from a laboratory accreditation standard requirement; a conclusion from laboratory assessment or audit activities that a non-conformance exists.

Holding Time: The maximum time that a sample may be held prior to analysis and still be considered not compromised. WPCL uses EPA-established holding times. The holding time is based on the assumption of proper sample preservation, if applicable.

Initial Calibration Verification (ICV): A standard prepared independently of the calibration standards, used to verify the accuracy of the calibration before any samples are analyzed. The ICV concentration may be different from any of the calibration standards but is within the calibration range. The typical response requirement is ±5% of the true value.

Interference: A substance in a sample (or added during sample analysis) that produces a bias in the analytical result. Interferences are often referred to as Matrix Effect.

Internal Standard (IS): An analyte added to a prepared sample which is used as a basis for quantification. Target analytes are quantified based on their analytical response relative to the Internal Standard response.

Laboratory Control Sample (LCS): A clean matrix spiked with a known amount of analyte, or a material containing a known, verified amount of an analyte. **LCS** is the general term for a sample prepared and analyzed identically to other samples in order to evaluate analytical accuracy (as % Recovery) without consideration of matrix interference. Other commonly used terms that represent QC samples with the same purpose are **Blank Spike, Check Standard,** and **LFB.**

Laboratory Fortified Blank (LFB): Another name for Laboratory Control Sample. The term **LFB** is commonly used in metals analysis.

Laboratory Information Management System (LIMS): A computer database used to track samples and store the associated data. Sample information such as collection date and time, collector, project association, matrix, and analysis request are logged into the LIMS at the time of sample receipt. Results are entered as they are available. At WPCL, every effort is made to assure the accuracy of data in the LIMS; however, the original chain-of-custody forms, laboratory notebooks, and instrument-generated analytical data are the official sources of sample information and data.

Limit of Detection (LOD): The laboratory estimate of the minimum amount of an analyte in a given matrix that an analytical process can reliably detect. At WPCL, this term is equivalent to **Method Detection Limit (MDL)**.

Limit of Quantitation (LOQ): The minimum concentration of a target analyte that can be reported with a specified degree of confidence. At WPCL, this term is equivalent to **Method Reporting Limit (MRL)**.

Low Level Calibration Verification (LLCV): A standard at or near the reporting limit, used to verify adequate response and calibration at low concentrations. The LLCV is similar to a CCV but is prepared at a lower concentration, has wider acceptance limits (in %R), and may be analyzed only once during an analytical batch.

Matrix: The component or substrate of a sample (e.g., wastewater, surface water, sludge, soil) which is to be analyzed for target analytes.

Matrix Duplicate: A replicate matrix prepared in the laboratory and analyzed to obtain a measure of precision. Also see **Duplicate**.

Matrix Spike (MS): An aliquot of sample which has been spiked (fortified) with a known concentration of target analyte(s) prior to sample preparation. Preparation and analysis of matrix spike is identical to samples in all respects unless otherwise noted in the referenced method. A matrix spike is used to determine the effect of matrix on a method's recovery efficiency.

Matrix Spike Duplicate (MSD): A replicate matrix spike used to obtain a measure of the precision of recovery for each analyte.

Measurement System: A method, as implemented by the laboratory, and which includes the equipment used to perform the test and the analysts(s).

Method: A body of procedures and techniques for performing an activity, systematically presented in the order in which they are to be executed.

Method Blank (MB): A sample of a matrix similar to the batch of associated samples, that is free of the target analytes. The method blank is processed and analyzed simultaneously and identically to the samples in all respects, and the results are evaluated for possible contamination or interferences resulting from the analytical process.

Method Detection Limit (MDL): A statistically-determined concentration that estimates the minimum concentration of an analyte that can be measured and reported with 99% confidence that the analyte concentration is greater than zero. The MDL is matrix-specific.

Method Detection Limit Study (MDL Study): An MDL determination. A standard MDL study involves the analysis of 7 replicates of a low-level spike in the matrix. The analysis of 7 method blanks is also required by TNI and 40 CFR part 136 for comparison.

Method Reporting Limit (MRL): The concentration that is the minimum reportable amount of target analyte, based on precision at low concentrations in the given matrix. If detected below the MRL, the analyte is not reported as being present in the sample unless

flagged as an estimate. The MRL is generally 3 to 5 times the MDL. The MRL is a laboratory-estimated limit of quantitation.

Nonconformance: An event that does not meet the applicable QA/QC requirements. Examples include low recovery on an LCS, failure to analyze a sample within the holding time, a contaminated Method Blank.

Percent Recovery (%R): A measured concentration value converted to a percent of the true or accepted value.

The calculation for %R for a standard or blank spike is:

$$\%R = \frac{X}{T} \times 100$$

where X = concentration determined for standard or blank spike
T = true or expected value, in concentration units

The general calculation for %R for a matrix spike sample is:

$$\%R = \frac{A - B}{T} \times 100$$

where A = concentration determined for the spiked sample
B = concentration determined for the non-spiked sample
T = true or expected value, in concentration units

Post-Digestion Spike (PDS): A known amount of target analyte added to a prepared sample digestate. The purpose is to determine the amount recoverable by the analysis procedure independent of sample preparation. This protocol is used mainly in metals analysis to verify that low recovery is due to sample matrix or loss during preparation, and not due to instrument problems.

Precision: The degree of agreement among a set of measurements, independent of knowledge of the true value. Precision is estimated by means of duplicate/replicate analyses of a sample (native or spiked) containing the target analyte at a concentration above the MRL. Precision is expressed in terms of Relative Percent Difference (RPD) for 2 values, or as Relative Standard Deviation (RSD) for 3 or more values.

Preparation Blank (PB): Synonymous with **Method Blank**, this term is commonly used in metals analysis.

Preservation: A means of maintaining the chemical or biological integrity of a sample prior to analysis. The most common types of preservation are refrigeration and the addition of reagents that change the pH or prevent chemical changes to the target analytes.

Procedure: A generic term for specific laboratory operations amenable to reduction to a set of steps. May include simple operations, such as taking the temperature of a refrigerator, to highly complex operations, such as the analysis of samples by gas chromatography – mass spectrometry. Synonymous with protocol or method.

Proficiency Testing and PT Samples: Proficiency Testing is a means of evaluating analytical performance by the analysis of unknown samples provided by an external source. PT Samples are single-blind QC samples of matrix and concentration similar to everyday samples.

Protocol: See **Procedure**.

Quality Assurance Program: A system of activities and protocols designed to integrate planning, quality control, quality assessment, documentation, and quality improvement, with the purpose of defining and implementing standards of data quality and validity that meet the needs of data users.

Quality Control (QC): A system of technical laboratory activities designed to evaluate and control data quality through the use of known concentration samples.

Quality Control Sample: A sample that is analyzed for purposes of evaluating data quality based on a particular QA/QC parameter such as accuracy or precision. A routine QC sample is one that is prepared by the analyst in the course of analyzing a batch of samples. A blind QC sample is one for which the true concentration of the target analyte is not known by the analyst. A double blind QC is one that is submitted for analysis without informing the analyst of its identity as a QC sample.

Quality Manual: A document that describes the laboratory quality program.

Quality System: See **Quality Assurance Program**.

Raw Data: Any original documented information from analytical activity, including manual written entries and computer-generated values, that contributes to the construction of a result or conclusion.

Reagent Blank (RB): A sample consisting of reagents, without the sample matrix or target analyte(s). A reagent blank is used to determine the contribution of the reagents to the analytical results.

Reagent Water: See **Deionized (DI) Water**.

Reference Material: A natural substance, such as a soil or type of biota, that has been analyzed for a particular set of constituents by a recognized authority (e.g., NIST or CANMET) using several independent analytical methods. An analysis certificate is supplied by the authority.

Reference Standard: A prepared sample in which one or more constituents are added and then analyzed by an established protocol. May be offered by either a recognized governmental authority (e.g., NIST) or commercial entity (e.g., NELAC accredited performance test sample provider).

Relative Percent Difference (RPD): The difference between two determined concentration values, converted to percentage of the average value of the two determinations. RPD is used as a standard representation of precision. The calculation for RPD is:

$$RPD = \frac{|A1 - A2|}{(A1+A2)/2} \times 100$$

where A1 = first determined concentration
A2 = second determined concentration

Relative Standard Deviation (RSD or %RSD): The standard deviation of three or more determined values, converted to percentage of the mean of the multiple determinations. RSD is used as a representation of precision, or as a measure of agreement among the response factors for points on a calibration curve. The calculation for RSD is:

$$RSD = \frac{s}{A} \times 100$$

where s = standard deviation of multiple determined concentrations or response factors
A = mean of multiple determined concentrations

Replicates: Two samples taken from and representative of the same population and carried through all steps of sampling and analytical procedures. The results from duplicate analyses are used to assess variance of the total method.

Representativeness: The degree to which data accurately and precisely represent the condition which is being measured. Sampling design and sub-sampling for analytical aliquots are key factors in establishing representativeness.

Root Cause: The fundamental reason for a particular observed phenomenon. An example is an improperly prepared calibration standard causing the failure of an instrument to properly calibrate.

Sample: Any substance provided to a laboratory for examination for one or more environmental parameters. An example is a jar of soil to be analyzed for metals.

Sampling: The act of taking a subset of a larger whole for subsequent environmental analysis. An example is collecting a volume of river water in a container for analysis of organic compounds.

Selectivity: The ability of an analytical technique to distinguish between different constituents with closely similar chemical or physical properties.

Sensitivity: The degree to which an analytical system can discriminate between measured values or detect low concentrations of an analyte. Sensitivity is often used as a relative term rather than a quantified parameter.

Spike: A known amount of target analyte added to a blank or sample aliquot. The purpose is to determine the amount of analyte recoverable by the analytical procedure.

Standard: A solution of known concentration, used to calibrate or verify calibration of an analytical system.

Standard Operating Procedure (SOP): A detailed written description of a procedure, designed to systematize (standardize) the performance of that procedure. The purpose of laboratory method SOPs is to ensure a consistent methodology among different analysts.

Standard Reference Material (SRM): A certified reference material produced by NIST, characterized for absolute content of target analyte(s) independent of analytical methodology.

Surrogate Compound (or System Monitoring Compound, SMC): A compound that is similar in chemical composition and analytical behavior to target analytes, but which is not normally found in environmental samples. SMCs are added to a sample before preparation and analysis begin, and %R is calculated for each compound. SMC recoveries provide a measure of bias for each individual sample analyzed, much like a matrix spike. SMCs are used mainly for trace organics analyses. They are also called System Monitoring Compounds.

Target Analyte: A compound, element, or aggregate property (e.g., COD, solids, alkalinity) for which a sample is analyzed.

Tentatively Identified Compound (TIC): In GC/MS analysis, a sample contaminant that is not on the target analyte list but is tentatively identified by comparison of the mass spectrum to those in a mass spectral library.

Traceability: The ability to relate a measurement to a standard reference material through an unbroken chain of comparisons.

Trip Blank: A sample of laboratory reagent water used to monitor for contamination during the transportation of samples, used when samples will be tested for volatile organic compounds. A trip blank is typically reagent water collected into an appropriate sample container, which then accompanies the containers used for field samples, both before and after sample collection.

Validation: Evaluation of available data and other information to confirm that results meet the quality requirements for their intended use.

Verification: The independent affirmation of a particular property. An example is the verification of instrument calibration via the analysis of an independent standard.

Warning Limits: Statistical limits determined on a control chart, usually ±2s distant from the mean value. When results fall outside the warning limits too frequently, steps must be taken to identify the source of the problem. A single value outside the warning limits does not require action but should prompt attention as a possible problem.

Appendix F

Laboratory Accreditation / Certification / Recognition

The Water Pollution Control Laboratory maintains the following certifications and accreditations with state and national entities:

Accreditation by the Oregon Environmental Laboratory Accreditation Program (ORELAP), which maintains primacy under the National Environmental Laboratory Accreditation Program (NELAP) as administered by The NELAP Institute (TNI). The WPCL received initial accreditation on 9/23/13 (Certificate #4023). The WPCL received additional accreditation for the analysis of lead and copper in drinking water on 6/10/2016. The WPCL did not request drinking water accreditation beginning in 2019-2020. If such accreditation is needed in the future, it will be requested at that time.

Based on successful performance of the annual DMR-QA study, the EPA and Oregon DEQ accept WPCL results for NPDES-regulated analysis. The parameters are those listed in the NPDES permits of the City of Portland and other clients (municipalities) for whom NPDES work is performed.

If accreditation or other approval is terminated or suspended, the laboratory will immediately cease to use the certificate number reference in any way and inform clients impacted by the change. Individual analyses or analytes that have not received accreditation are indicated on client reports.

Appendix G

Data Qualifiers

The list of active data qualifiers is provided in Table G-1, below. Additional data qualifiers may be added to the LIMS at any time by a LIMS administrator. Qualifiers are not deleted from the LIMS.

Qualifier statements shown as "[Custom Value]" are variable. A comment is written at the time the qualifier is applied.

Qualifiers designated "Retained" appear in the result field rather than as a qualifier flag. This allows non-numeric results to be reported.

Qualifiers designated "Comment" are only viewable in the LIMS and do not appear on reports to clients. They provide a means of internal communication between analyst and data reviewer.

Qualifier	Qualifier Statement	Retained	Comment
>1200	>1200	X	
>140	>140	X	
>14000	>14000	X	
>18	>18	X	
>22	>22	X	
>220	>220	X	
>2400	>2400	X	
>24000	>24000	X	
>240000	>240000	X	
>300	>300	X	
>350	>350	X	
>42000	>42000	X	
>60	>60	X	
>70	>70	X	
>700	>700	X	
>760000	>760000	X	
>8	>8	X	
>84000	>84000	X	
0	0	X	
0.0	0.0	X	
0.00	0.00	X	
A2	Result is the average of duplicate analysis.		
A3	Result is the average of triplicate analysis.		
A4	Result is the average of 4 analyses.		
ALK	Because the pH of the sample is less than 8.3, the total alkalinity result is equal to the bicarbonate alkalinity.		
AR0	[Custom Value]		
AR1	PCB quantified as Aroclor 1260 may be a mixture of 1260 and 1254.		
AR10	Quantification may be affected by overlapping Aroclor pattern.		
AR11	Identified Aroclor pattern differs somewhat from the reference standard, affecting quantification.		
AR2	PCB quantified as Aroclor 1254 may be a mixture of 1254 and 1260.		
AR3	PCB quantified as Aroclor 1254 may be a mixture of 1254 and 1248.		
AR4	PCB quantified as Aroclor 1248 may be a mixture of 1248 and 1254.		
AR5	PCB quantified as Aroclor 1260 may be a mixture of 1260 and 1262.		
AR6	PCB quantified as Aroclor 1248 may be a mixture of 1248 and 1016/1242.		
B1	Analyte was detected in the Method Blank at a concentration greater than one tenth the amount in the sample. Sample result may be a high estimate.		

Qualifier	Qualifier Statement	Retained	Comment
B2	Analyte was detected in the Method Blank, but at a concentration less than one tenth the amount in the sample(s).		
B3	This analyte was detected in the Method Blank but not in the samples; results are not affected.		
B4	Analyte was detected in the blank. Results are estimates.		
BF	Analyte was detected in the associated Filter Blank at a concentration greater than one tenth the amount in the sample. The sample results may be a high estimate.		
BL	This blank was carried through the leaching process.		
C1	Sample was submitted in a container that does not comply with analytical method requirements.		
C2	The sample was not preserved according to analytical method requirements.		
C3	VOA vial had headspace; target analytes may have volatilized prior to analysis.		
C4	VOA vial was not sufficiently acidified for preservation for 14-day holding time. The 7-day non-preserved holding time was exceeded.		
C5	The sample container had visible headspace.		
D1	The sample required dilution due to non-target matrix interferences, resulting in raised reporting limits.		
D2	The sample required dilution due to high levels of target analytes.		
D3	Reporting limits are raised for this sample due to the low % solids.		
D4	Reporting limit is raised for this analyte due to non-target matrix interference.		
D5	Reporting limits are raised for this sample due to non-target matrix interference.		
E	Sample result exceeded the calibration range for the analyte.		
EST	Result is an estimate.		
F0	[Custom Value]		
F1	Result for diesel-range hydrocarbons is primarily due to overlap from the heavy oil range.		
F10	Identified product appears to be weathered gasoline.		
F11	Sample aliquot was sub-sampled from a soil jar. The sub-sampled aliquot was preserved with methanol within 48 hours of sampling.		
F12	Sample aliquot was sub-sampled from a soil jar. The sub-sampled aliquot was not preserved with methanol within 48 hours of sampling. Sample results may be biased low.		
F2	Result for heavy oil is primarily due to overlap from diesel-range hydrocarbons.		
F3	Result for diesel-range hydrocarbons is primarily due to overlap from gasoline range.		
F4	Result for gasoline is primarily overlap from diesel-range hydrocarbons.		
F5	Detected components do not resemble a fuel pattern but the quantity exceeds the reporting threshold.		
F6	Surrogate recovery could not be determined due to the high concentration of hydrocarbons in the sample.		
F7	This sample underwent silica gel clean-up.		
F8	Hydrocarbons quantified as Diesel and Lube Oil appear to be a single petroleum product that is heavier than Diesel #2 and lighter than the reference Lube Oil.		
F9	Hydrocarbons were detected in one replicate but not in its duplicate. By method protocol, the sample result is DETECTED.		
FO1	The result for this field parameter is an estimate because post-measurement check of the field instrument was outside the acceptance range.		

Qualifier	Qualifier Statement	Retained	Comment
FO2	Dissolved oxygen is not reportable because it exceeds 200% of saturation concentration.		
FO3	The result for this field parameter is not reportable due to instrument malfunction.		
H1	Holding time was exceeded for this analysis due to laboratory error.		
H10	Hold time was exceeded before sample delivery to lab. Sample was analyzed upon receipt.		
H2	Holding time was exceeded for required re-analysis.		
H3	Holding time was exceeded due to delayed sample delivery.		
H4	Compliance with holding time requirement could not be verified because sample collection time was not available.		
H5	Holding time was exceeded due to delayed request for analysis.		
H6	Holding time verification is based on collection time of the earliest field sample.		
H7	Holding time was exceeded for required dilution.		
H8	Holding time exceedance for Total Solids does not adversely affect its use for calculating other results on a dry weight basis.		
H9	Sample was set up for E coli analysis more than 8 hours but less than 24 hours after sample collection.		
I1	One or more internal standard responses were outside the acceptance range due to matrix effect. Results should be considered estimates.		
I2	One or more internal standard responses were outside the acceptance range due to matrix effect. No sample remained for re-analysis. Results should be considered estimates.		
J	Analyte was detected but at a concentration below the reporting limit; the result is an estimate.		
K1	BOD result is a minimum because the seed value could not be calculated.		
K10	No peroxide detected.		
K11	Result is an estimate becaue the RPD between sample dilution results was >30%.		
K2	BOD result is a maximum because the seed value could not be calculated.		
K3	BOD result should be considered an estimate due to failed check standard result.		
K4	BOD result is an estimate based on failed duplicate precision (non-homogeneous matrix).		
K5	BOD is not reportable for regulatory purposes due to failed QC results (high blanks).		
K6	Requested BOD analysis is not reportable due to QC failure; a re-sample has been requested.		
K7	Results for multiple BOD dilutions indicate sample toxicity; reported result may be a low estimate.		
K9	The average of the blanks in the batch is acceptable; sample results may be reported.		X
KCl2	Chlorine was detected at approximately [Custom Value] ppm.		
KH2O2	Peroxide was detected at approximately [Custom Value] ppm.		
L1	Recovery for this analyte in the laboratory control sample was outside the acceptance range (low). Sample results may be low estimates.		
L2	Recovery for this analyte in the laboratory control sample was outside the acceptance range (high). Sample results may be high estimates.		

Qualifier	Qualifier Statement	Retained	Comment
L5	High recovery in the Standard Reference Material is due to use of an alternate sample preparation procedure.		
LF1	Filtration for dissolved metals occurred in the laboratory within 24 hours of sample receipt.		
LF2	Filtration for dissolved metals occurred in the laboratory more than 24 hours after sample receipt.		
M0	[Custom Value]		
M1	Matrix duplicate precision measurement indicates non-homogeneous sample matrix. Sample result should be considered an estimate.		
M10	RPD exceeds the advisory limit. Duplicate microbiology results may vary due to matrix factors and the nature of biological analysis.		
M11	Matrix spike recovery for this analyte was high; the analyte was not detected in the sample and results are not affected.		
M12	High matrix spike recovery is due to low spike amount and a trace level of target analyte not accounted for in the % recovery calculation.		
M13	Dissolved metal result greater than total metal result was verified as probable bottle contamination.		
M14	Dissolved metal result greater than total metal result was verified as probable laboratory contamination.		
M15	The result is an estimate due to chromatographic interference that affected quantitation.		
M16	MS/MSD RPD is high for this analyte; recoveries are acceptable.		
M17	Matrix spike recovery could not be determined due to high concentration of analyte in the sample.		
M18	Matrix spike recovery(ies) could not be determined due to required sample dilution.		
M19	Matrix spike recovery is outside the acceptance limits due to low spiking level and matrix interference.		
M2	Matrix duplicate precision measurement indicates non-homogeneous sample matrix.		
M20	The TCLP leachate was prepared using less than the method-specified 100 gram aliquot, due to the limited quantity of sample received. Proportionately less leaching solution was used.		
M22	Volatile organic compounds acrolein and 2-chloroethylvinyl ether were not recoverable from this sample due to acid preservation.		
M23	Duplicate RPD is not applicable for microbiology. The duplicate analysis met QC requirements.		
M24	Duplicate precision did not meet acceptance criteria. Result should be considered an estimate.		
M25	Analyte was detected in the duplicate of this sample.		
M26	Result is an estimate due to non-homogeneous matrix.		
M3	Inconsistent results for matrix QC (duplicates and/or matrix spikes) indicate non-homogeneous sample matrix. Sample results should be considered estimates.		
M4	Based on low matrix spike recovery, the sample result may be a low estimate due to matrix interference.		
M5	Based on high matrix spike recovery, the sample result should be considered an estimate due to matrix effect and/or non-homogeneous matrix.		
M6	Based on low matrix spike recovery, sample results may be low estimates due to matrix interference.		
M7	Based on high matrix spike recovery, sample results should be considered estimates due to matrix effect and/or non-homogeneous matrix.		

Qualifier	Qualifier Statement	Retained	Comment
M8	The matrix duplicate control limit is not applicable at concentrations less than 5 times the reporting limit.		
M9	Matrix spike recovery control limits are not applicable because the sample concentration is greater than 4 times the spike amount.		
N	Refer to case narrative.		
NR	NR	X	
OG0	[Custom Value]		
OG1	Based on Total Oil & Grease result <5 mg/L, Non-polar Oil & Grease is also <5 mg/L.		
OG2	Based on Total Oil & Grease result <10 mg/L, Non-polar Oil & Grease is also <10 mg/L.		
Q0	[Custom Value]		X
Q1	Analyte in blank but samples >10x amount in blank.		X
Q10	Hg 201 is reported due to Tungsten interference on Hg 202.		X
Q11	This data is not reportable but should not be deleted.		X
Q12	This Aroclor was quantitated using less than 5 peaks due to interference or overlap.		X
Q13	Overlying water was removed from the sample prior to mixing for prep.		X
Q14	Sample result(s) greater than 10 times the absolute value of the blank.		X
Q15	MDL study		X
Q2	RPD out but results are <5x MRL.		X
Q3	MS recovery out but sample concentration is >4x the spike amount.		X
Q4	All analytical criteria were met for this analysis.		X
Q5	Analyte detected in blank >1/2 MRL but samples are < MRL.		X
Q6	Analyte detected in blank >1/2 MRL but analysis of the results do not indicate contamination in the sample.		X
Q7	Dup or MS out; re-analysis of QC sample passed.		X
Q8a	Extract cleaned up with H2SO4.		X
Q8b	Extract cleaned up with H2SO4 and copper.		X
Q8d	Extract cleaned up with H2SO4, copper, and Florisil.		X
Q9	Holding time not applicable. Sample is a PT or other QC sample.		X
R	Revised result(s).		
RE1	Result is reported from re-analysis; all QA/QC criteria were met.		
RE2	Results are reported from re-analysis; all QA/QC criteria were met.		
RE3	Required re-analysis was done outside the holding time; both results are reported.		
RE4	The result was confirmed by re-analysis.		
SU1	Recovery for one or more surrogate compounds was outside the acceptance range (low). Sample results may be low estimates.		
SU2	Recovery for one or more surrogate compounds was outside the acceptance range (high). Sample results may be high estimates.		
SU3	Recovery for one or more acidic surrogates was outside the acceptance range (low). Results for acidic compounds may be low estimates.		
SU4	Recovery for one or more acidic surrogates was outside the acceptance range (high). Results for acidic compounds may be high estimates.		

Qualifier	Qualifier Statement	Retained	Comment
SU5	Surrogate recovery could not be determined due to required dilution of the sample extract.		
SU6	Recovery for surrogate compound was high. No associated target analytes were detected and results are not affected.		
SU7	High surrogate recovery is due to co-eluting matrix interferent.		
SU8	Low surrogate recovery is due to matrix interference.		
SU9	Low surrogate recovery is likely due to the high level of suspended solids in the sample.		
T1	The result for Total Suspended Solids should be considered an estimate because the high concentration affects the precision of the analysis.		
T2	The result for Total Dissolved Solids should be considered an estimate because the high concentration of suspended solids affects the precision of the analysis.		
TC1	Room temperature during extraction was outside the 21-25 °C range specified in the method.		
TC2	Due to limited sample volume, the amount extracted was less than that specified in the method.		
TIC	Refer to case narrative for information on tentatively identified compounds.		
TSS1	Dried residue was outside 2.5-200 mg as specified in the method.		
V1	Continuing calibration verification was high; sample results for this analyte may be high estimates.		
V3	Continuing calibration verification was low; sample results for this analyte may be low estimates.		
V4	Recovery for this analyte in the initial calibration verification was outside the acceptance limits (low). Sample results may be low estimates.		
V5	Recovery for this analyte in the initial calibration verification was outside the acceptance limits (high). Sample results may be high estimates.		
Z0	[Custom Value]		

Appendix H

Equipment & Maintenance

H.1 EQUIPMENT

Equipment purchasing procedures are covered in Section 9. When a major piece of equipment is needed, appropriate lab staff may participate in vendor presentations and follow-up Q&A sessions and are consulted for technical specifications and requirements. They also may be involved in the writing of technical statements of work that are incorporated into formal solicitation documents.

Minor equipment is usually replacement with the same or similar piece of equipment and vendor presentations and technical specifications are not required. Minor equipment generally costs less than $5,000.

Major equipment is decommissioned when either ongoing maintenance becomes prohibitively expensive or when regulatory and/or technical advances require purchasing new technologies. A list of major equipment is provided in Table H-1, below. The room numbers and section names are keyed to the laboratory floor plan provided in Appendix C.

H.2 MAINTENANCE

H.2.1 Vendor Maintenance Contracts. Equipment for which the WPCL carries annual vendor maintenance contracts are indicated in Table H-1 with an asterisk (*) following the description. While the degree of service may vary with individual vendors, all contracts provide for at least one annual preventative maintenance visit, a specified call-back time (e.g., within 24 or 48 hours), a specified level-of-service for instrument repair, tuning or calibration, and parts replacement.

H.2.2 Balances and Spectrophotometers. The WPCL contracts with Quality Control Services (Portland, OR) for the annual calibration and servicing of various thermometers (covering range of use), spectrophotometers, balance calibration masses, and all balances used in the lab. WPCL is provided with written certificates of service and calibration, including an attestation that calibrations are done using test standards traceable to NIST standards.

H.2.3 Ongoing Internal Maintenance & Calibrations. Tables H-2a through H-2e summarize by section the routine maintenance and calibrations done by WPCL staff and instrument vendors. Note that the laboratory's CEM microwave system (Metals) is covered in Table H-2f.

Table H-1: WPCL Major Equipment

SECTION	ROOM #	DESCRIPTION	ACQUIRED	MANUFACTURER	MODEL #
Metals	139	Laminar Flow Hood		Microzone	V8-PP-36-FX
	139	Subboiling Distillation System	2003	Milestone	Duopur
	139	Rotary Extractor (TCLP) System #1	1992	Lars Lande	--
	138	ICP System 5110*	2018	Agilent	G8014A
	138	SPS-4 Autosampler For ICP	2018	Agilent	G8410A
	138	Chiller For ICP (from old P-E instrument)	2005	Polyscience	N0772026
	138	ICP/MS System #2*	2013	Thermo Electron	iCAP-Qc
	138	Chiller	2013		
	138	Autosampler	2013	Elemental Scientific	SC-4DXS
	138	Fast System	2013	Elemental Scientific	FVA
	138	ICP/MS System #3*	2015	Thermo V.G.	iCAP-Qc
	138	Autodilutor	2015	Thermo V.G.	ID 100
	138	Fast System	2015	CETAC	ASXPRESS-PLUS
	138	Autosampler From Old X-7 ICP/MS	2007	CETAC	ASX-520
	138	Microwave Sample Digestion System*	2016	CEM	Mars 6
	138	Milli-Q Water Purification System #2*	2011	Millipore	Integral-10
	138	Centrifuge	1976	IEC	HN-S II
Microbiology	141	Autoclave (Sterilizer)*	1994	Steris	Renaissance-38
Organics	140	Extraction Solvent Evaporator #1	2002	Zymark	Turbovap II
	140	Extraction Solvent Evaporator #2	2004	Zymark	Turbovap II
	139	VOA Gas Chromatograph #1	2007	Agilent	7890A
	139	MSD (includes ion guage & NIST library)	2007	Agilent	5975C
	139	VOA Gas Chromatograph #2	2018	Agilent	7890C
	139	MSD #2 (includes ion guage & NIST library)	2018	Agilent	5975
	139	Autosampler	2012	EST Analytical	Centurian WS
	139	Concentrator #1 (solids)	2007	Tekmar	Solatek 72
	139	Concentrator #2 (aqueous)	2010	EST Analytical	Encon Evolution
	136	GC-FID System	2014	Agilent	7890
	136	Programmable Large Volume Injector	2014	ASAP	Titan XL-7890
	136	GC-ECD System	2002	Agilent	6890N
	136	Software Upgrade For GC-ECD System	2006	Agilent	
	136	Programmable Large Volume Injector	2015	ASAP	Titan XL-6890
	136	SVOA Gas Chromatograph #1	2003	Agilent	6890N
	136	Mass Spectrometer	2003	Agilent	5973N
	136	Large Volume Injector	2008	ATAS	GL-Optic-3-8270
	136	SVOA Gas Chromatograph w/ FID #2	2008	Agilent	7890A
	136	Mass Spectrometer	2008	Agilent	5975C
	136	Large Volume Injector	2012	ATAS	Optic-4
	134	SVOA Gas Chromatograph/TOF	2020	LECO	
Process/	143	10-Position Cyanide Distillation System	2014	Kimble	MIDI-VAP 4000
Gen. Chem.	142	UV/VIS Spectrophotometer	2004	Perkin-Elmer	EZ-301
	142	TOC Analyzer*	2011	Shimadzu	TOC-L CSH E100
	142	Solids Unit	2011	Shimadzu	SSM-5000A
	142	Autosampler	2011	Shimadzu	ASI-L
	142	Total-N Module for TOC Analyzer*	2018	Shimadzu	TNM-L ROHS
	135	Muffle Furnace	2018	Thermo-Fisher	F30420C
Nutrients	134	Ion Chromatograph System #2*	2016	Metrohm	Compact 930
		Autosampler For Compact-930 IC	2016	Metrohm	919
	134	Discrete Analyzer	2015	Astoria-Pacific	4600 ChemWell-T
	134	Segmented Flow Analyzer	2011	Astoria-Pacific	Astoria 2
	134	Autosampler		Astoria-Pacific	311
	134	Milli-Q Water Purification System #1*	2009	Millipore	Integral-5
	134	Undercounter Flaskwasher	2009	LabConCo	4400320
Other	--	Promium Element LIMS Software*	2010	Promium	Element
	--	Original Benchwork Throughout Lab	1996		
	151	Milli-Q Water Purification System #3*	2011	Millipore	Integral-10
In Storage	138	Cold Vapor AA	1997	CETAC	M61-991A
	139	Computer From Old PE VOA GC/MS	1999	Dell	Optiplex GXa
	139	Concentrator	2007	Tekmar	Solatek 72

Table H-2a. Nutrients Section Routine Maintenance

INSTRUMENT	PROCEDURE	INTERNAL/ VENDOR	FREQUENCY
Ion Chromatograph	check/replace ultra-filtration membrane	internal	weekly
	new/clean columns	internal	as needed
	new/clean suppressor	internal	as needed
	check/replace pump seals	vendor	semi-annual
	check valves	vendor	semi-annual
	check backup seals	vendor	semi-annual
	check autosample wear	vendor	semi-annual
	check inlet/outlet check valve	vendor	semi-annual
	check/replace line end eluent filter	internal	quarterly
	check/replace tubing	internal	as needed
Astoria Pacific SFA	clean sampler	internal	daily
	check/replace tubing	internal	as needed
	clean wash fluid recepticle	internal	as needed
	check/replace lamp	internal	as needed
Astoria Pacific DA	check/change lamp	vendor	as needed
	syringe priming	internal	as needed
Milli-pore DI System	change filters	vendor	quarterly
	check/replace UV lamp	vendor	quarterly
	sanitize	vendor	quarterly

Table H-2b. General Chemistry / Process Sections Routine Maintenance

INSTRUMENT	PROCEDURE	INTERNAL/ VENDOR	FREQUENCY
CN distillation block	replace tubing	internal	as needed
	clean vacuum valves, replace if needed	internal	as needed
	replace rubber gasket	internal	as needed
COD spectrophotometer	calibration and PM	vendor	annual
	lamp adjustment, replacement	internal	as needed
PE spectrophotometer	calibration and PM	vendor	annual
BOD LDO probe	replace sensor cap, iCal control button, stirrer	internal	as needed
pH probe	clean probe	internal	as needed
residual chlorine probe	clean probe	internal	as needed
TOC analyzer	autosampler tubing replacement	vendor	as needed
	replacing 8-port valve rotor	vendor	as needed
	replace syringe and/or syringe plunger	vendor	as needed
	regenerate,wash,and/or replace catalyst	vendor	as needed
	replace halogen and sulfur scrubber	vendor	as needed
	replace CO2 absorber	vendor	as needed

Table H-2c. Organics Section Routine Maintenance

	foreline pump oil change	vendor	biannual
VOA GC-MS	leak check	internal	as needed
P&T Concentrator	flow check	internal	as needed
	replace sparging vessel	internal or vendor	as needed
	condition/bake traps	internal	as needed
	replace traps	internal or vendor	as needed
VOA GC-MS	axis calibration for water or soils	internal or vendor	as needed
Autosampler	check displayed pressure	internal	as needed
	refill & prime internal standards	internal	as needed
	injector & sampling syringe leaks	internal	as needed
	check/refill water reservoir	internal	as needed
	empty waste container	internal	as needed

Table H-2d. Metals Section Routine Maintenance

INSTRUMENT	PROCEDURE	INTERNAL/ VENDOR	FREQUENCY
Agilent ICP	check air supply for RF coil cooling	internal	daily
	check chiller coolant fluid level	internal	daily
	check vent system flow rate	internal	daily
	inspect/clean torch, glassware and injector tube	internal	daily
	inspect/clean nebulizer and capillary tubing	internal	daily
	inspect/replace pump tubing	internal	daily
	inspect/clean drain tubing, empty drain bottle	internal	daily
	check/replace pump rollers	internal	as needed
	clean pump head	internal	as needed
	check/replace spray chamber drain fittings, tubing and connection	internal	as needed
	clean/replace spectrometer and generator air filters	vendor	as needed
	check for pitting of RF coil	vendor	as needed
Thermo ICP/MS	complete instrument log	internal	daily
	inspect/clean cones	internal	daily
	prepare fresh performance monitoring solution	internal	weekly
	clean/replace ICP glassware	internal	weekly
	replace peristaltic pump tubing	internal	as needed
	clean spray chamber drain plug & nebulizer	internal	weekly
	check/clean air filter	internal	as needed
	replace sample uptake tubing	internal	monthly
	check rotary pump oil & oil mist filters	vendor	annual
	check chiller reservoir water level	internal	monthly
	check/clean lens system & penning gauge	vendor	annual
	change rotary pump oil	vendor	annual
	replace work o-rings	vendor	annual

Table H-2e. CEM Microwave Systems Routine Maintenance

INSTRUMENT	PROCEDURE	INTERNAL/ VENDOR	FREQUENCY
CEM Mars 6	clean pressure control cable contacts	internal	as needed
Microwave (metals)	inspect/replace vessel insulator sleeve	internal	as needed
	inspect/replace vessel cap assembly	internal	as needed
	replace vessel cap pressure safety membrane	internal	as needed
	replace fiber optics cable	internal	as needed
	magnetron leak test	vendor	annual
	cavity vent leak test	vendor	annual
	door leak test	vendor	annual
	waveguide leak test	vendor	annual
	blower leak test	vendor	annual
	I/O port leak test	vendor	annual
	temperature calibration check	vendor	annual
	check power	vendor	annual

Table H-2f. Microbiology Section Routine Maintenance

INSTRUMENT	PROCEDURE	INTERNAL/ VENDOR	FREQUENCY
Steris Autoclave	general cleaning	internal	weekly
	check temperature maximum	internal	as needed
	spore strips	internal	monthly
	check timer	internal	quarterly
	replace safety valve	vendor	annual
	calibrate temperature & pressure	vendor	annual
	check/replace piping, valve, other parts	vendor	annual
Laminar Flow Hood	check pressure across HEPA filter	internal	monthly
	replace HEPA filter	internal	as needed
	clean hood	internal	monthly
UV lamp	replace lamp bulb	internal	annual
Incubators	clean	internal	monthly
Water Baths	clean & add algacide	internal	monthly
Refrigerators	clean	internal	monthly
Sepco Pipet	lubricate parts & check volume	internal	monthly

Appendix I

Table I-1. WPCL Policy Statements

WPCL policy statements are tabulated below and available on the Group 100 common drive at

GROUP 100 (\\OBERON) S:\LAB\Policy Statements.
This list is an example and others may be available.

#	TYPE	ORIGINATED	UPDATED	TITLE/SUBJECT
1	operations	08/01	6/20	Lab Automobile
4	QA*	03/02	2/18	Compromised Samples
5	operations	03/02	---	Lab Tours
6	operations	04/02	---	Archive Room Access
10	QA*	10/02	04/13	Late-Arriving Samples
11	QA*	01/02	1/18	Sample Receiving
12	QA*	08/03	04/13	Method Appropriateness
13	QA*	03/04	---	Indirectly Relinquished Samples
15	operations	09/04	04/13	Training Opportunities
17	operations	5/11	---	Management Reviews
18	operations	10/10	---	Standby
19	operations	08/12	---	Prohibition Against Pro Bono Work
20	QA*	08/12	---	Lab Access
21	QA*	08/12	---	Non-Capital Purchasing
22	QA*	04/99	2/18	Documentation of Reagents, Standards
23	operations	11/12	---	Prohibition Against Using Flash Drives on the Lab Network
30	QA	07/98	---	Sample Dilution
33	QA	05/03	08/17	Trip Blank Identification and Log-In
34	QA*	02/03	01/18	Emergency Sample Receiving Instructions
35	QA/ops	6/13	---	Field Sampling Updates
36	QA/ops	8/13	10/21	Ongoing DOC
37	QA/ops	7/13	---	Verifying Standards & Reagents
39	QA/ops	10/13	07/19	Chemical Preservation for Outside Clients
40	QA/outside	1/15	5/16	Microbiology Sample Bottles
41	QA/ops	5/15	8/15	Sub-contract Short Hold Samples
42	QA/ops	8/15	01/19	Limited-volume Sample Handling
43	QA/ops	8/16	01/18	Instrument Identification
44	QA/outside	3/17	---	Notification of Analysis Changes
45	operations	5/17	---	Analytical Policy Statements
47	operations	7/17	---	Solids Benchsheet Documentation
48	operations	11/17	11/19	Plant Sampling During City Closure
49	QA/ops/out	2/18	---	Dissolved Metals Qualifier
50	QA/ops	4/99	2/18	Documentation of Equipment maintenance
51	QA/ops/out	6/18	---	Field Dup Lab Sample Handling
53	operations	6/19		Process/General Chemistry Sample Storage
54	operations	3/20		Plant Sampling During Widespread Absences
55	operations	5/20		Verifying VOA Vial Preservation
56	QA/ops/out	10/21		Electronic Signatures
57	QA	11/21	---	Non-class A Glassware

* Referenced in Quality Manual.

Appendix J

Significant Figures and Rounding

The number of significant figures reported for a sample result depends on the precision of the measurement system. Different analyses have different levels of precision. This document states the determined number of significant figures to be reported for the various analyses performed at WPCL, and also clarifies the protocol for rounding off to significant figures for final reporting and QC calculations.

The standard laboratory criterion is used for assigning significant figures: the measurement with the least number of significant figures determines the significant figures in the final reported result. That still leaves questions about the precision of some measurements, and sample matrix can affect the precision of measurements applied to the sample. When matrix effects are a consideration, fewer significant figures should be reported.

The number of significant figures reported for a given analysis also depends upon how close the result is to the reporting limit. Lower results commonly have fewer significant figures reported because the significance of digits that are lower than the reporting limit is questionable. Sample results are generally reported to no more than one decimal place past the reporting limit and may be limited to the same number of places as in the reporting limit.

The following table lists significant figures for reporting results at WPCL. The LIMS is programmed to round final results to the appropriate significant figures and decimal places. Method SOPs address any special significant figure reporting issues, such as TSS. For QC results an extra significant figure is usually reported, to increase precision in calculated spike recoveries and RPD values.

Analysis	Significant Figures Reported
Alkalinity	3 generally, but 2 for results <10.0
Ammonia	3
Anions by IC	3
BOD	up to 3, whole numbers only
Chlorophyll-*a*	3 generally, but 2 for results <10.0
COD	2
Conductivity	3
Cyanide	3
E.coli/total/fecal coliforms	2
Hardness (by ICP or ICPMS)	3
Metals by ICP	3
Metals by ICP-MS, water	3
Metals by ICP-MS, soil	3
NWTPH-Dx	2
Nitrite	3
Oil & Grease	3
ortho-Phosphate	3
PAH	2
PCBs	3

pH	report to the tenths place
Phosphorus, Total	3
Residual chlorine	2 generally, but 3 for results >1.00
Semivolatile Organics	2
TOC	3
TKN	3
TDS	3, whole numbers only
TS-waters	3, whole numbers only
TS-solids	3 generally, but 2 for results <1.00
TSS	3, whole numbers only
Volatile Acids	2
Volatile Organics	3

The basic protocol for rounding off is: above 5 rounds up, below 5 rounds down, and 5 rounds to the nearest even number. Thus, 8850 rounds to 8800. There are two specific points that need clarification. The first is, when there are non-zero digits following a 5, you do consider those digits and round up. For example, if a calculated result is 8851 and you are rounding to two significant figures, round up to 8900 because "51" is greater than 50.

The second common question concerns *when* to do the rounding. Always use more significant figures in the calculations than will be used for the final reported result. If, for example, a sample is diluted, applying the rounding too early will affect the final result:

Analysis result = 156	Rounded analysis result = 160
Dilution factor = 2	Dilution factor = 2
Final result = 312, rounded to **310**	**Final result = 320**

When calculating QC statistics, very different values may be attained when working at the high or low end the result range. For spike recoveries, if the sample result is above the spike amount, the calculated spike recovery can be significantly affected by rounding:

Sample result = 116 mg/L	Rounded sample result = 120
Spike amount = 50 mg/L	Spike amount = 50 mg/L
Spike result = 164	Rounded spike result = 160
Spike recovery = 96%	**Spike recovery = 80%**

For duplicate RPD, the effect is especially evident at the low end of the reporting range when fewer significant figures are reported at the low end:

TSS Result 1 = 7.6	Rounded result 1 = 8
TSS Result 2 = 6.4	Rounded result 2 = 6
RPD = 17	**RPD = 29**

These two QC examples both show situations that favor the analyst by not rounding too early. There are other situations where rounding would bring unacceptable QC results into range, but it is not allowable to use rounding to make the data look better.

The WPCL policy is to always use at least one extra significant figure in calculations, leaving the rounding until the end.

Appendix K

Table K-1. WPCL List of Analyses

Accreditation status may change. Check LIMs and current Field of Accreditation documentation for current status.

Analysis Description	Matrix	Specific Method	Instrument
Ammonia-Nitrogen	Solid	EPA 350.1	-
Ammonia-Nitrogen	Water	EPA 350.1	-
Ash (fixed solids)	Solid	SM 2540G	-
Ash (fixed solids)	Water	EPA 160.4	-
Bicarbonate Alkalinity	Water	SM 2320B	-
Biochemical Oxygen Demand (BOD)	Water	SM 5210B/ H10360	-
Bromide	Solid	EPA 300.0	-
Bromide	Water	EPA 300.0	-
Carbonaceous BOD	Water	SM 5210B/ H10360	-
Chemical Oxygen Demand (COD)	Water	SM 5220D	-
Chloride	Solid	EPA 300.0	-
Chloride	Water	EPA 300.0	-
Chlorophyll a	Water	SM 10200H	-
Conductivity	Water	SM 2510B	-
Copper (withdrawn until needed)*	Drinking water	EPA 200.8	ICP-MS
Cyanide, amenable*	Water	SM 4500-CN HK	-
Diesel/Oil Hydrocarbons	Solid	NWTPH-Dx	GC-FID
Diesel/Oil Hydrocarbons	Solid as rcvd	NWTPH-Dx	GC-FID
Diesel/Oil Hydrocarbons	Water	NWTPH-Dx	GC-FID
Diesel/Oil Hydrocarbons SPLP	Solid	NWTPH-Dx	GC-FID
Diesel/Oil Hydrocarbons SPLP	Solid as rcvd	NWTPH-Dx	GC-FID
Dissolved BOD	Water	SM 5210B/ H10360	-
Dissolved COD	Water	SM 5220D	-
Dissolved Metals	Water	EPA 200.7	ICP
Dissolved Metals	Water	EPA 200.8	ICPMS
Dissolved Organic Carbon	Water	SM 5310B	-
Dissolved Oxygen*	Water	H10360	-
E. coli	Solid	SM 9221F	MPN
E. coli	Water	Colilert QT	Colilert QT
E. coli*	Water	SM 9221F	MPN
Fecal Coliform Bacteria	Solid	SM 9221E	MPN
Fecal Coliform Bacteria*	Water	SM 9221E	MPN
Flocculated COD*	Water	SM 5220D	-
Fluoride	Solid	EPA 300.0	-
Fluoride	Water	EPA 300.0	-
Gasoline/Hydrocarbons	Solid	NWTPH-Gx	GC-MS
Gasoline/Hydrocarbons	Solid as rcvd	NWTPH-Gx	GC-MS

Gasoline/Hydrocarbons	Water	NWTPH-Gx	GC-MS
Hardness	Water	Calculation	ICP/ICPMS
Herbicides, Chlorinated	Water	EPA 515.4, modified	GC-MS
Hydrocarbon Scan	Solid	NWTPH-HCID	GC-FID
Hydrocarbon Scan	Solid as rcvd	NWTPH-HCID	GC-FID
Hydrocarbon Scan	Water	NWTPH-HCID	GC-FID
Lead (withdrawn until needed)*	Drinking water	EPA 200.8	ICP-MS
Nitrate	Solid	EPA 300.0	-
Nitrate	Water	EPA 300.0	-
Nitrite	Water	EPA 300.0	-
Nitrite	Water	EPA 353.2	-
Nitrite*	Water	SM 4500-NO2 B	-
Oil & Grease (Non Polar)	Solid	EPA 1664	-
Oil & Grease (Non Polar)	Solid as rcvd	EPA 1664	-
Oil & Grease (Non Polar)	Water	EPA 1664	-
Oil & Grease (Total)	Solid	EPA 1664	-
Oil & Grease (Total)	Solid as rcvd	EPA 1664	-
Oil & Grease (Total)	Water	EPA 1664	-
Organic Matter	Solid	SM 2540G	-
Organic Matter	Water	SM 2540E	-
ortho-Phosphate-P	Water	EPA 300.0	-
ortho-Phosphate-P	Water	EPA 365.1	-
PCB Aroclors	Solid	EPA 8082	GC-ECD
PCB Aroclors	Solid as rcvd	EPA 8082	GC-ECD
PCB Aroclors	Water	EPA 8082	GC-ECD
PCB Aroclors	Wipe	EPA 8082	GC-ECD
Pentachlorophenol	Water	EPA 8270	GCMS
Pentachlorophenol	Solid	EPA 8270-SIM	GCMS-SIM
Pentachlorophenol	Water	EPA 8270-SIM	GCMS-SIM
pH	Solid	EPA 9045	-
pH	Solid as rcvd	EPA 9045	-
pH	Water	SM 4500-H B	-
Polynuclear Aromatic Hydrocarbons	Solid	EPA 8270-SIM	GCMS-SIM
Polynuclear Aromatic Hydrocarbons	Solid as rcvd	EPA 8270-SIM	GCMS-SIM
Polynuclear Aromatic Hydrocarbons	Water	EPA 8270-SIM	GCMS-SIM
Polynuclear Aromatics & Phthalates#	Solid	EPA 8270-SIM	GCMS-SIM
Polynuclear Aromatics & Phthalates#	Solid as rcvd	EPA 8270-SIM	GCMS-SIM
Polynuclear Aromatics & Phthalates	Water	EPA 8270-SIM	GCMS-SIM
Polynuclear Aromatics, PCP, & Phthalates#	Solid	EPA 8270-SIM	GCMS-SIM
Polynuclear Aromatics, PCP, & Phthalates	Water	EPA 8270-SIM	GCMS-SIM
Pyrene	Water	EPA 8270-SIM	GCMS-SIM
Residual Chlorine	Water	SM 4500-Cl D	-
Semivolatile Organic Compounds	Water	EPA 625.1	GCMS
Semivolatile Organic Compounds	Water	EPA 8270	GCMS
Semivolatile Organic Compounds SPLP	Solid	EPA 8270	GCMS
Semivolatile Organic Compounds, Acids	Water	EPA 625.1	GCMS
Settleable Solids*	Water	SM 2540F	-
SPLP Metals	Solid	EPA 6010	ICP

SPLP Metals	Solid	EPA 6020	ICPMS
Sulfate	Solid	EPA 300.0	-
Sulfate	Water	EPA 300.0	-
TCLP Metals	Solid	EPA 6010/6020	ICP/ICPMS
TCLP Metals	Solid as rcvd	EPA 6010/6020	ICP/ICPMS
Total Alkalinity	Water	SM 2320B	-
Total Coliform Bacteria	Water	SM 9223B	Colilert QT
Total Cyanide	Solid	SM 4500-CN E	-
Total Cyanide	Water	SM 4500-CN E	-
Total Dissolved Solids	Water	SM 2540C	-
Total Kjeldahl Nitrogen	Solid	EPA 351.2	-
Total Kjeldahl Nitrogen	Water	EPA 351.2	-
Total Kjeldahl Nitrogen	Water	calculation	
Total Metals**	Solid	EPA 6010	ICP
Total Metals	Solid	EPA 6020	ICPMS
Total Metals	Solid as rcvd	EPA 6010	ICP
Total Metals	Solid as rcvd	EPA 6020	ICPMS
Total Metals	Water	EPA 200.7	ICP
Total Metals	Water	EPA 200.8	ICPMS
Total Metals-mercury	Water	WPCLSOP M-10	ICPMS
Total Metals	Wipe	EPA 6020 mod	ICPMS
Total Nitrogen	Water	ASTM D8083	
Total Organic Carbon	Water	SM 5310B	-
Total Phosphorus	Solid	EPA 6020	ICPMS
Total Phosphorus	Water	EPA 200.8	ICPMS
Total Phosphorus	Solid	EPA 6010	ICP
Total Phosphorus	Water	EPA 200.7	ICP
Total Solids	Solid	SM 2540G	-
Total Solids	Water	SM 2540B	-
Total Suspended Solids	Water	SM 2540D	-
Total Suspended Solids, whole volume*	Water	SM 2540D Mod	-
Volatile Acids*	Water	SM 5560	-
Volatile Organic Compounds	Water	EPA 624.1	GCMS
Volatile Organic Compounds	Water	EPA 8260	GCMS
Volatile Organics, BTEX	Water	EPA 624.1	GCMS
Volatile Organics, BTEX	Solid	EPA 8260	GCMS
Volatile Organics, BTEX	Solid as rcvd	EPA 8260	GCMS
Volatile Organics, BTEX	Water	EPA 8260	GCMS
Volatile Solids	Solid	SM 2540G	-
Volatile Solids	Water	SM 2540E	-
Volatile Suspended Solids*	Water	SM 2540E	-

* not NELAC accredited
** Sn and V not accredited by ICP
# accreditation pending on phthalates on solid

Appendix L

Containers, Preservation, and Holding Times

☼ In addition to required chemical preservation, samples are refrigerated per method requirements.

Analysis	Container	Chemical Preservation ☼	Holding Time
GENERAL CHEMISTRY / NUTRIENTS			
Anions (F, Cl, Br, SO_4)	½ Pint[1] Plastic	none	28 days
Ammonia-N	½ Pint[2] Plastic	H_2SO_4 to pH 1.8-2.0	28 days
Alkalinity	Pint Plastic[5]	none	14 days
BOD	Quart Plastic	none	48 hours
COD	½ Pint Plastic	H_2SO_4 to pH <2.0	28 days
Chlorophyll a	Liter Glass amber	none	filter 48 hrs, frozen filter 30 days
Conductivity	½ Pint Plastic	none	28 days
Cyanide, Total	Pint Plastic	NaOH to pH >12.0	14 days
Cyanide, Amenable	Pint Plastic	NaOH to pH >12.0	14 days
DOC	125 mL Glass amber[13]	HCl to pH 2-3	28 days
*Flash Point	½ Pint[5] Glass	none	14 days
*Grain Size	8 oz. glass jar (or 2 x 4 oz.)	none	14 days
Hardness	½ Pint Plastic	HNO_3 to pH <2.0	6 months
*MBAS Surfactants	Pint Plastic	none	48 hours
Nitrate-N	½ Pint[1] Plastic	none	48 hours
Nitrite-N	½ Pint[3] Plastic	none	48 hours
Oil & Grease, industries	400 mL Glass wide-mouth	HCl to pH <2.0	28 days
Oil & Grease, environmental	Liter Glass	HCl to pH <2.0	28 days
*Particle Size	Liter Plastic	none	14 days
pH	½ Pint Plastic	none	15 minutes[15]
ortho-Phosphate-P	½ Pint[3] Plastic[13]	none	48 hours
Phosphorus, Total	½ Pint[11] Plastic	HNO_3 to pH <2.0	6 months
Residual Chlorine	Pint Plastic	none	15 minutes[15]
Solids (Residue)			
Dissolved	Pint[4] Plastic	none	7 days
Suspended	Pint[4] Plastic	none	7 days
Total	Pint[4] Plastic	none	7 days
*Sulfide	500 mL vial[5] Plastic	ZnAce/NaOH	7 days
TKN	½ Pint[2] Plastic	H_2SO_4 to pH <2.0	28 days
TN	½ Pint[2] Plastic	H_2SO_4 to pH <2.0	28 days
TOC	250 mL Glass amber	HCl to pH 2-3	28 days
*Turbidity	½ Pint Plastic	none	48 hours
Volatile Acids	Pint Plastic	none	14 days
METALS in Water			
ICP-MS Total Metals	Pre-cleaned 500mL Plastic	HNO_3 to pH <2.0	6 months
Mercury	Pre-cleaned 500mL Plastic	HNO_3 to pH <2.0	28 days
ICP Total Metals	Pint Plastic	HNO_3 to pH <2.0	6 months
Dissolved Metals	Pre-cleaned 500mL Plastic	filter, then HNO_3 pH <2.0	6 months

Analysis	Container	Chemical Preservation ☼	Holding Time
ORGANICS in Water			
*Dioxins/Furans	Liter Glass amber	none	7/40 days
*Herbicides	varies	varies	7 or 14 days
Herbicides 515.4mod	500 mL Glass amber	none	14/7 days
HCID, Dx	500 mL Glass amber	none	7/40 days
*Organotins	Liter Glass amber	none	14/40 days
PAH/phthalates/PCP	500 mL Glass amber	none	7/40 days
PCB	Liter Glass amber	none	180/40 days
*Pesticides / PCB	Liter Glass amber[12]	none	7/40 days
*Phenols	500mL or Liter Glass amber	H_2SO_4 to pH <2.0	28 days
Semi-Volatiles (EPA 625, 8270)	500 mL Glass amber	none	7/40 days
Volatiles – Gx, BTEX, EPA 624, and 8260	3 x 40 mL vials[5] Glass and	none[6]	7 days[14]
	1 x 40 mL vial[5] Glass	HCl to pH <2.0[6]	14 days
Volatiles - EPA 624 Composite[7]	4-7 x 125 mL vials[5] Glass	none or $Na_2S_2O_3$[7]	14 days
MICROBIOLOGY in Water			
Total Coliforms	250 mL[8] Plastic sterile	none or $Na_2S_2O_3$ [9]	8 or 24 hours
Fecal Coliforms	250 mL[8] Plastic sterile	none or $Na_2S_2O_3$ [9]	8 or 24 hours
E. coli	250 mL[8] Plastic sterile	none or $Na_2S_2O_3$ [9]	8 or 24 hours
SOIL, SLUDGE SAMPLES			
Anions	1 x 4 oz jar or plastic bag	none	28 days
E.coli or Fecal coliforms	Whirlpack bag sterile	none	24 hours
Metals, except Mercury	1 x 4 oz jar [10]	none	6 months
Mercury	1 x 4 oz jar [10]	none	28 days
Nutrients (N or P species)	1 x 4 oz jar or plastic bag	none	28 days
Organic Analyses, various	1 x 4 oz jar per test [10]	none	14 days most
pH	1 x 4 oz jar [10]	none	
Volatiles	5035 container	methanol	14 days
TCLP or SPLP	1 x 4 oz jar [10]	none	refer to analyte HT
Total Solids	1 x 4 oz jar [10]	none	7 days
Total Solids/Volatile Solids, Ash, Organic Matter	1 x 4 oz jar or plastic bag	none	7 days

* Analysis performed by a contract laboratory
[1] If collecting for Nitrate and other Anions, a single ½ Pint is enough.
[2] If collecting for Ammonia and TKN, collect a single sample of 1 pint.
[3] If collecting for ortho-Phosphate and Nitrite, a single ½ Pint is enough.
[4] If collecting for 2 or 3 Solids analyses, collect a single sample of 1 quart. For low-level TSS, collect a separate quart.
[5] Sample must be collected with no headspace or air bubble remaining in the vial.
[6] Method 624 requires 1 HCl-preserved vials + 3 non-preserved vial for 2-chloroethyl vinyl ether and acrolein.
[7] For VOA composites, several grab samples are collected in 125-mL bottles, composited by the laboratory into HCl-preserved 40-mL vials + at least 1 non-preserved 40-mL vial for 2-chloroethyl

vinyl ether. For chlorinated effluent samples, the 125-mL bottles contain $Na_2S_2O_3$ for dechlorination. Volume of individual grabs may vary depending on permit requirements.
[8] One 250 mL bottle is sufficient for multiple tests.
[9] For chlorinated effluent samples, $Na_2S_2O_3$ is added for dechlorination.
[10] Sample jars may be shared to some extent. Volatiles analyses require a separate jar. One jar may provide enough volume for up to 3 tests + total solids. However, it is preferable to have separate jars for organics and metals.
[11] If collecting for Hardness and Total Phosphorus, a single ½ Pint is enough. If collecting for other metals, a single pre-cleaned 500mL plastic is enough.
[12] For low-level 608 analyses, 2 Liter Glass amber bottles are required.
[13] Field filtered
[14] Hold time 3 days for acrolein.
[15] Samples are analyzed upon receipt and qualified.

Appendix M

Vendors

Chemicals	Instrument & parts	Service/PT Provider	Standards	Supplies
Acros	Agilent	ERA	Acculon	Alconox
Alfa Aesar	AND	NW Tech Glass	Accu-Standard	Cole Parmer
Amresco	Astoria Pacific	Phenova	Aqua Solutions	Fisher
Astoria Pacific	Brand	QC Services	BDH	Hach
BDH	Branson	Sovereign Analytical	Chem Service	Idexx
Burdick & Jackson	Brinkmann	Promium	CPI International	Microtech Scientific
Chemproducts	Burrell	Mera	ERA	Nurnberg Scientific
EMD	Cascade Tek		Hach	NW Tech Glass
Fisher	CEM		High Purity	VWR International
Foss Analytical	Dionex		Inorganic Ventures	ICHEM
Hach	Environmental Express		Labchem	ESS
JT Baker/Baker	Fisher		Mesa Labs	CTL
Labchem	Hach		Microtech Scientific	Dymo
Macron	Idexx		NIST	BD
Mallinckrodt	Leco		o2si	Coors Tek
MCB	Metrohm		Perkin Elmer	Kimax
Merck kGaA	Millipore		QCD Analysts	Pyrex
Metrohm	Ohaus		Raven	Stockwell
Microtech Scientific	Phenomenex		Restek	Falcon
MP Biomedical	Sartorius		Ricca	EP Scientific
Ricca	Shimadzu		Sigma Aldrich	
Sigma Aldrich	Thermo		Spex Certi-Prep	
Spectrum	VWR International		Supelco	
Supelco			Thermo	
TCI			VHG Labs	
Thermo			VWR International	
VWR International				

New Supplier / Vendor Evaluation Form Example

Requested by:

Date:

Supplier name:

Item or service:

Is the item or service available from this supplier:

Is the item or service of the appropriate quality?

Is the item or service available from this supplier in the time frame required?

Reason for choosing this supplier:

Lab Manager approval: Date:

Memo updated: 02/23/11

State of Oregon
Department of Environmental Quality Memorandum

To: Willamette Basin Permit Writers **Date:** 12/23/10

From: Agnes Lut, Willamette Basin Phase 2 Hg TMDL Coordinator

Section: Watershed Management, Water Quality Division, HQ

Subject: Mercury Monitoring Requirements for Willamette Basin Permittees

Mercury (Hg) data is needed from permitted sources in the Willamette Basin in order to fill critical data gaps identified during Phase 1 and to complete Phase 2 of the Willamette Hg Total Maximum Daily Load (TMDL). In-river ambient Hg data is being collected by the Department to be used with the Hg data collected by the permitted sources to develop the Phase 2 Willamette Basin Hg TMDL. Any questions regarding this requirement are to be directed to Agnes Lut, 503-229-5247, Phase 2 Willamette Hg TMDL Coordinator.

This memo outlines the mercury monitoring requirements that are to be added to Willamette Basin permits as they are issued or renewed. The permit types in the Willamette Basin that will monitor for mercury and methyl mercury were selected based on their potential to be a source of mercury or methyl mercury. The specific permit types are:

- Major Industrial
- Major Municipal
- Specific Minors:
  - NPDES-IW-B08
  - NPDES-IW-B15
  - NPDES-IW-B16
  - NPDES-IW-B19
  - NPDES-IW-B20
  - NPDES-IW-B21
- MS4 Phase I Stormwater

Each point source permit type identified above is required to monitor for total and dissolved mercury and methyl mercury. Point sources are required to use the following methods for sample collection and analysis:

- EPA Method 1669 ultra clean sampling protocol to collect samples
- EPA Method 1631E for mercury analyses
- EPA Method 1630 for methyl mercury analyses

The following Level of Quanitation (LOQ) shall be achieved but may vary slightly depending on effluent quality and matrix interference. The reason for stating the acceptable LOQ is to assure that the analysis is conducted to environmentally relevant concentrations for non-detects.

- Mercury, total and dissolved: LOQ = 0.5 ng/l;
- Methyl mercury, total and dissolved: LOQ = 0.05 ng/l.

The point sources will be required to collect samples during a time that would be representative of typical effluent flow and mercury removal efficiency. Sample collection will occur during day light hours, typically between the hours of 2pm and 7pm. Samples will be collected from the effluent.

The effluent discharge flow rate will be recorded at the time the mercury sample is collected. Flow or rainfall will be collected, estimated or modeled for each stormwater monitoring event.

This data will be used by DEQ to develop the Phase 2 Willamette Mercury TMDL, calculate the mercury loading capacity and set load allocations. During the Phase 1 TMDL DEQ did not have sufficient Willamette specific mercury data to conduct a thorough source identification. Additionally, the data is needed to verify or revise the modeling that was used to develop the interim water-column guidance value of 0.92 ng/L total mercury that was set for protecting beneficial uses in the Phase 1 mercury TMDL.

Determining how the mercury and methylmercury monitoring will be implemented by permittees is up to the discretion of the permit writer with consultation with the TMDL coordinator, Agnes Lut.

Major Industrial and Municipal:

The following mercury and methyl mercury requirements are to be specified in each **major industrial and municipal permit** issued or renewed in the Willamette Basin, using the EPA methods and limits of quanitation identified above :

Sample Parameters	Sampling Frequency	Sampling Type
Total mercury Dissolved mercury	2 times / year, for **2** years September and February, (*See Note 1*)	Grab, during the daylight hours
Total methyl mercury Dissolved methyl mercury	2 times / year, for **2** years September and February, (*See Note 1*)	Grab, during the daylight hours

Below is the language referencing Note 1 to include in the permit. After two years of monitoring is fulfilled, creating a minimum of 4 samples, the permit writer shall review the data and contact the TMDL Coordinator, Agnes Lut, to determine whether additional monitoring is warranted. If additional monitoring is not warranted, the Department may eliminate the mercury monitoring from the permit.

Note 1: After 2 years of monitoring (minimum of 4 samples), the permittee may request in writing to the Department that the mercury and methyl mercury monitoring be eliminated. The monitoring may be eliminated only after written approval by the Department. Monitoring for total and dissolved mercury must be performed according to US EPA method 1631E with a quanitation limit of 0.5 ng/L. Monitoring for total and dissolved methyl mercury must be performed according to US EPA method 1630 with a quanitation limit of 0.05 ng/L. The effluent

discharge flow rate will be recorded at the time the mercury sample is collected.

Minor Industrial:

The following 27 identified **minor industrial** facilities are to include mercury and methyl mercury monitoring (source: SIS download 1/24/11):

Common Name	Region	Permit Nbr	Permit Type	Permit Writer
EVRAZ OREGON STEEL	NWR	101007	NPDES-IW-B08	Burkhart
J.H. BAXTER & CO., INC.	WR	102432	NPDES-IW-B15	
KOPPERS	NWR	101642	NPDES-IW-B15	Burkhart
MCFARLAND CASCADE POLE & LUMBER CO	WR	102392	NPDES-IW-B15	
OREGON STATE UNIVERSITY	WR	102735	NPDES-IW-B15	Pfauth
SLLI	NWR	101180	NPDES-IW-B15	Burkhart
SUNSTONE CIRCUITS	NWR	101015	NPDES-IW-B15	Burkhart
ARCLIN	WR	101235	NPDES-IW-B16	
CASCADE STEEL	WR	101487	NPDES-IW-B16	Schnurbusch
COVANTA MARION, INC	WR	101240	NPDES-IW-B16	Graybill
GEORGIA-PACIFIC CHEMICALS LLC	WR	101474	NPDES-IW-B16	Schnurbusch
GP MILLERSBURG RESIN PLANT	WR	102603	NPDES-IW-B16	Graybill
OREGON-CANADIAN FOREST PRODUCTS - NORTH PLAINS	NWR	101634	NPDES-IW-B16	Wiren
COTTAGE GROVE LUMBER	WR	101449	NPDES-IW-B19	Schnurbusch
FRANK LUMBER CO. INC.	WR	101583	NPDES-IW-B19	Graybill
HULL-OAKES LUMBER CO.	WR	101466	NPDES-IW-B19	
RSG FOREST PRODUCTS - LIBERAL	NWR	100929	NPDES-IW-B19	Burkhart
SENECA SAWMILL COMPANY	WR	101893	NPDES-IW-B19	McFetridge
DURAFLAKE	WR	100668	NPDES-IW-B20	Schnurbusch
FOSTER ENGINEERED WOOD PRODUCTS (EWP)	WR	101777	NPDES-IW-B20	Graybill
KINGSFORD MANUFACTURING COMPANY -	WR	102153	NPDES-IW-B20	Wiltse
ROSBORO	WR	101467	NPDES-IW-B20	Ullrich
STIMSON LUMBER COMPANY - FOREST GROVE	NWR	101480	NPDES-IW-B20	Burkhart
JASPER WOOD PRODUCTS, LLC	WR	101427	NPDES-IW-B21	Graybill
PACIFIC WOOD PRESERVING OF OREGON, INC.	WR	101267	NPDES-IW-B21	Graybill
PERMAPOST	NWR	101489	NPDES-IW-B21	Burkhart
ROYAL PACIFIC INDUSTRIES INC	WR	101213	NPDES-IW-B21	Graybill

The following mercury and methyl mercury requirements are to be specified using the above identified EPA methods and limits of quanitation for minor industrials:

Sample Parameters	Sampling Frequency	Sampling Type
Total mercury Dissolved mercury	2 times / year, for **1** year, September and February (*See Note 2*)	Grab, during the daylight hours
Total methyl mercury Dissolved methyl mercury	2 times / year, for **1** year, September and February (*See Note 2*)	Grab, during the daylight hours

Below is the language referencing Note 2 to be included in the permit. After one year of monitoring is fulfilled, creating a minimum of 2 samples, the permit writer shall review the data and contact the TMDL Coordinator, Agnes Lut, to determine whether additional monitoring is warranted. If additional monitoring is not warranted, the Department may eliminate the mercury monitoring requirement from the permit.

Note 2: After 1 year of monitoring (minimum of 2 samples), the permittee may request in writing to the Department that the mercury and methyl mercury monitoring be eliminated. The monitoring may be eliminated only after written approval by the Department. Monitoring for total and dissolved mercury must be performed according to US EPA method 1631E with a quanitation limit of 0.5 ng/L. Monitoring for total and dissolved methyl mercury must be performed according to US EPA method 1630 with a quanitation limit of 0.05 ng/L. The effluent discharge flow rate will be recorded at the time the mercury sample is collected.

MS4 Phase 1 Stormwater:

The following mercury and methyl mercury requirements are to be specified using the above identified EPA methods and limit of quanitation in each **MS4 Phase 1** Stormwater permit issued or renewed in the Willamette Basin:

Sample Parameters	Sampling Frequency	Sampling Type
Total mercury Dissolved mercury	2 times / year, for **2** years, Wet and Dry storm season (*see Note 3*)	Grab, during the storm event
Total methyl mercury Dissolved methyl mercury	2 times / year, for **2** years, Wet and Dry storm season (*see Note 3*)	Grab, during the storm event

The mercury and methyl mercury samples must be collected from a representative set of stormwater outfalls during significant runoff events.

Below is the language referencing Note 3 to include in the permit. A summer event is considered to be equivalent to a dry season storm event (May 1-September 30), and a winter

event is equivalent to a wet season storm event (October 1-April 30). After two years of monitoring is fulfilled, creating a minimum of 4 samples, the permit writer shall review the data and contact the TMDL Coordinator, Agnes Lut, to determine whether additional monitoring is warranted. If additional monitoring is not warranted, the Department may eliminate mercury monitoring requirements from the permit.

Note 3: After 2 years of monitoring (minimum of 4 samples), the permittee may request in writing to the Department that the mercury and methyl mercury monitoring be eliminated. The monitoring may be eliminated only after written approval by the Department. Monitoring for total and dissolved mercury must be performed according to US EPA method 1631E with a quanitation limit of 0.5 ng/L. Monitoring for total and dissolved methyl mercury must be performed according to US EPA method 1630 with a quanitation limit of 0.05 ng/L.

Sample Shipment and Analysis:

Mercury sampling requirements in the permits must specify that samples be shipped within 24 hours of collection and processed at the analytical laboratory within 48 hours of collection. The analytical lab must be NELAC certified for mercury and methyl mercury analysis. If the analytical lab can perform the mercury analysis as specified in this memo, utilizing the specific EPA Methods and also able to achieve the stated LOQs, then the lab does not have to be NELAC certified. Samples will be chilled to 4ºC in the field and for transport to the analytical laboratory. Preservation acid is to be added at the analytical laboratory in order to avoid contamination during field sampling. Filtering for dissolved mercury and methyl mercury is to occur at the analytical lab when processing the samples.

A partial list of analytical labs that are able to achieve the LOQ's is below, however, this is not an endorsement of these labs:

Mercury and Methyl Mercury Analytical Labs	Phone
Battelle Marine Science Laboratory 1529 West Sequim Bay Road Sequim, WA 98382	360-681-3650
Frontier GeoSciences 414 Pontius Ave N Seattle WA 98109 http://www.frontiergeosciences.com	206-622-6960
Brooks-Rand 3958 6th Ave N.W. Seattle WA 98107 http://www.brooksrand.com	206-632-6206

If you have questions regarding this monitoring requirement please contact Agnes Lut, 503-229-5247.

Distribution and Updates:

Memo sent via Email, 12/23/10: [WQ] Permit Writers;
[WQ] Willamette Basin;
[WQ] Permit Managers;
FOSTER Eugene P;
LUT Agnes

Memo sent via Email, 01/26/11: [WQ] Permit Writers;
[WQ] Willamette Basin;
[WQ] Permit Managers;
FOSTER Eugene P;
LUT Agnes

Memo was emailed to update the specific minor permit types that shall monitor for mercury. Originally the following permit types were identified:

- Specific Minors:
  - NPDES-IW-G
  - NPDES-IW-N
  - NPDES-IW-O

This list was updated to reflect the permit type designation change that occurred in 2006 to the following permit types:

- Specific Minors:
  - NPDES-IW-B08
  - NPDES-IW-B15
  - NPDES-IW-B16
  - NPDES-IW-B19
  - NPDES-IW-B20
  - NPDES-IW-B21

A table of the 27 affected minor industrial permits was added, source SIS download 1/24/11.

Memo sent via Email, 02/23/11: [WQ] Permit Writers;
[WQ] Willamette Basin;
[WQ] Permit Managers;
FOSTER Eugene P;
LUT Agnes

Seperate email sent to: Frank Wildensee, Krista Reininga, Torrey Lindbo, Roy Iwai, Jon Nottage, Rajeev Kapur, Thomas Mendes, Andrew Swanson, Dave Gilbey, Dennis Ades, Annette Liebe, Benjamin Benninghoff, Agnes Lut, Gene Foster

Memo was emailed to update the following:

- Page 2: Text Added = "Determining how the mercury and methylmercury monitoring will be implemented by permittees is up to the discretion of the permit writer with consultation with the TMDL coordinator, Agnes Lut."
- Page 2: Text Added = "Flow or rainfall will be collected, estimated or modeled for each stormwater monitoring event."
- Page 4: Text Change = Change sampling frequency from "Summer and Winter" to "Wet and Dry", as defined in the permit. Wet Oct. 1 – April 30.
- Page 4: Text Change = Change "daylight" to "storm event".
- Page 4: Text Added = "A summer event is considered to be equivalent to a dry season storm event (May 1-September 30), and a winter event is equivalent to a wet season storm event (October 1-April 30)."
- Page 5: Text Added = "If the analytical lab can perform the mercury analysis as specified in this memo, utilizing the specific EPA Methods and also able to achieve the stated LOQs, then the lab does not have to be NELAC certified."

Debris Characterization Study

Background

This Debris Characterization Study is intended to address questions that arise from both the City's National Pollutant Discharge Elimination System (NPDES) municipal stormwater permit and a future Water Pollution Control Facility (WPCF) permit for drywells (Underground Injection Control systems, or UICs). These permits are both issued by the Oregon Department of Environmental Quality; they address stormwater discharges to surface and groundwater, respectively. This study was designed to determine if the debris removed by various maintenance BMPs (street sweeping, catch basin cleaning, drywell cleaning) has attached pollutants that would leach some soluble fraction into stormwater if not removed through maintenance activities.

Stormwater that Drains to Surface Waterbodies: The City of Gresham and its NPDES co-permittees must submit estimates to DEQ of the quantity of pollutants that are anticipated to enter surface waters in stormwater runoff from the City's stormwater system. The estimates must account for local land uses and practices designed to minimize pollution (called best management practices, or BMPs). Such estimates can be derived from either monitoring data or models based on monitoring data, or a combination of both.

Use of monitoring data without models is impractical in the near term due to the extreme variability of stormwater quality data. Such variability requires large numbers of samples in order to support statistically valid conclusions. For example, Geosyntec consultants have shown that about 75 paired influent/effluent storm samples would be required to characterize the pollutant removal effectiveness of a single water quality facility.

Collecting large numbers of samples is feasible over a period of many years and/or through collaboration among a number of parties, but may not provide adequate data for estimates that must be updated every five years as required by the City's permit. The co-permittees' strategy, therefore, has been to use datasets that include local data, as well as data from others' studies to support a model. The model used by the co-permittees has varied over time, from P8 (Part II of NPDES permit application, 1993) to PLOADs (Interim Evaluation Report, May 1, 2006), to a GIS-supported Excel spreadsheet (July, 2008). These models are all based on the Simple Method, which multiplies land-use-based runoff coefficients by acreage, by annual rainfall, by pollutant concentrations to generate loads. PLOADs and the GIS-supported Excel spreadsheet allow for inclusion of BMPs and associated pollutant load reductions.

Stormwater that Drains to the Ground: The City of Gresham and other jurisdictions that own more than 50 drywells have applied for WPCF permits and rule authorization under Oregon Administrative Rule (OAR) 340-44 to cover their stormwater discharges to the ground. Since 2002, a collaborative monitoring program has existed to collect data from two to three storms per year at several drywells around the state. The monitoring has focused on the quality of stormwater as it enters the drywells. The water has typically passed through a structural BMP

prior to entry to the drywell. Additionally, the City of Portland began sampling 30 drywells per year in 2006-07 to comply with their WPCF permit. Based on the data to date, it appears that bacteria, lead, phthalates, and pentachlorophenol (PCP) can occur at levels that exceed drinking water standards, which are the relevant standards for protecting groundwater.

Problem Statement

Stormwater that Drains to Surface Waters: BMP effectiveness data is limited to certain types of structural facilities. Many of the BMPs implemented by permittees to reduce stormwater pollution are non-structural. Examples include catch basin cleaning, street sweeping, and public education. This study focuses on catch basin cleaning and street sweeping.

In the past, the City of Gresham has reported the volume of debris removed by cleaning catch basins and sweeping streets, but has had no way to relate debris removal to water quality improvement. This study will serve as a beginning effort to quantify the concentration of pollutants that would be expected to transfer to rainwater as it passes through the debris, with the assumption that by removing the debris, that load of pollutants is no longer transferred to runoff that flows over a street or through a catch basin into the stormwater system. (Additional evaluation is needed to refine this assumption, since laboratory extraction methods don't exactly simulate the real world.)

Stormwater that Drains to the Ground: It is not known whether, and to what degree, concentrations that exceed drinking water standards in influent to drywells extend into the surrounding soil. Studies of groundwater in urban areas of Oregon that use drywells have shown no problems that have been attributed to stormwater from typical runoff.

In September 2007, Multnomah County crews retrofit about ten drywells by removing the rocks and soil surrounding the drywells and replacing them with clean materials. This presents an opportunity to determine whether, and to what degree, the pollutants of concern are found in the used materials.

Literature Review

Stormwater that Drains to Surface Waters: Several online searches using Google and Google Technical as the search engine were performed using the words "catch basin" [and/or] "street sweeping debris characterization." No study was found that attempted to meet the goals of this study. However, Clean Water Services (CWS), another NPDES permittee in western Oregon, is conducting a similar study. The CWS study plan was obtained, reviewed, and used as something of a model for this study.

Several studies were found that dealt with the leachability of pollutants in road and catch basin debris bound for landfills. The City of Gresham also has several years of data on the leachate qualities of a mix of debris from catch basins, street sweeping, and manholes bound for landfills. However, none of these studies provide the results sought by this study because of the extraction procedure used. Leachate studies conducted prior to disposal in landfills assume that the debris

will be bathed in acetic acid from the decomposition of organic matter, and pollutants are extracted using the acetic-acid-based TCLP procedure. Acetic acid has a pH of about 4.93. Data from the National Atmospheric Deposition Program for NW Oregon/SW Washington indicate typical rainwater pHs in that range, but the likely source of the low pHs is nitrogen and sulfur compounds, rather than acetic acid (an organic acid). An alternative procedure, the SPLP procedure, uses an acidic solution based on those compounds, which better simulates the chemistry of rainfall.

Stormwater that Drains to the Ground: No additional literature review was conducted specific to drywells. The rain that falls in areas with pervious soils is likely to be the same as rainfall that falls on areas with impervious soils, if the surrounding land uses are the same.

Copies of the studies and information reviewed are attached as Appendix A.

Methodology:

Collection of General Information: Maps designating the area of the City from which street sweeping debris has been collected for sampling will be created, and the land uses of the drainage area will be noted. The section of the City street sweeping samples were collected from was selected based on the mixture of land, which was approximately the same as that of the entire City, so the sample was assumed to be representative. Catch basin debris is stockpiled in one location, and composite samples will be drawn from across the pile to represent the City as a whole. The location of drywells being retrofitted will also be noted on a map, and staff will drive by the drywells to look for potential sources of pollutants that may distinguish the drywells from drywells throughout the City.

Sample collection for Stormwater that Drains to Surface Waters:

Parameters to be Measured: **Table 1** shows the pollutants for which tests will be conducted, and the test procedure to be used. In some cases, suites of pollutants are listed, since the same test provides results for a range of pollutants. Where a DEQ standard exists, the criteria are shown; and drinking water criteria are distinguished from those set to protect aquatic life.

Number of Samples: Two composite samples each will be taken of debris from street sweeping and catch basin cleaning (for a total of four composite samples). Street sweeping is conducted on a monthly basis, year round in Gresham, except during winter. The catch basin debris samples will be taken during fall, because that is when catch basins are cleaned. An attempt will be made to take one sample of debris prior to leaf-fall, and the other after leaf fall. Street sweeping debris will be collected in the Spring and Summer to compare results during rainy and dry weather. This number of samples will not allow for statistical analysis, but should provide ballpark values, and indicate whether additional study is warranted. (All leachate values could be non-detects.)

Protocol for Taking Samples:

Catch Basins: Debris from around the City is dumped onto a covered drying pad. When dry, it is transported to a covered dock. During the transport process, it is mixed.

Street Sweeping: Debris from specified sections of the City is placed in a dumpster and left outside in the elements. Street sweeping samples were collected the same day as they were deposited in the dumpster, after scraping away the surface debris to reveal debris that was still wet. The spring 2008 sample (collected May 7, 2008) was a warm day preceded by 3+ days of dry weather; the sample contained a large amount of organic material, particularly conifer needles. The summer 2008 sample (collected August 7, 2008) was preceded by 5+ days of no rain; this sample also contained a large amount of organic material, as well as coarse inorganic materials (sand and small gravel).

Street sweeping areas were selected in an effort to be representative of the land uses within the entire city. **Table 1** list the land uses within the two sections of the city street sweeping samples were collected from (sections 5 and 11) and compares those percentages to the land use areas used in the TMDL benchmark process for the entire City of Gresham draining into the municipal storm sewer system (MS4). Percentages for industrial and commercial land uses are higher than the city as a whole since both street sweeping sections are within more developed areas, while much of the vacant land in the benchmark values is on the periphery of the city. Land use within the drywell/UIC area is assumed to be similar.

Table 1: Land uses within street sweeping areas and within MS4 area

Land Use	**Street Sweeping**	***2008 Benchmarks***	***2005 Benchmarks***
Commercial	16.9%	*10.1%*	*13.3%*
Industrial	24.8%	*9.5%*	*9.9%*
Parking	0.6%	*NA*	*NA*
Residential	30.5%	*40.2%*	*41.4%*
Multi-Residential	9.0%	*6.5%*	*8.3%*
Open Space	12.7%	*16.5%*	*12.0%*
Vacant	5.0%	*16.0%*	*12.2%*
<blank>	0.5%	*NA*	*NA*

Drywell rock: The renovation of drywells is not routinely done, so the following description reflects what happened during sample collection: The material surrounding the drywells was dumped in two piles near the dumpster with street sweeping debris. Composite samples were taken across the piles, with samples from each pile composited separately. One pile was dark grey and the other more golden colored. Operations staff said that dark grey material came from closer to the drywell, and golden colored material came from father away.

A stainless steel spoon will be/was used to collect a composite sample that draws from at least five sites across the debris pile. The samples will be/were deposited in a large stainless steel bowl and mixed with a stainless steel spoon. Rocks and gravel in excess of 1/2" diameter will be/were removed using the spoon. Subsamples of the material in the bowl will be/were put into 12 four ounce jars provided by the City of Portland Water Pollution Control Laboratory.

Sample collection for Stormwater that Drains to the Ground:

Parameters to be Measured: **Table 2** shows the pollutants for which tests will be conducted, and the test procedure to be used. The pollutants are the same as for the catch basin and street sweeping protocol.

Number of Samples: Two composite samples will be taken from materials stockpiled beside the street near where the drywells are being retrofitted.

Protocol for Taking Samples: The protocol for taking samples will be the same as that for the catch basin and street sweeping debris.

Constituents to be Monitored:

Table 2. Summary of Pollutants and Procedures

SYNTHETIC PRECIPITATE LEACHATE (SPLP)				
Parameter	**Extraction Procedure**	**Lab Procedure**	**MRL (µg/L)**	**DEQ Standard* (aquatic or DW) µg/L**
Dissolved Metals (**Zn**, **Hg, Pb**, **Cu, Ba,** Ni, Ag, Cd, As, Cr, Fe, Se, Mg, Ca)	SPLP to analyze pollutants that wash off with rainfall (EPA 1312)	EPA 6000 series	Zn = 10 Hg = 0.025 Pb = 5 Cu = 10 Ba = 10 Ni = 10 Ag = 5 Cd = 5 As = 5 Cr = 10 Fe = 20 Se = 10 Mg = 50 Ca = 100	Zn = 110c/5000 Hg = 0.012c/2 Pb = 3.2c/50 (15) Cu = 12/1000 (1300) Ba = 1000 (2000) Ni = 160c Ag = 0.12c/50 Cd = 1.1c/10 (5) As = 48c/50 (10) Cr3 = 210c/50 (100 for total Cr) Cr6 =11c/50 Fe = 1000c/300 Se = 35c/10 Mg = Ca =
Hardness				
pH				6.5-8.5
VOCs				
Semivolatile OCs (**PCP**)		GCMS (EPA 8270)	1.0	PCP = 13c/1.0
Phthalates				3c
Pesticides (**DDT, dieldrin**, trichlopyr,		EPA 8081	DDT = 0.10 Dield = 0.10	DDT = 0.001c Dield = 0.0019c

chlorpyrifos)				
Herbicides (2,4-D; glyphosate)		EPA 8151	3.00	2,4-D = 70 Glyphosate = 700
E. coli				406/100 ml
TPH				
COD				
Total Phosphorus		EPA 365.4	30 ug/L	100
Nitrate N				10000

SOIL ANALYSIS

Parameter	Lab Procedure	Detection Limit (mg/Kg dry wt)	DEQ Standard* (aquatic or DW)
Particle size	ASTM D421/422	0.1 Fract %	
Density			
Total Metals (**Zn, Hg, Pb, Cu, Ba,** Ni, Ag, Cd, As, Cr, Fe, Se)	ICP-MS (EPA 6020) EPA 6010	Zn = 0.50 Hg = 0.01 Pb = 0.10 Cu = 0.25 Ba = 0.10 Ni = 0.25 Ag = 0.10 Cd = 0.10 As = 0.50 Cr = 0.50 Se = 1.00 Fe = 2.5	
Hardness?			
pH?			
VOCs			
Semivolatile OCs (**PCP**)	EPA 8270B	Varies PCP = 5.51	
Phthalates			
Pesticides (**DDT, Dieldrin**, chlorpyrifos, trichlopyr)	EPA 8081	DDT = 0.102 Dield = 0.102	
Herbicides (2,4-D, glyphosate)	EPA 8081	0.102	
TOC	EPA 9060 MOD	100	
E. coli			
TPH			
COD			

Total Phosphorus	EPA 365.4	30 ug/L	100
Nitrate N			
Hydrocarbons	NWTPH-HCID	Diesel = 50 Gas = 20 Fuel, Lube and Other Oil = 100	
	NWTPH-Dx NWTPH-Gx	Diesel = 28.5 Heavy Oil = 56.9 Gas = 6.06	

*Aquatic life criteria depend on hardness. The values listed here are for total metals and correspond to a hardness of 100 mg/L.
Aquatic life standards are in black. Small c indicates use of the chronic criterion.
DW=Drinking water standard MCLs in red. Values in (parenthesis) are EPA listed values that differ from DEQ.
Risk-Based Concentrations from Appendix A are in green.
Boldface pollutants are higher priority than others.

Questions to answer:

- Types of street sweepers used (brushes, vacuum, etc)?
- Do we want to try to differentiate by land use type? (COM, IND, RES)

References

Liebens, J. 2001. Contamination of sediments in street sweepings and stormwater systems: Pollutant composition and sediment reuse options. Dept of Environmental Studies, University of West Florida, http://www.uwf.edu/environmental/facultystaff/liebens/Microsoft%20Word%20-%20new_final_report%20revision.pdf

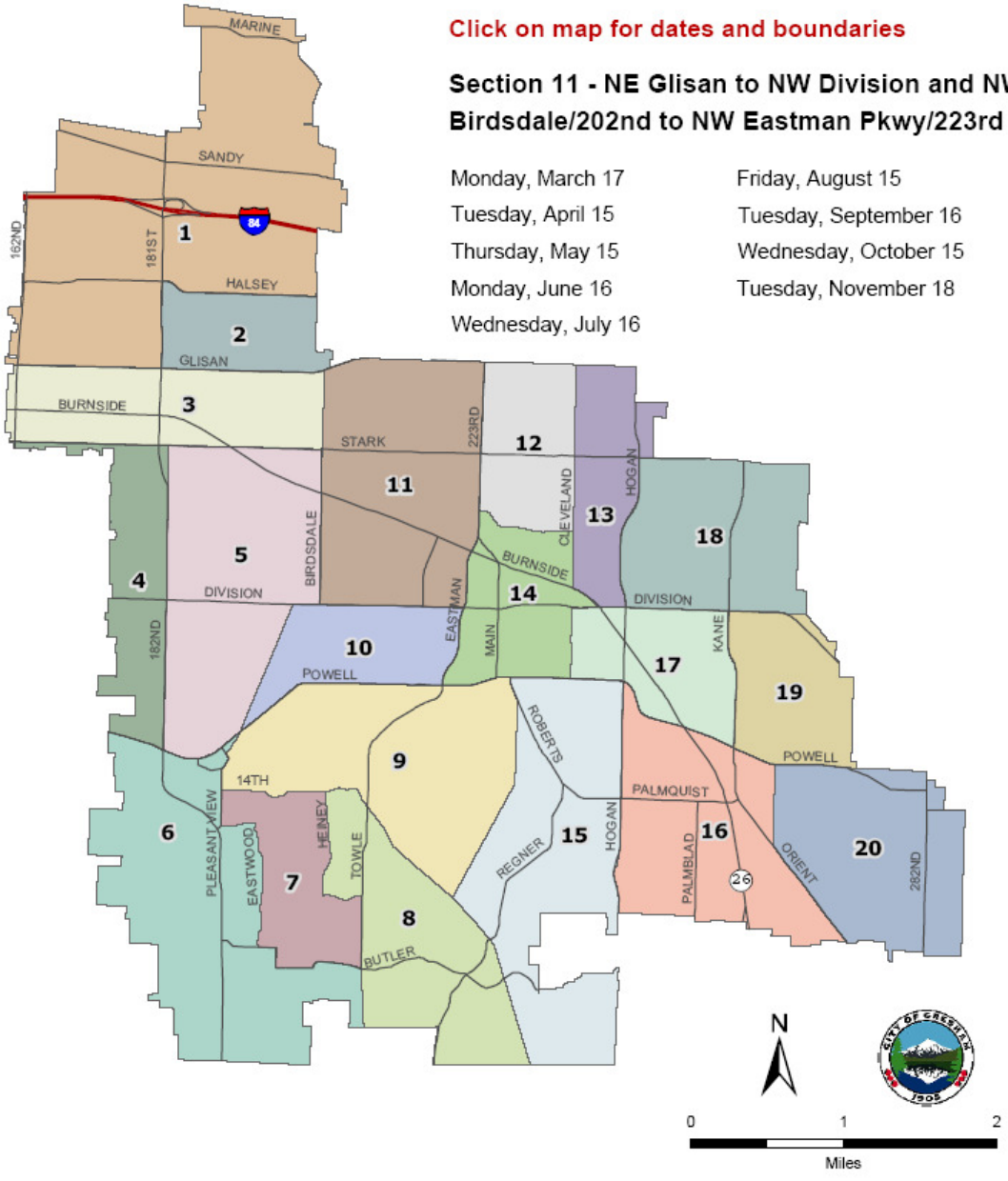
Walch, M. 2006. Monitoring contaminants in Delaware street sweeping residuals and evaluation of recycling/disposal options. Presentation at 21st Inter. Conf. On Solid Waste Technology and Management, Philadephia, PA, March 26-29, 2006.

City of Gresham
Street Sweeping 2008

Click on map for dates and boundaries

Section 11 - NE Glisan to NW Division and NW Birdsdale/202nd to NW Eastman Pkwy/223rd

Monday, March 17
Tuesday, April 15
Thursday, May 15
Monday, June 16
Wednesday, July 16
Friday, August 15
Tuesday, September 16
Wednesday, October 15
Tuesday, November 18



INTERGOVERNMENTAL AGREEMENT BETWEEN MULTNOMAH COUNTY AND THE CITY OF GRESHAM FOR JOINT SERVICES RELATED TO NPDES MUNICIPAL SEPARATE STORM SEWER PERMIT AND TMDL PROGRAM IMPLEMENTATION

County No. 4600008715
City of Gresham No. 5232

05/31/2061

This Agreement is between the City of Gresham, Oregon (Gresham), and Multnomah County, Oregon (County), hereinafter collectively referred to as the Parties.

RECITALS

WHEREAS, the Parties' goal is to work cooperatively through this Agreement to comply with existing federal and state National Pollutant Discharge Elimination System (NPDES) and Total Maximum Daily Load (TMDL) laws and regulations; and

WHEREAS, the Gresham City Council and the Board of Multnomah County Commissioners recognize the need to identify and control pollutants entering the municipal separate storm sewer systems (hereinafter "MS4") through the application of best management practices established and implemented by each jurisdiction; and

WHEREAS, it has been determined that urban stormwater runoff transports pollutants into our rivers and streams; and

WHEREAS, pollutant allocations for streams within the jurisdictions of Gresham and the County are identified in the Total Maximum Daily Loads (TMDL) for the respective streams; and

WHEREAS, Gresham and the County are authorized to implement stormwater management programs to reduce the contribution of pollutants in stormwater to the maximum extent practicable and to discharge stormwater to public waters in conformance with the requirements and conditions set forth in the municipal permit conditions of their respective NPDES permits issued by Oregon Department of Environmental Quality (DEQ); and

WHEREAS, Gresham and the County are Designated Management Agencies responsible for developing and implementing pollutant reduction plans for TMDL streams; and

WHEREAS, the development of a consistent and comprehensive stormwater monitoring plan that satisfies Gresham and Multnomah County's federal NPDES stormwater requirements can best be realized by a coordinated monitoring approach between Gresham and the County within the Urban Services Boundary.

NOW, THEREFORE, the Parties agree as follows:

A. PARTIES' EXISTING PERMITS.

1. Gresham has a five-year municipal MS4 NPDES permit as required under 40 CFR Section 122.26; and permitted by Oregon DEQ Municipal NPDES Permit #101315, dated December 30, 2010. This permit serves as the TMDL implementation plan for the waste load allocations for stormwater within the permit boundary.

2. The County has a five-year municipal MS4 NPDES permit as required under 40 CFR Section 122.26; and permitted by Oregon DEQ Municipal NPDES Permit #103004 dated December 30, 2010. This permit serves as the TMDL implementation plan for the waste load allocations for stormwater covered by the permit boundary.

3. Each Party is responsible for complying with its own permit conditions relating to stormwater discharges from those parts of the respective MS4 that the Party continues to operate or own. No Party is responsible for another Party's non-compliance with its respective permit.

B. PARTIES' OBLIGATONS.

1. The County.

1.1 The County shall assist Gresham in developing procedures to best implement the monitoring and compliance actions in the areas subject to the County's MS4 NPDES permit under Section A. 3 above.

1.2 The County may undertake tasks to assist Gresham with monitoring activities in the compliance areas subject to the County's MS4 NPDES permit under Section A.3 above. The County will only perform such work based upon a mutual written agreement of the County and Gresham which shall be in the form of a "Notice to Proceed," signed by the County and Gresham, which expressly identifies the dates and specific tasks the County is to perform.

2. Gresham.

2.1 Gresham shall perform the monitoring services required by its own NPDES MS4 Permit under Section A.1 above and any other TMDL requirements set forth in the Scope of Work in Exhibit A.

2.2 Gresham shall compile and report the relevant and applicable water quality data collected for all of the Parties' permitted areas identified in Section A and provide the monitoring data directly to Troutdale and the County annually, or as otherwise agreed to by the Parties.

C. PERIODIC REVIEW. Every five years, or more frequently if the Parties desire, the County and Gresham will update and/or prepare projected annual budgets for the next five fiscal years for the monitoring tasks conducted by Gresham. Upon written approval of the budgets by the MS4 permit compliance representative for each Party, Exhibit A will be updated and will be subject to the payment terms of Section E. Budget projections are understood to be estimates only, subject to the oversight and appropriation authority of the Parties' respective governing bodies, and shall not be binding.

D. EFFECTIVE AND TERMINATION DATES. This Agreement shall be effective on July 1, 2011, and shall continue indefinitely, unless otherwise terminated in accordance with Section F.

E. INVOICING PROCEDURE AND COSTS.

1. Not later than June 30th of each calendar year during the term of this Agreement, Gresham shall submit invoices for work performed during the preceding fiscal year (July 1 to June 30) to the County for the cost of the services performed.

2. Each Gresham invoice shall be on City letterhead and shall include the total amount due and shall include the specific dates, times, services, employees' hourly rates, services performed and/or product being invoiced, as needed, to satisfy the County's fiscal and financial reporting requirements.

3. The County's payment to Gresham shall be full compensation for services rendered, including all labor, materials, supplies, equipment, and authorized incidental costs necessary to perform the work and services.

4. Invoiced payments that are payable to the City of Gresham are due within 60 days of the invoice date. Payments to Gresham shall be made payable to the City of Gresham and delivered to City of Gresham, Financial Services Division, 1333 NW Eastman Parkway, Gresham, Oregon, 97030.

5. The Cost Estimate for the work and scope of services to be performed under this Agreement is set forth in Exhibit A.

F. EARLY TERMINATION OF THE AGREEMENT.

1. The Parties may mutually agree to terminate the Agreement in writing. A Party may terminate its participation in this agreement unilaterally for any reason on 90 days' written notice to the other Party.

2. Any Party may terminate its participation in this Agreement in the event of a breach of the Agreement by the other Party. Prior to such termination, however, the Party seeking the termination shall give to the other Party written notice of the breach and of the Party's intent to terminate. If the breach is not cured within thirty (30) days of the notice, then the Party giving the notice may immediately terminate the Agreement at any time thereafter by giving a written notice of termination.

G. THIS IS THE ENTIRE AGREEMENT. This Agreement constitutes the entire Agreement between the Parties. This Agreement may be modified or amended only by the written agreement of the Parties.

H. INDEMNIFICATION. To the extent permitted by the Oregon Tort Claims Act, Gresham agrees to indemnify, defend, and hold harmless Multnomah County from any and all claims, demands, suits, and actions (including attorney fees and costs) resulting from or arising out of the acts of Gresham and its officers, employees, and agents in performance of this intergovernmental agreement. To the extent permitted by the Oregon Tort Claims Act, Multnomah County agrees to indemnify, defend, and hold harmless Gresham from any claims, demands, suits, and actions (including attorney fees and costs) resulting from or arising out of the acts of Multnomah County and their officers, employees, and agents in performance of this intergovernmental agreement.

I. **DISPUTE RESOLUTION.** If disputes arise under this Agreement, the parties agree to negotiate in good faith to resolve the disputes in a cost effective manner. If the parties cannot resolve the dispute by negotiation, the parties agree to submit the dispute to mediation before a mediator agreed upon by the parties. If the parties cannot agree upon a mediator, either party may ask the Presiding Judge in Multnomah County Circuit Court to designate a neutral mediator. That designation shall be binding upon the parties. Regardless of the outcome of the mediation, the parties shall share the costs of the mediator equally. If mediation fails to resolve the dispute, the parties may agree to submit the dispute to arbitration, or either party may initiate litigation in an appropriate court to resolve the dispute.

J. **NON-APPROPRIATION CLAUSE.** This agreement is subject to future appropriations by any future City Council or Board of County Commissioners.

K. **ASSIGNMNENT.** This Agreement is binding on each Party, its successors, assigns, and legal representatives and may not, under any condition, be assigned or transferred by the Parties without prior written approval by the other Parties.

L. **SEVERABILITY.** If any portion of this Agreement is found to be illegal or unenforceable, this Agreement nevertheless shall remain in full force and effect and the offending provision shall be stricken.

M. **ADHERENCE TO LAW.** Each party shall comply with all federal, state, and local laws and ordinances applicable to this agreement.

N. **NON-DISCRIMINATION.** Each party shall comply with all requirements of federal and state civil rights and rehabilitation statutes and the Parties' respective local non-discrimination ordinances.

O. **ACCESS TO RECORDS.** Each party shall have access to the books, documents, and other records of the other which are related to this agreement for the purpose of examination, copying, and audit, unless otherwise limited by law.

CITY OF GRESHAM

By: _____
Erick Kvarsten, City Manager

Date: 7/15/11

BOARD OF COUNTY COMMISSIONERS FOR MULTNOMAH COUNTY, OREGON

By: Jeff Cogen / JT
Jeff Cogen, Chair

Date: June 30, 2011

REVIEWED:

APPROVED AS TO FORM:

HENRY H. LAZENBY, JR., COUNTY ATTORNEY FOR MULTNOMAH COUNTY, OREGON

By: David R Ris
David Ris, City Attorney for City of Gresham

Date: 7/11/11

By: /s/ Matthew O. Ryan
Matthew O. Ryan, Assistant County Attorney

Date: May 31, 2011

EXHIBIT A

A. GRESHAM'S SCOPE OF WORK.

1. Each quarter of each calendar year of the term of this Agreement Gresham shall complete in-stream monitoring and annual macro invertebrate monitoring at two (2) sites on Beaver Creek. The sites shall be selected by mutual agreement of the Parties. In-stream monitoring includes sampling and/or analyses of the following, as per the Gresham Stormwater Monitoring Plan:
   a. Total metals (Copper, Lead, Nickel, Zinc)
   b. Dissolved metals (Copper, Lead, Nickel, Zinc)
   c. Mercury
   d. E. coli
   e. Nutrients (Chloride, Ammonia-Nitrogen, Nitrate-Nitrogen, o-Phosphate-Phosphorus-Dissolved, Total Kjeldahl Nitrogen, Total Phosphorus)
   f. Conventionals (BOD5, Total Suspended Solids, Chlorophyll-a, Total Hardness)
   g. Field parameters (pH, Temperature, Dissolved Oxygen)

2. Following the requirements of the County's stormwater mercury monitoring requirement, Gresham shall complete monitoring for mercury and methyl mercury from a regional stormwater source.

B. COST ESTIMATE. Monitoring cost estimate for quarterly in-stream monitoring and annual macro invertebrate monitoring at two (2) sites on Beaver Creek are included as Task 1 below. Annual mercury monitoring in stormwater at one site is included as Task 2 below.

	Task 1. Beaver Creek	**Task 2. Mercury - Stormwater**
FY 2011/12	$10,000	$1,500
FY 2012/13	$10,250	$1,600
FY 2013/14	$10,500	$1,700
FY 2014/15	$10,750	$1,800
FY 2015/16	$11,000	$1,900
Estimated 5-year Total	**$52,500**	**$8,500**

1. Multnomah County shall reimburse Gresham for the cost of laboratory, taxonomic identification, equipment use, and sampling personnel services at two sites on Beaver Creek.
2. Multnomah County shall reimburse Gresham for the cost of laboratory equipment and personnel services for stormwater mercury monitoring at one location according to the requirements in the Multnomah County NPDES permit.
2. The Parties stipulate that the cost estimates provided herein are solely for the purpose of budget planning; actual costs may vary depending upon laboratory costs, staff time, and vehicle/equipment required for acquiring and delivering samples provided, however, that actual costs exceeding 20% of the estimated costs set forth herein shall require an update of Exhibit A, and any such cost increase shall be reimbursed only if agreed to in writing by the affected Parties.

MULTNOMAH COUNTY, OREGON

EXECUTIVE RULE NO. 351

Delegation of Signing Authority

a. Under section 6.10(7) of the Multnomah County Home Rule Charter, the Chair may delegate administrative powers but shall retain full responsibility for the acts of subordinates.

b. The efficient carrying out of the County's business occasionally requires the Chair's signature on official documents in the Chair's absence or unavailability.

The following Executive Rule is adopted:

1. Joanne Fuller and Marissa Madrigal are authorized to sign the Chair's name to orders, contracts and other official documents requiring the Chair's signature.

2. Authorized signature will appear as the signature of the Multnomah County Chair followed by initials of the delegate.

3. This Executive rule shall remain in effect until rescinded or modified.

Dated this 13 day of January 2011.

Jeff Cogen, Multnomah County Chair

REVIEWED:
Henry H. Lazenby, Jr., County Attorney
for Multnomah County, Oregon

Pesticide Assessment for Stormwater Monitoring

Prepared by the Cities of Gresham and Fairview
Submitted to Oregon Department of Environmental Quality
November 1, 2011

Background

The NPDES MS4 permit issued to the City of Gresham and City of Fairview by the Oregon Department of Environmental Quality (DEQ) on December 30, 2010 required the co-permittees to begin monitoring pesticides as part of the environmental monitoring program. In the Stormwater Monitoring-Storm Event requirement of Table B-1, DEQ specified monitoring for 2,4-D (the most widely used herbicide) and pentachlorophenol (a fungicide used to treat utility poles) in stormwater during the 5-year permit term. DEQ also added the following special condition in Table B-1:

Additional pesticide pollutant parameters that must be considered for purposes of stormwater monitoring – storm event include any pesticide currently used by the co-permittees within their jurisdictional areas and the following: Insecticides: Bifenthrin, Cypermethrin or Permethrin, Imidacloprid, Fipronil, Malathion, Carbaryl; Herbicides: Triclopyr, 2,4-D, Glyphosate & degradate (AMPA), Trifluralin, Pendamthalin; and, Fungicides: Chlorothananil, Propiconazole, Myclobutanil.

The co-permittees have been collecting information on pesticides; this report contains the current status of this assessment, which will be adaptively managed as additional information is considered.

Method

The first step in conducting the pesticide evaluation was developing a list of pesticides to consider. The sources of information considered for developing the list of pesticides included:

- List of pesticides (20 total) used by Gresham and Fairview public works/operations crews (including facilities, parks, stormwater, wastewater, water and transportation);
- The list of 15 pesticides DEQ included in the 2010 NPDES MS4 permit;
- Pesticides included on Oregon's 2009 Public Use Reporting System (PURS) list that were indicated as having a residential or urban use (12 pesticides);
- Pesticides available in pet, home, and garden stores in the Portland Metro area collected during a Metro shelf survey conducted in 2008 (122 pesticides);
- Pesticides identified by the Oregon Water Quality Pesticide Management Team (WQPMT 2011) as being either a Pesticide of Interest (POI), an Oregon Pesticide of Interest (POI-OR), a DEQ Priority Persistent Pollutant (P3), or on the DEQ Priority Toxic List (PTL) (74 pesticides)

The lists above have many pesticides in common and therefore the total number evaluated from all lists was 115.

Evaluation of pesticides was based on multiple criteria, including:

- Mobility (movement from soil to water),
- Persistence (based on half life in soil),
- Toxicity to humans,
- Toxicity to aquatic life,
- Use by the Co-permittees
- Availability for purchase in the permit area,
- Known widespread use by residents or businesses

- Of interest to Water Quality Pesticide Management Team (WQPMT) and labeled for non-agricultural use, and
- Whether or not DEQ has detected the pesticide in Oregon streams

The criteria used to evaluate pesticides fell into two broad categories – one related to environmental characteristics and the other related to introduction into the environment. The characteristics that determine how a pesticide moves through the environment and the risk posed to human or aquatic life are important, but these criteria only become important if the pesticide is available for use within the permit area. To this end, both categories were assumed to be equally important and the potential maximum score available for environmental characteristics was set equal to those related to availability and use.

Environmental Characteristics – Mobility, Toxicity and Persistence

Information on mobility, toxicity and persistence was obtained primarily from a literature review. The references section lists the sources of information used to obtain a rating for each pesticide.

In order to convert mobility, toxicity and persistence information to a value that could be evaluated for ranking, the ratings were converted using the following: Very Low (1), Low (2), Low to Moderate (3), Moderate (4), Moderate to High (5), High (6), Very High (7). Once converted to numeric scores, the weighting factor each of these parameters was: Mobility * 2, Persistence * 1.5, Human Toxicity *1, Aquatic Life Toxicity * 1.5. Since toxicity was considered separately for human and aquatic life, the maximum weighted score for toxicity is 17.5, the maximum for mobility is 14, and the maximum for persistence is 10.5. The maximum score a pesticide could receive for environmental characteristics is 42.

The logic behind the environmental characteristic weightings is as follows: Toxicity is key since the goal is to protect beneficial uses, and the other factors become less important if the pesticide isn't very toxic. Within the toxicity criteria, aquatic life toxicity was judged more important than human toxicity because human exposure to pesticides via water is typically through ingestion, and treatment of drinking water is presumed, unless the source of the water is groundwater—in which case soil provides some filtration/adsorption. Mobility was judged the next most significant criterion because pesticides need to leave the soil and enter water in order to cause water quality problems. Persistence was given the next highest weight because the half-life determines how far the pesticide moves before attenuating below levels of concern.

Use and Availability

The inventory of pesticides used by the City of Gresham was compiled from those reported for the annual NPDES MS4 report. An inventory of pesticides used by the City of Fairview during 2011 was obtained from the City of Fairview. Because DEQ specifically requested consideration of *any pesticide currently used by the co-permittees within their jurisdictional areas,* all pesticides used by either Co-Permittee were given a score of 15.

Pesticides available for purchase by residents in the permit area were identified by obtaining study data collected by Metro in 2008 assessing pesticides available on the shelf of local box retail locations, home and garden centers, and veterinary supply stores. The shelf survey contained brand names, as well as the active ingredients, in products available for use on pets, around the home, or in the garden. Because the frequency data for some products was skewed based on the variety available (e.g. pet shampoos containing the same active ingredient were available in multiple scents and container sizes), the data were sorted so that active ingredients in products available for pet and home use were given a value of 1, ingredients available in products for use in the garden or outdoors were given a score of 5, and ingredients available in both were given a score of 6. More weight was given to products used in the garden or

outdoors, since the exposure to precipitation and potential for runoff to groundwater or surface water is greater than for products designed for pet or indoor use.

In addition to availability data accessible through Metro, a ~~"k~~known widely used" pesticide criteria was also used in the assessment. Based on feedback from Gresham outreach staff conducting outreach visits with homeowners related to lawn care, the two most highly used pesticides (2,4-D and Glyphosate) were identified and scored a 10 for this criteria. Based on data from the City of Portland's UIC monitoring program, Pentachlorophenol was identified as widely used based on the density of treated utility poles within the urban environment.

The criterion associated with Oregon's Water Quality Pesticide Management Team (WQPMT) is a composite of two measures (or sub-criteria): number of lists, and urban use. The WQPMT created four lists (POI, POI-OR, P3, PTL); a pesticide received one point for each list upon which it appeared, for a maximum potential score of four points. The WQPMT also evaluated uses for each pesticide, identifying eight non-agricultural uses (lawns, turf, etc.). A pesticide was given one point for each of the eight uses the WQPMT associated with that pesticide, and a weighting factor of 0.5 was then applied to the total. A maximum score of 4 was therefore possible for a pesticide used in all 8 non-agricultural uses identified by the WQPMT. Considering both the number of lists and urban use sub-criteria, a pesticide could accrue up to 8 points total for the WQPMT criterion.

DEQ provided a list of pesticides detected in Oregon streams; however, the stream samples were located primarily in agricultural areas. Pesticides which have been detected in statewide stream sampling conducted by DEQ between 2007-2010 were given a score of 3. Pesticides which have either not been detected or not evaluated received a zero (0) for this criteria. The overall score for this criterion was lower than for other criteria in the use/availability category since little to none of the data was collected from streams with an urban stormwater influence.

Other than the weighting factor used within the WQPMT criterion, all use and availability criteria were given the same weight with respect to one another. Implicit weighting was achieved through the potential amount of points that could be awarded for each criterion.

<u>Possible score</u>
Based on the criteria descried in the methods section, the lowest and highest possible scores are listed in Table 1.

Table 1. Minimum and maximum scores for criteria used to assess pesticides

	Environmental Characteristics			Use and Availability						
	Mobil-ity	Toxic-ity	Persis-tence	Use by permit-tees	Avail-ability - Metro	Widely Used	WQPMT		DEQ in-stream	Total
							Lists	Non-ag Use		
Max Score	14	17.5	10.5	15	6	10	4	4	3	84
Min Score	2	2.5	1.5	0	0	0	0	0	0	6

As previously explained, environmental characteristics and availability and use characteristics each had equal potential to influence the total rating for a given pesticide, since a maximum of 42 points is possible for each category.

Results

Of the 115 pesticides assessed, the highest ranked pesticide was the herbicide 2,4-D, which scored 57 out of 84. In addition to 2,4-D, three other pesticides scored >50 points. Table 2 shows the top 10 pesticides from the assessment. Table 3 contains the ranked scores and complete set of criteria considered for the 155 pesticides considered in this assessment.

Table 2: Top 10 pesticides identified in assessment

Pesticide	Type	Mobility (*2)	Toxicity (human; *1)	Toxicity (aquatic life, *1.5)	Persistence (* 1.5)	Use by co-permittees (*15)	Availability (Metro)	Widely Used	WQPMT Lists	WQPMT non-ag uses	Detected in-stream by DEQ (*3)	Total
2,4-D *	**Herbicide**	**10**	**2**	**4.5**	**4.5**	**15**	**5**	**10**	**2**	**4**	**0**	**57**
Trifluralin *	Herbicide	4	2	12	7.5	15	5	0	1	4	3	53.5
Triclopyr *	Herbicide	12	2	6	6	15	5	0	1	4	0	51
Dicamba *	**Herbicide**	**14**	**2**	**3**	**6**	**15**	**5**	**0**	**1**	**4**	**0**	**50**
Dichlorbenil *	Herbicide	12	2	4.5	9	15	5	0	0	0	0	47.5
Glyphosate	**Herbicide**	**2**	**2**	**3**	**4.5**	**15**	**5**	**10**	**1**	**4**	**0**	**46.5**
Mecoprop (MCPP) *	Herbicide	12	2	3	6	15	5	0	0	0	0	43
Pentachloro-phenol *	**Fungicide**	**10**	**4**	**9**	**6**	**0**	**0**	**10**	**1**	**0**	**0**	**40**
Imidacloprid *	Insecticide	8	4	6	7.5	0	6	0	1	3.5	3	39
Isoxaben *	Herbicide	8	2	7.5	6	15	0	0	0	0	0	38.5

Pesticides highlighted in gray are those DEQ listed in Schedule B of the NPDES MS4 permit.
Pesticides in bold are those the co-permittees plan to monitor during the permit term.
* Pesticides with an asterisk are included in Pacific Agricultural Laboratory's Multi-residue screen.
Primary data used to assign points is provided in the attached spreadsheet, labeled Table 3: Pesticide Assessment

Conclusions

Based on widespread use, mobility and other environmental characteristics, the co-permittees plan to collect wet weather stormwater samples for the two pesticides (2,4-D and Pentachlorophenol) listed in Table B-1 of the NPDES MS4 permit during the permit term.[1] Environmentally relevant[2] results (e.g. method known to produce measurable results; MRL lower than EPA or other benchmark; MRL lower than values expected based on DEQ in-stream testing) for these two pesticides can be obtained through Test America's analysis using the chlorinated acid herbicide method (EPA 515.3). In addition to 2,4-D and pentachlorophenol, the chlorinated acid herbicide panel includes: 2,4,5-T, 2,4,5-TP (Silvex), 2,4-DB, 3,5-Dichlorobenzoic acid, Aciflurofen, Bentazon, Dicamba, Dichloprop, Dinoseb, and Picloram.

Because Glyphosate is included in the draft of the WPCF permit, the Co-Permittees anticipate that this pesticide will be monitored during at least one year of the permit term. The draft WPCF permit also includes Diazinon, which the Co-Permittees will likely ask to have replaced with one of the pesticides identified in this assessment. Because Diazinon is a restricted use pesticide not used by the Co-Permittees or available for purchase or use by residents, it is not anticipated to be present at detectable levels. Monitoring for Trifluralin or Triclopyr would be a more effective use of limited monitoring resources.

Additional monitoring beyond that required for NPDES MS4 or WPCF permit compliance requires a large amount of resources subject to the maximum expent practicable (MEP) standard. Most analyses cost between $100-200 per sample. The cost of additional information on presence of pesticides competes with the same finite pool of resources used to provide educational programs targeted at reducing use or other BMPs that prevent or reduce the amount of pesticides or other pollutants entering our local waterways.

During the permit term, the Co-Permittees will evaluate the cost, feasibility, and relevance of data obtained through monitoring some or all of the pesticides listed in Table 2. Pacific Agricultural Laboratory (PAL)[3] in Portland, OR offers a multi-residue screen (MRS) that includes many of the pesticides contained in Table 2 (asterisks next to all of the pesticides contained within this screen). While the broad nature of PAL's MRS is appealing, an evaluation of the method reporting limits (MRLs) available for each pesticide in the MRS versus the maximum value detected in-stream by DEQ determined that most of the pesticides would yield no detectable result, as the majority of MRLs were higher than the maximum value DEQ had detected in the environment. Based on verbal communication with Steve Thun at PAL, their analytical capabilities are improving, so the co-permittees will check with PAL to see if lower detection limits that would be environmentally relevant could be attained for some or all of the highest rated pesticides identified in this assessment.

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[1] Explanation of the decision to analyze for these two pesticides is provided in the monitoring plans for the NPDES and UIC-related WPCF permits, respectively.

[2] "Environmentally relevant" as used here means that the method reporting limit for a pesticide is low enough to detect its presence in stormwater, groundwater, or surface waters. Pollutant levels expected to occur in these waters are based on sampling results from studies conducted within Oregon.

[3] The co-permittees have most water quality samples analyzed by the City of Portland's Water Pollution Control Laboratory, except that Portland outsources specialty constituents to outside contract labs. Test America is often used, although Pacific Agricultural Laboratory (PAL) is a local lab that specializes in pesticide analysis and is capable of achieving low level analyses. Test America contracts with PAL for some low level pesticide analyses.

The co-permittees will report any additional pesticide testing performed to DEQ in the annual report that follows a decision to add analytes.

References

Borax, 2000. Sodium metaborate MSDS. Borax 20 Mule Team. http://www.borax.com/pdfs/dist/MSDS_Sodium_Metaborate_4_Mol.pdf

CFR, 1995. Monosodium Methanearsonate and Disodium Methanearsonate; Toxic Chemical Release Reporting; Community Right-to-Know. 40 CFR 372. http://www.gpo.gov/fdsys/pkg/FR-1995-04-20/pdf/95-9782.pdf (Accessed 10/27/11)

Chemwatch, 2010. D-limonene MSDS. http://datasheets.scbt.com/sc-205283.pdf

Clark, L., Cummings, J., Bird, S., Aronov, E. 1993. Acute toxicity of the bird repellent, methyl anthranilate, to fry of Salmo salar, Oncorhynus mykiss, Ictalurus punctatus and Lepomis macrochirus. Pest. Sci 39: 313-317. http://www.aphis.usda.gov/wildlife_damage/nwrc/publications/93pubs/93-14.pdf

Cox, C. 1996. Imazapyr Herbicide Fact Sheet. Journal of Pesticide Reform 16(3). http://www.pesticide.org/get-the-facts/pesticide-factsheets/factsheets/imazapyr

Cox, C. 1998. Clopyralid Herbicide Fact Sheet. Journal of Pesticide Reform 18(4). http://www.mindfully.org/Pesticide/Clopyralid.htm

Dow, 2006. Milestone VM MSDS. http://www.cdms.net/ldat/mp7I2002.pdf. EPA, 2005. Pesticide Fact Sheet: Aminopyralid. http://www.epa.gov/opprd001/factsheets/aminopyralid.pdf

Dow, 2010. Product Safety Assessment: DOW Monoethanolamine. http://msdssearch.dow.com/PublishedLiteratureDOWCOM/dh_0459/0901b80380459c23.pdf?filepath=productsafety/pdfs/noreg/233-00265.pdf&fromPage=GetDoc

Dow, 2010. Ethalfluralin Product Safety Assessment. The Dow Chemical Company. http://www.dow.com/productsafety/pdfs/233-00786.pdf

Dow, 2011. Preside MSDS. Dow AgroSciences (New Zealand). http://msdssearch.dow.com/PublishedLiteratureDAS/dh_05e4/0901b803805e4429.pdf?filepath=nz/pdfs/noreg/012-00035.pdf&fromPage=GetDoc

ECOTOXNET, 1996. Bifenthrin Technical Fact Sheet. National Pesticide Information Center, Oregon State University Extension Services. http://extoxnet.orst.edu/pips/bifenthr.htm (Accessed Jan 2011)

EPA, 1991. R.E.D. Facts Proprionic acid. 738-F-91-106. http://www.epa.gov/oppsrrd1/REDs/factsheets/4078fact.pdf (accessed Jan 2011)

EPA, 1992. R.E.D. Facts: Zinc Salts. http://www.epa.gov/oppsrrd1/REDs/old_reds/zinc_salt.pdf (accessed Jan 2011)

EPA, 1994. R.E.D. FACTS: Fenbutatin-oxide. EPA-738-F-94-021, http://www.epa.gov/oppsrrd1/REDs/factsheets/0245fact.pdf

EPA, 1998. Dichlobenil R.E.D. Facts. EPA-738-F-98-005. http://www.epa.gov/oppsrrd1/REDs/factsheets/0263fact.pdf (Accessed Jan 2011)

EPA, 1998. Isoxaflutole Pesticide Fact Sheet. http://www.epa.gov/opprd001/factsheets/isoxaflutole.pdf

EPA, 1998. Tralkoxydim Pesticide Fact Sheet. http://www.epa.gov/opprd001/factsheets/tralkoxydim.pdf

EPA, 2001. Mesotrione Pesticide Fact Sheet. http://www.epa.gov/opprd001/factsheets/mesotrione.pdf

EPA, 2001. Propargite RED Facts. EPA 738-F-01-012. http://www.epa.gov/oppsrrd1/REDs/factsheets/propargite_fs.htm

EPA, 2004. RED Facts Benfluralin. EPA-738-F-04-007. http://www.epa.gov/oppsrrd1/REDs/factsheets/benfluralin_fs.pdf

EPA, 2006. Dimethenamid Ecological Risk Assessment. http://www.epa.gov/pesticides/chem_search/cleared_reviews/csr_PC-129051_6-Dec-06_a.pdf

EPA, 2006. Reregistration Eligibility Decision for Pentachloronitrobenzene. http://www.epa.gov/oppsrrd1/REDs/pcnb_red.pdf (accessed Jan 2011).

EPA, 2006. Reregistration Eligibility Decision (RED) for Aliphatic Solvents. http://www.epa.gov/oppsrrd1/REDs/aliphatic_solvents_red.pdf (accessed Jan 2011)

EPA, 2006. Reregistration Eligibility Decision (RED) for Propiconazole. EPA 738R-06-027. http://www.epa.gov/oppsrrd1/REDs/propiconazole_red.pdf (accessed Jan 2011)

EPA, 2007. Registration eligibility decision for dikegulac sodium. EPA 738-R-07-003. http://www.epa.gov/pesticides/reregistration/REDs/dikegulac_red.pdf (Accessed Jan 2011)

EPA, 2008. RED Fact Sheet: Methyldithiocarbamate Salts - Metham Soidium/Potassium and MITC

EPA, 2009. Effects Determination for Myclobutanil and the California Red-legged Frog, Appendix C: Environmental Fate Data. http://www.epa.gov/oppfead1/endanger/litstatus/effects/redleg-frog/myclobutanil/appendix-c.pdf

EXTOXNET, 1986. Ethoprop Chemical Fact Sheet. National Pesticide Information Center, Cornell University. http://pmep.cce.cornell.edu/profiles/insect-mite/ddt-famphur/ethoprop/insect-prof-ethoprop.html

EXTOXNET, 1989. Avermectin Pesticide Fact Sheet. Cornell University. http://pmep.cce.cornell.edu/profiles/insect-mite/abamectin-bufencarb/avermectin/insect-prof-avermectin.html

EXTOXNET, 1993. MCPA Pesticide Information Profile. Extension Toxicology Network, Cornell University. http://pmep.cce.cornell.edu/profiles/extoxnet/haloxyfop-methylparathion/mcpa-ext.html

EXTOXNET, 1993. Prometryn pesticide information profile. National Pesticide Information Center, Oregon State University Extension Services. http://pmep.cce.cornell.edu/profiles/extoxnet/metiram-propoxur/prometryn-ext.html

EXTOXNET, 1995. Sodium chlorate pesticide information profile. National Pesticide Information Center, Oregon State University Extension Services. http://extoxnet.orst.edu/pips/sodiumch.htm(Accessed Jan 2011)

EXTOXNET, 1996. Sulfometuron-methyl Technical Fact Sheet. National Pesticide Information Center, Oregon State University Extension Services. http://extoxnet.orst.edu/pips/sulfomet.htm (Accessed Jan 2011)

EXTOXNET, 1996. 2,4-DP Technical Fact Sheet. National Pesticide Information Center, Oregon State University Extension Services. http://extoxnet.orst.edu/pips/24-DB.htm (Accessed Jan 2011)

EXTOXNET, 1996. Acephate Technical Fact Sheet. National Pesticide Information Center, Oregon State University Extension Services. http://extoxnet.orst.edu/pips/acephate.htm (Accessed Jan 2011)

EXTOXNET, 1996. Alachlor Pesticide Information Profile. National Pesticide Information Center, Oregon State University Extension Services. http://extoxnet.orst.edu/pips/alachlor.htm

EXTOXNET, 1996. Amitraz Pesticide Information Profile. National Pesticide Information Center, Oregon State University Extension Services. http://extoxnet.orst.edu/pips/amitraz.htm

EXTOXNET, 1996. Amitrole Technical Fact Sheet. National Pesticide Information Center, Oregon State University Extension Services. http://extoxnet.orst.edu/pips/amitrole.htm (Accessed Jan 2011)

EXTOXNET, 1996. Azoxystrobin Pesticide Information Profile. National Pesticide Information Center, Oregon State University Extension Services. http://pmep.cce.cornell.edu/profiles/extoxnet/24d-captan/azoxystrobin-ext.html

EXTOXNET, 1996. Bentazon Pesticide Information Profile. National Pesticide Information Center, Oregon State University Extension Services. http://extoxnet.orst.edu/pips/bentazon.htm

EXTOXNET, 1996. Chlorothalonil Technical Fact Sheet. National Pesticide Information Center, Oregon State University Extension Services. http://extoxnet.orst.edu/pips/chloroth.htm (Accessed Jan 2011)

EXTOXNET, 1996. Clethodim Technical Fact Sheet. National Pesticide Information Center, Oregon State University Extension Services. http://extoxnet.orst.edu/pips/clethodi.htm (Accessed Jan 2011)

EXTOXNET, 1996. Cyfluthrin Technical Fact Sheet. National Pesticide Information Center, Oregon State University Extension Services. http://extoxnet.orst.edu/pips/cyfluthr.htm (Accessed Jan 2011)

EXTOXNET, 1996. Deltamethrin Pesticide Information Profile. National Pesticide Information Center, Oregon State University Extension Services. http://extoxnet.orst.edu/pips/deltamet.htm

EXTOXNET, 1996. Dicofol Pesticide Information Profile. National Pesticide Information Center, Oregon State University Extension Services. http://extoxnet.orst.edu/pips/dicofol.htm

EXTOXNET, 1996. Dinoseb Technical Fact Sheet. National Pesticide Information Center, Oregon State University Extension Services. http://extoxnet.orst.edu/pips/dinoseb.htm (Accessed Jan 2011)

EXTOXNET, 1996. Diuron Technical Fact Sheet. National Pesticide Information Center, Oregon State University Extension Services. http://extoxnet.orst.edu/pips/diuron.htm (Accessed Jan 2011)

EXTOXNET, 1996. Esfenval Pesticide Information Profile. National Pesticide Information Center, Oregon State University Extension Services. http://extoxnet.orst.edu/pips/esfenval.htm

EXTOXNET, 1996. Folpet Pesticide Information Profile. National Pesticide Information Center, Oregon State University Extension Services. http://extoxnet.orst.edu/pips/folpet.htm

EXTOXNET, 1996. Hydropene Pesticide Information Profile. National Pesticide Information Center, Oregon State University Extension Services. http://npic.orst.edu/factsheets/hydropregen.pdf

EXTOXNET, 1996. Imidacloprid Technical Fact Sheet. National Pesticide Information Center, Oregon State University Extension Services. http://extoxnet.orst.edu/pips/imidaclo.htm (Accessed Jan 2011)

EXTOXNET, 1996. Linuron Pesticide Information Profile. National Pesticide Information Center, Oregon State University Extension Services. http://extoxnet.orst.edu/pips/linuron.htm

EXTOXNET, 1996. Mecoprop Technical Fact Sheet. National Pesticide Information Center, Oregon State University Extension Services. http://extoxnet.orst.edu/pips/mecoprop.htm(Accessed Jan 2011)

EXTOXNET, 1996. Metalaxyl Pesticide Information Profile. National Pesticide Information Center, Oregon State University Extension Services. http://extoxnet.orst.edu/pips/metalaxy.htm

EXTOXNET, 1996. Metaldehyde Technical Fact Sheet. National Pesticide Information Center, Oregon State University Extension Services. http://extoxnet.orst.edu/pips/metaldeh.htm (Accessed Jan 2011)

EXTOXNET, 1996. Metolachlor Pesticide Information Profile. National Pesticide Information Center, Oregon State University Extension Services. http://extoxnet.orst.edu/pips/metolach.htm

EXTOXNET, 1996. Metribuzin Pesticide Information Profile. National Pesticide Information Center, Oregon State University Extension Services. http://extoxnet.orst.edu/pips/metribuz.htm

EXTOXNET, 1996. Metsulfuron methyl Pesticide Information Profile. National Pesticide Information Center, Oregon State University Extension Services. http://extoxnet.orst.edu/pips/metsulfu.htm

EXTOXNET, 1996. Napropamide Pesticide Information Profile. National Pesticide Information Center, Oregon State University Extension Services. http://extoxnet.orst.edu/pips/napropam.htm

EXTOXNET, 1996. Oryzalin Technical Fact Sheet. National Pesticide Information Center, Oregon State University Extension Services. http://extoxnet.orst.edu/pips/oryzalin.htm (Accessed Jan 2011)

EXTOXNET, 1996. Oxyfluorofen Technical Fact Sheet. National Pesticide Information Center, Oregon State University Extension Services. http://pmep.cce.cornell.edu/profiles/extoxnet/metiram-propoxur/oxyfluorfen-ext.html

EXTOXNET, 1996. Pendimethalin Technical Fact Sheet. National Pesticide Information Center, Oregon State University Extension Services. http://extoxnet.orst.edu/pips/pendimet.htm (Accessed Jan 2011)

EXTOXNET, 1996. Pentachlorophenol (PCP) Technical Fact Sheet. National Pesticide Information Center, Oregon State University Extension Services. http://extoxnet.orst.edu/pips/pentachl.htm (Accessed Jan 2011)

EXTOXNET, 1996. Phosmet Pesticide Information Profile. National Pesticide Information Center, Oregon State University Extension Services. http://extoxnet.orst.edu/pips/phosmet.htm

EXTOXNET, 1996. Picloram Technical Fact Sheet. National Pesticide Information Center, Oregon State University Extension Services. http://extoxnet.orst.edu/pips/picloram.htm (Accessed Jan 2011)

EXTOXNET, 1996. Propazine Pesticide Information Profile. National Pesticide Information Center, Oregon State University Extension Services. http://extoxnet.orst.edu/pips/propazin.htm

EXTOXNET, 1996. Simazine Technical Fact Sheet. National Pesticide Information Center, Oregon State University Extension Services. http://extoxnet.orst.edu/pips/simazine.htm(Accessed Jan 2011)

EXTOXNET, 1996. Triadimefon Pesticide Information Profile. National Pesticide Information Center, Oregon State University Extension Services. http://extoxnet.orst.edu/pips/triadime.htm

EXTOXNET, 1996. Triallate Pesticide Information Profile. National Pesticide Information Center, Oregon State University Extension Services. http://extoxnet.orst.edu/pips/trialla.htm

EXTOXNET, 1996. Trifluralin Technical Fact Sheet. National Pesticide Information Center, Oregon State University Extension Services. http://extoxnet.orst.edu/pips/triflura.htm (Accessed Jan 2011)

EXTOXNET, 1996. Acetochlor Pesticide Information Profile. National Pesticide Information Center, Oregon State University Extension Services. http://pmep.cce.cornell.edu/profiles/extoxnet/24d-captan/acetochlor-ext.html

EXTOXNET, 1996. Aldicarb Pesticide Information Profile. National Pesticide Information Center, Oregon State University Extension Services. http://extoxnet.orst.edu/pips/aldicarb.htm

EXTOXNET, 1996. Allethrin Pesticide Information Profile. National Pesticide Information Center, Oregon State University Extension Services. http://pmep.cce.cornell.edu/profiles/extoxnet/24d-captan/allethrin-ext.html

EXTOXNET, 1996. Atrazine Pesticide Information Profile. National Pesticide Information Center, Oregon State University Extension Services. http://extoxnet.orst.edu/pips/atrazine.htm

EXTOXNET, 1996. Azinophos-methyl Pesticide Information Profile. National Pesticide Information Center, Oregon State University Extension Services. http://extoxnet.orst.edu/pips/azinopho.htm

EXTOXNET, 1996. Bromacil Pesticide Information Profile. National Pesticide Information Center, Oregon State University Extension Services. http://extoxnet.orst.edu/pips/bromacil.htm

EXTOXNET, 1996. Carbofuran Pesticide Information Profile. National Pesticide Information Center, Oregon State University Extension Services. http://extoxnet.orst.edu/pips/carbofur.htm

EXTOXNET, 1996. Chlorpyrifos Pesticide Information Profile. National Pesticide Information Center, Oregon State University Extension Services. http://extoxnet.orst.edu/pips/chlorpyr.htm

EXTOXNET, 1996. Copper Sulfate Pesticide Information Profile. National Pesticide Information Center, Oregon State University Extension Services. http://extoxnet.orst.edu/pips/coppersu.htm

EXTOXNET, 1996. Dichlorvos Pesticide Information Profile. National Pesticide Information Center, Oregon State University Extension Services. http://extoxnet.orst.edu/pips/dichlorv.htm

EXTOXNET, 1996. Disulfoton Pesticide Information Profile. National Pesticide Information Center, Oregon State University Extension Services. http://extoxnet.orst.edu/pips/disulfot.htm

EXTOXNET, 1996. Endosulfan Pesticide Information Profile. National Pesticide Information Center, Oregon State University Extension Services. http://extoxnet.orst.edu/pips/endosulf.htm

EXTOXNET, 1996. Endosulfan Pesticide Information Profile. National Pesticide Information Center, Oregon State University Extension Services. http://extoxnet.orst.edu/pips/endosulf.htm

EXTOXNET, 1996. Hexazinone Pesticide Information Profile. National Pesticide Information Center, Oregon State University Extension Services. http://extoxnet.orst.edu/pips/hexazin.htm

EXTOXNET, 1996. Lindane Pesticide Information Profile. National Pesticide Information Center, Oregon State University Extension Services. http://extoxnet.orst.edu/pips/lindane.htm

EXTOXNET, 1996. Methoprene Pesticide Information Profile. National Pesticide Information Center, Oregon State University Extension Services. http://extoxnet.orst.edu/pips/methopre.htm

EXTOXNET, 1996. Tebuthiuron Pesticide Information Profile. National Pesticide Information Center, Oregon State University Extension Services. http://extoxnet.orst.edu/pips/tebuthiu.htm

EXTOXNET, 1996. Terbacil Pesticide Information Profile. National Pesticide Information Center, Oregon State University Extension Services. http://extoxnet.orst.edu/pips/terbacil.htm

EXTOXNET, 1998. Cypermethrin Technical Fact Sheet. National Pesticide Information Center, Oregon State University Extension Services. http://npic.orst.edu/factsheets/cypermethrin.pdf (Accessed Jan 2011)

EXTOXNET, 2001. Boric Acid Technical Fact Sheet. National Pesticide Information Center, Oregon State University Extension Services. http://npic.orst.edu/factsheets/borictech.pdf (Accessed Jan 2011)

EXTOXNET, 2002. Dicamba Technical Fact Sheet. National Pesticide Information Center, Oregon State University Extension Services. http://npic.orst.edu/factsheets/dicamba_tech.pdf (Accessed Jan 2011)

EXTOXNET, 2003. Carbaryl Technical Fact Sheet. National Pesticide Information Center, Oregon State University Extension Services. http://npic.orst.edu/factsheets/carbtech.pdf (Accessed Jan 2011)

Gervais, J. A.; Luukinen, B.; Buhl, K.; Stone, D. 2008. 2,4-D Technical Fact Sheet; National Pesticide Information Center, Oregon State University Extension Services. http://npic.orst.edu/factsheets/2,4-DTech.pdf (accessed Jan 2011)

Gervais, J. A.; Luukinen, B.; Buhl, K.; Stone, D. 2009. Malathion Technical Fact Sheet. National Pesticide Information Center, Oregon State University Extension Services. http://npic.orst.edu/factsheets/malatech.pdf (accessed Jan 2011)

Harper, B.; Luukinen, B.; Gervais, J. A.; Buhl, K.; Stone, D. 2009. Diazinon Technical Fact Sheet; National Pesticide Information Center, Oregon State University Extension Services. http://npic.orst.edu/factsheets/diazinontech.pdf.

Health Canada, 1993. Decision Document: Myclobutanil. Consumer Product Safety. http://www.hc-sc.gc.ca/cps-spc/pubs/pest/_decisions/e93-01/index-eng.php#fish (accessed March 2011).

Health Canada, 2008. Proposed Registration Decision: Pyraclostrobin Insignia EG Fungicide, Headline EC Fungicide, Cabrio EG Fungicide. http://www.hc-sc.gc.ca/cps-spc/pest/part/consultations/_prd2008-04/index-eng.php

Jackson, D.; Cornell, C. B..; Luukinen, B.; Buhl, K.; Stone, D. 2009. Fipronil Technical Fact Sheet; National Pesticide Information Center, Oregon State University Extension Services. http://npic.orst.edu/factsheets/fiptech.pdf (accessed Jan 2011)

Lily Miller, 2004. Noxall MSDS. EPA #66222-45-33116. http://www.lillymiller.com/msds/lillymiller/weed_brush_insect/Liquid_Noxall.pdf

Luukinen, B.; Buhl, K.; Stone, D. 2008. DEET Technical Fact Sheet; National Pesticide Information Center, Oregon State University Extension Services. http://npic.orst.edu/factsheets/DEETtech.pdf.

Miller, A.; Gervais, J. A.; Luukinen, B.; Buhl, K.; Stone, D. 2010. Glyphosate Technical Fact Sheet; National Pesticide Information Center, Oregon State University Extension Services.http://npic.orst.edu/factsheets/glyphotech.pdf (accessed Jan 2011)

NPIC, 2001. Lamba-cyhalothrin Pesticide Information Profile. National Pesticide Information Center, Oregon State University Extension Services. http://npic.orst.edu/factsheets/l_cyhalogen.pdf

NPIC, 2002. Triclopyr General Fact Sheet. National Pesticide Information Center. http://npic.orst.edu/factsheets/triclogen.pdf

NuFarm, 2006. Assert Herbicide MSDS. NuFarm Inc, EPA reg # 71368-62. http://www.cdms.net/LDat/mp866002.pdf

PAN. Pesticide Action Network Pesticides Database. Dithiopyr. http://www.pesticideinfo.org/Detail_Chemical.jsp?Rec_Id=PC33292 (accessed Jan 2011)

PAN. Pesticide Action Network Pesticides Database. Isoxaben. http://www.pesticideinfo.org/Detail_Chemical.jsp?Rec_Id=PC35460 (accessed Jan 2011)

PAN. Pesticide Action Network Pesticides Database. Mefluidide. http://www.pesticideinfo.org/Detail_Chemical.jsp?Rec_Id=PC35960 (accessed Jan 2011)

PMEP, 1985. Benefin Herbicide Profile. Pesticide Management Education Program, Cornell University. http://pmep.cce.cornell.edu/profiles/herb-growthreg/24-d-butylate/benefin/herb-prof-benefin.html

PMEP, 1988. DCPA (Dacthal) Herbicide Profile. Pesticide Management Education Program, Cornell University. http://pmep.cce.cornell.edu/profiles/herb-growthreg/dalapon-ethephon/dcpa/herb-prof-dcpa.html

PUR, 2009. Pesticide Use Reporting System, 2008 Annual Report. Oregon Dept. of Agriculture.

Rayfull, 2007. Thiamethoxam MSDS. RAYFULL HOLDING CO., LTD. http://www.rayfull.com/UploadFiles/20071214172730401.pdf

Thurston County Health Department, 2009. Pelargonic acid (nonanoic acid) summary. http://www.co.thurston.wa.us/health/ehipm/pdf_terr/terrestrial%20actives/Pelargonic%20acid.pdf

Toxipedia, 2011. Myclobutanil. Toxipedia Pesticides TXP-2. http://toxipedia.org/display/toxipedia/Myclobutanil

Toynton, K.; Luukinen, B.; Buhl, K.; Stone, D. 2009. Permethirn Technical Fact Sheet; National Pesticide Information Center, Oregon State University Extension Services. http://npic.orst.edu/factsheets/Permtech.pdf (accessed January 2011)

WSDOT, 2006. Chlorsulfuron Roadside Vegetation Management Herbicide Fact Sheet. Washington State Department of Transportation. http://www.wsdot.wa.gov/NR/rdonlyres/BA59FA46-057D-4526-9BC3-F7B3831E453D/0/chlorsulfuron.pdf

WSDOT, 2006. Norflurazon: Roadside Vegetation Management Herbicide Fact Sheet. Washington State Dept of Transportation. http://www.wsdot.wa.gov/NR/rdonlyres/5CCF6051-0429-49BB-99B8-E023E0A8A2A7/0/Norflurazon.pdf